Renegotiating Home Mortgages: Evidence from the Subprime Crisis*

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Abstract

When borrowers default on home mortgages, lenders have the option to renegotiate or, in the language of the mortgage business, modify the loan. We use a large dataset of home mortgages and identify both delinquent borrowers and those who have received modifications. Our most important finding is that the ownership status of the loan – whether it is held in a portfolio or by a securitization trust – does not inhibit modification. Portfolio-held loans are no more likely to get a modification than those held by securitization trusts. That said, we show that loans held by securitization trusts are about 20% more likely to redefault conditional on receiving a modification than loans held in portfolio, although this difference is quite sensitive to the specification and the sample of loans we look at.

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1 Introduction

With the housing bust and foreclosure crisis of 2008, much attention has been focused on the relationship between mortgage servicers and delinquent mortgage borrowers. Specifically, the focus has centered on negotiations, or the lack-thereof, between these two parties in the period between delinquency and the initiation of foreclosure proceedings. During this period, the servicer has the option to forego filing foreclosure proceedings, and to instead adjust the terms of the mortgage contract in a manner that increases the probability of future repayment. This process is called modification, and a mortgage servicer, acting on behalf of the owners of the mortgage, makes this decision by weighing the expected costs, which include the costs of foreclosure (such as taking possession of the house, fixing any property damage, and re-selling the property) against the expected benefits, which include an increased likelihood of repayment by the borrower.

Modifications have become highly controversial of late. Some see them as a golden opportunity to minimize the costs of the foreclosure crisis by simultaneously helping borrowers keep their homes and investors to recoup their money. But modification proponents have long argued that the process of securitization makes modifications difficult to do:

> The complex webs that securitization weaves can be a trap and leave no one, not even those who own the loans, able effectively to save borrowers from foreclosure. With the loan sliced and tranched into so many separate interests, the different claimants with their antagonistic rights may find it difficult to provide borrowers with the necessary loan modifications, whether they want to or not. In the tranche warfare of securitization, unnecessary foreclosures are the collateral damage. (Eggert, 2007)

Economic theory offers many stories that are consistent with the above argument. Since the cash flow from a mortgage goes to different securities each owned by many different investors, one can imagine all kinds of hold up problems, either from a class of investors in a particular security or even from a single investor. In addition, asymmetric information may lead to misaligned incentives between the mortgage servicer and investor or, as some have argued, efforts to align their interests through overly rigid rules may have the unintended consequence of blocking Pareto-improving renegotiation.

In this paper we evaluate the effect of securitization on modifications. We address two questions. First, are servicers less likely to modify loans when they are securitized? And second, when servicers modify loans, are the modifications more effective at preventing foreclosure? In response to the first question, we find that the answer is no. Unconditionally,

servicers actually modify *more* securitized mortgages but this results largely from the fact that securitized mortgages are more risky and when we control for the characteristics of the loan and the borrower, this gap vanishes.

The answer to the second question, on the role of securitization in inhibiting effect modification, is more ambiguous: Modifications of securitized loans appear to be less effective than modifications of portfolio loans. Our best guess is that the foreclosure hazard of modified mortgages is about 20% higher than for loans held in the servicer's portfolio. While this may seem large, we make two caveats. First, the results are very sensitive to the specification and the sample. For at least some versions of the model, securitized loans actually default less. Second, because so few delinquent loans receive modifications, the overall effect on foreclosures is small.

To our knowledge, this paper is the first to estimate directly the likelihood of modification and the performance of modified loans for both securitized and portfolio-held loans. We do this by developing an algorithm that allows us to overcome the unwillingness of servicers to identify modified loans in the data. We show below that our algorithm works very well on a sample of loans in which the lender has identified the modifications, with relatively small fractions of false positives and false negatives, giving us confidence that most of the loans we identify as modified are, in fact, modified. Previous researchers who addressed the question of the effects of securitization on renegotiation (Piskorski, Seru, and Vig (2009)) did identify modifications but rather attempted to infer the presence of modifications by looking at the performance of the loans. We show that their methodology overstates the gap and that when done consistently, the gap in performance between securitized and portfolio loans is narrow and consistent with our other findings.

Our results may seem surprising in light of the formidable arguments many have made for the benefits of modifications as a strategy for dealing with foreclosures. But we use a simple model to show that measuring the benefits of modification is extremely difficult, far more difficult than proponents seem to realize. One cannot simply compare the cost of foreclosure with the cost of modification. There are at least three other important considerations that must be taken into account. First, one must take into account that many delinquent borrowers cure without modification, and perhaps more importantly, that some borrowers who are current may have an incentive to stop making payments in order to qualify for a concessionary modification, a type of moral hazard. Second, borrowers who receive a loan modification, are still at risk of default, especially in an environment of falling house prices. Finally, for borrowers that eventually re-default, modification is costly because it delays recovery, and, in the current environment, exposes the investor to additional house price risk. With realistic parameters such issues dramatically change the calculations of the

benefits of modification. In short, the simplest explanation for the apparently small number of modifications is that expected recovery from foreclosure is higher.

The implications of our research for policy are two-fold. First, at the very least, the effect of securitization is confined to the types of modifications and not to the number. Therefore eliminating legal restrictions on the number of modification a servicer can do on a pool of securitized loans may have little or no effect. Second, more broadly, the number of "preventable foreclosures" may be far smaller than many believe. Even if servicers treat securitized mortgages exactly as they do portfolio loans, the effect will be modest. In that case, it might make sense for policy makers to focus resources on managing the foreclosure and its effect on the community rather than preventing it.

1.1 Related Literature and Existing Evidence

There is widespread concern that an inefficiently low number of mortgages have been modified during the current crisis (COP 2009; Zingales 2008; Levitin 2009), which leads to excessive foreclosure levels and leaves both families and investors worse off. We use data from the current housing crisis to shed more light on the determinants of mortgage modification, with a special focus on the claim that delinquent loans have different probabilities of renegotiation depending on whether they are securitized or held in a bank's portfolio. We also look at other determinants of modifications, including differences between different types of borrowers and the role played by house prices in renegotiation outcomes.

Several sources of frictions may be responsible for differences in renegotiation rates between investors. Servicers of (privately) securitized loans do not sustain the losses due to foreclosure but have to bear the costs of negotiating with borrowers (unlike banks who both own and service the loans). Also, the contractual restrictions imposed by pooling and servicing agreements (discussed above) and standard economic arguments on the effects of dispersed ownership of debt (as in Bolton and Scharfstein 1996 and Asquith, Gertner, and Scharfstein 1994) further reduce the incentives of servicers to modify mortgages. Cordell, Dynan, Lehnert, Liang, and Mauskopf (2008) further point to lack of staff and technology, as well as lack of guidance from (private) investors as important reasons why we observe few modifications on the part of servicers. These authors also point out that it may be harder to successfully modify subprime mortgages as there may be fewer affordable options for this type of borrower. Finally, borrowers who receive modifications often re-enter delinquency (as shown in Section 3), which can ultimately produce higher losses for the investor.

The debate on the optimal rate of mortgage modifications hinges on the assumptions made about the losses under both the modification and the foreclosure outcomes. If losses

from both are similar, the investors could potentially be indifferent between the two. On the other hand, if modifications produced much smaller losses to the investors, it is likely that they would exert at least some pressure on the servicers to proceed with renegotiations. If the potential gain were sufficiently large it would be worth the effort of attempting some coordination between different tranche holders. In a paper that examines the sensitivity of lenders to the risk of mortgage modifications under bankruptcy Levitin (2009) finds that the market does not price this type of risk at origination. This is suggestive evidence that (at least *a priori*) lenders do not place a significant premium on being able to foreclose on properties relative to the risk of having to modify the loan.

There is little empirical evidence on the actual impact of different ownership structures of loans on probability of renegotiation. Piskorski, Seru, and Vig (2009) find that conditional on delinquency loans held in a bank's portfolio are less likely to go into foreclosure relative to loans that are privately securitized. This result is robust to restricting the analysis to borrowers with high credit scores and full documentation loans, which mitigates the concern that it might be due to selection on unobservable characteristics. The authors interpret this result as confirming the view that loans are serviced differently (and thus have different probability of being modified) depending on whether they are securitized or held in a bank's portfolio. In the context of commercial mortage-backed securities Gan and Mayer (2006) find that servicers delay liquidation of delinquent mortgages when they are also the holders of the equity tranche of the deal. This suggests that participating in the losses due to liquidation may alleviate some of the agency problems posed by the separation of ownership and servicing pointed out before. However, it may also lead to conflicts of interest between holders of different tranches. In their setting, Gan and Mayer (2006) find that the servicers' behavior is consistent with asset substitution, as servicers seek to benefit from the option-like payoff of their position.

House prices played a significant role in the onset of the current crisis (Gerardi, Lehnert, Sherlund, and Willen 2009; Mayer and Hubbard, 2008) and it is likely that they also influence the outcome of renegotiation between borrowers and servicers. Benmelech and Bergman (2008) find that liquidation values influence the outcomes of renegotiation between creditors and borrowers by giving borrowers increased bargaining power when liquidation values are low. Similarly, borrowers that have large negative equity in their houses may have stronger bargaining power over the servicer by both having a credible threat of walking away from their home and due to the reduced value of the property for the mortgage holder in the event of foreclosure. We discuss evidence that supports this view in Section 3.

Also need to cite Stegman, Quercia, Ratcliffe, Ding, Davis, Li, Ernst, Aurand, and Van Zandt (2007), Pennington-Cross (2009), Cutts and Green (2005), Mason (2007), Cutts

and Merrill (2008)

2 A Simple Model of Loss Mitigation

In this section, we present a simple framework for thinking about the the lender's decision to offer loss mitigation options to the borrower. The key task for the lender is to identify borrowers who are truly at risk of foreclosure. If the lender provides loss mitigation to a borrower who is not at risk, then it incurs the cost of this action, but obtains no benefit from it, since the borrower would have made the promised payments anyway. The better job a lender can do to accurately identify at-risk borrowers, the more assistance it can profitably offer to individual at-risk borrowers, and the more foreclosures it can avert.

Consider the following model. There are three periods: $t = 0, 1, 2$. The borrower owes payment m at time 1 and is due to repay the loan balance M in period 2. The loan is collateralized by a house which is worth P_1 and P_2 in periods 1 and 2 respectively. The lender has to make a decision whether to modify the loan. If the lender fails to modify the loan, then with probability α_0, the borrower will default in period 1 and the lender will foreclose and recover $P_1 - \lambda$ where λ is the cost of foreclosing on the property. If the borrower does not default next period, then the lender receives the periodic payment m in period 1 and the borrower repays the loan in full in period 2. The value to the lender of the loan without modification equals the present discounted value of the cash flow:

$$\alpha_0(P_1 - \lambda) + (1 - \alpha_0)[m + (1/R)M]. \tag{1}$$

where we ignore discounting for the first period because there is no income in period 0. If the lender modifies the loan, then we assume that the borrower makes a reduced periodic payment m^* in period 1 with certainty but then either defaults with probability α_1 or repays a modified amount M^* in period 2. The value to the lender of the loan with modification is:

$$m^* + (1/R)\alpha_1(P_2 - \lambda) + (1 - \alpha_1)(1/R)M^*. \tag{2}$$

Modification makes sense if the net present value of the loan with modification exceeds the net present value of the loan without modification. This condition is met if expression

(2) exceeds expression (1) or if:

$$(\alpha_0 - \alpha_1)[m^* + \tfrac{1}{R}M^* - (P_1 - \lambda)] \\ - (1 - \alpha_0)[m + \tfrac{1}{R}M - (m^* + \tfrac{1}{R}M^*)] \\ + \alpha_1[m^* + \tfrac{1}{R}(P_2 - \lambda) - (P_1 - \lambda)] > 0 \quad (3)$$

To interpret equation (3), divide the population of borrowers into three groups. The first group, with mass of $\alpha_0 - \alpha_1$ are borrowers who will repay in full with a modification but who will default otherwise. For this group, the investor gains the difference between the present value of the modified repayment $m^* + \frac{1}{R}M^*$ and the recovery given foreclosure $P_1 - \lambda$. The second group, with mass $1 - \alpha_0$, includes borrowers who will repay whether or not they receive a modification. For this group, the investor loses the difference between full repayment and modified repayment. Gerardi and Willen (2009) refer to the first two terms as Type I error and Type II error respectively, in analogy with the statistical concepts. In this context, Type I error corresponds to the cost of not renegotiating loans that need modifying, while Type II error corresponds to the cost of modifying loans that will be repaid in the absence of assistance. The third term, with mass α_1, includes borrowers who will default regardless of whether they recieve a modification. For these borrowers, modification yields a periodic payment but postpones foreclosure. Whether this is good or bad for the lender depends on the evolution of house prices and the rate at which the lender discounts the cash flow.

To illustrate the implications of the model, we perform some simple comparative statics. All else equal, an increase in α_0 makes modification more attractive to the investor, while an increase in α_1 makes modification less attractive. Intuitively, a higher α_0 means higher Type I error and lower Type II error and a higher α_1 implies higher Type II error. Since in general, one would think that α_0 and α_1 would move in the same direction across borrowers, it is useful to note that an increase the gap $\alpha_0 - \alpha_1$ makes modification more attractive.

We make three points about the model. First, when looking at the data, it is not sufficient to show that you would recover more from a modified loan than from foreclosure *ex post* to prove that modification is *ex ante* optimal. To prove that a modification makes sense, you must show that the Type I error, the modified loans that would have defaulted exceeds the Type II error, the modified loans that would have paid off. White (2009) among many others focuses entirely on Type I error:

> The average loss for the 21,000 first mortgages liquidated in November was $145,000, representing an average loss of 55% of the amount due. Losses on

> second lien mortgages were close to 100%. In comparison, for the modified loans with some amount of principal or interest written off, the average loss recognized was $23,610. This seven-to-one difference between foreclosure losses and modification write-offs is striking, and lies at the heart of the failure of the voluntary mortgage modification program. At a minimum, there is room for servicers to be more generous in writing down debt for the loans they are modifying, while still recovering far more than from foreclosures in the depressed real estate market of late 2008. I will consider some of the reasons for this apparently irrational behavior in a later section.[1]

To see why this is wrong, take an extreme example with $\alpha_1 = 0$. In that case, the gain to modifications equals

$$\alpha_0[m^* + \tfrac{1}{R}M^* - (P_1 - \lambda)] - (1 - \alpha_0)[m + \tfrac{1}{R}M - (m^* + \tfrac{1}{R}M^*)] \tag{4}$$

With α_0 sufficiently low, modification won't make sense. To be clear, our criticism of White (2009) and others has nothing to do with the possibility that the modified loan will default, as we have assumed here that the modified loan will pay off in full.

The second point here is that both the rate at which lenders discount future payoffs and the evolution of prices affect the gains to modification. For mass $(1 - \alpha_1)$ of the borrowers, modification will simply delay foreclosure. In that case, the lender will get some extra income from any mortgage payments the borrower makes but has to wait longer to get the payment and will get less if prices fall more.

The lender's information set plays a crucial role here and one can argue that it should only contains information outside the control of the borrower, which would limit it to the origination characteristics of the loan, prices and interest rates. Employment status, income and health and marital status all present problems, although they can be partially overcome – as in the case of unemployment insurance. Delinquency status, which seems like a natural candidate, is a difficult issue. On one hand, a borrower has complete control over it. On the other hand, it is a costly signal, as a sixty day delinquency does adversely affect one's credit history and future access to credit markets.

3 Modifications in the Data

The LPS data denote whether a mortgage is held in portfolio, securitized by a GSE such as Freddie Mac or Fannie Mae, or securitized by a non-agency, private entity. If institutional

[1] White (2009), p. 14-15

constraints are restricting the modification process for securitized loans, we would expect to see relatively few modifications among securitized loans, as compared to portfolio loans. Unfortunately, our LPS sample does not include direct information regarding loan modifications.[2] However, LPS does provide monthly updates to loan terms, so it is possible to identify loan modifications indirectly (and imperfectly). We denote a loan as being modified if there is a change in its terms that was not stipulated by the initial terms of the contract. Such modifications include interest-rate reductions, principal-balance reductions, and term extensions. We can also identify principal-balance and mortgage-payment *increases* that reflect the addition of arrears to the balance of a loan.[3] There are two potential mistakes we can make in this exercise. First, we may falsely identify modifications ("false positives") because of measurement error in the data (for example, a mistake in the updated balance or interest rate), or some endogenous behavior on the part of the borrower (for example, a borrower making extra principal payments). Second, we could miss modifications ("false negatives") because our algorithm for finding modifications is incomplete. In this section we are more concerned with false positives than with false negatives, so we use a conservative set of criteria.[4]

3.1 Summary Statistics from the Data

Table 3 reports the number of modifications made in different quarters, disaggregated by the type of modification made. Each of the numbers is a multiple of 10 because we used a 10% random sample and scaled up the numbers we found. The first column of Table 3 simply reports the total number of loan modifications made. Not surprisingly, modifications have been become more common as the housing market has weakened. There appear to be more than 7 times as many modifications performed in the fourth quarter of 2008 as compared to the first quarter of 2007. In addition to the rapid growth in loan modifications, the composition of modifications has changed over time. This can be seen in the remaining

[2]In a recent report, the Office of Thrift Supervision (OTS), in collaboration with the Office of the Comptroller of Currency (OCC), used data from LPS to analyze the outcomes of recent mortgage modification programs (OCC and OTS Mortgage Metrics Report, Third Quarter 2008) In this report, they had access to supplementary data from servicers that included the identification of loans in the LPS data that had been modified. We have not been able to obtain access to this data.

[3]One of the major types of loan modifications that we are largely unable to identify are interest rate freezes for subprime ARMs that reset after two or three years. However, the reason that we cannot identify those freezes is because many are not binding; the fully-indexed rate is lower than the initial rate. These modifications will have no major effect on the current terms of the mortgage, so we do not view this as a major drawback.

[4]These criteria will be spelled out in an appendix to the paper.

columns of Table 3, which list the incidence of modifications of different types.[5]

An interesting finding is that most modifications entailed *increases* in the principal balance of a mortgage. Such increases are likely due to the addition of arrears to the outstanding mortgage balance for delinquent borrowers, and often increase the monthly mortgage payment by a nontrivial amount. While the absolute numbers of balance-increasing modifications are still rising, they are falling as a percentage of total modifications. In the last few quarters, interest-rate reductions, which necessarily involve a decrease in the mortgage payment, have become more frequent, rising to more than 26 percent of all modifications performed in 2008:Q4. Table 3 provides further information regarding the behavior of monthly mortgage payments for loans that have undergone a modification. There are several notable patterns in this table. First, as of 2008:Q4, modifications that involved payment decreases were more common than those that involved payment increases. Furthermore, the average and median magnitude of payment decreases has recently increased in our sample. From 2007:Q1 to 2008:Q2 the average payment decrease ranged from approximately 10% to 14%, but then increased to approximately 20% and 22% in 2008:Q3 and 2008:Q4, respectively. Based on the logic from our simple framework above, it is likely that these will have more success than modifications involving increases in the payment and/or balance.

Figure 3 contains some evidence from the LPS data to support this claim. The figure contains Kaplan-Meier non-parametric, survival estimates (also known as the product limit estimator) of the transition from modification to default.[6] The top panel considers a loan to be in default when it becomes 90-days delinquent (approximately 3 missed payments), while the bottom panel assumes a more stringent definition of default, corresponding to the situation in which foreclosure proceedings are initiated by the holder of the mortgage. The figure shows that modifications involving a decrease in the monthly payment are far more successful than those involving an increase in the payment. For example, after 1 year, the probability that a modified loan involving a payment increase becomes 90-days delinquent is approximately 69% and the probability that it falls into foreclosure is about 34%. In

[5]In many cases a mortgage will experience multiple types of modifications at the same time. For example, we see cases in the data in which the interest rate is decreased and at the same time the term of the loan is extended. Thus, the percentages in Table 3 are not calculated with respect to the number of loans modified, but rather with respect to the number of modifications performed.

[6]The Kaplan-Meier estimate of the survival function for delinquency is given by:

$$\hat{S}_t = \prod_{t_i<t} \frac{n_i - m_i}{n_i} \tag{5}$$

where $S(t)$ is the probability that a borrower will not default through time t, d_i corresponds to the number of loans that default at time t_i, while n_i corresponds to the number of loans that are "at-risk" of default at time t_i, or in other words the number of loans that are still active and that have not defaulted before time t_i.

contrast, a modified loan involving a payment decrease has a probability of becoming 90-days delinquent of approximately 52%, and a probability of falling into foreclosure of about 17%. Now, one must be a little cautious in assigning too much weight to Figure 3, as the underlying data come predominantly from loan modifications that took place in 2007 and early-to-mid 2008. According to Table 3, the majority of modifications in the LPS data occurred in the last two quarters of 2008, and while the Kaplan Meier estimates do control for right-censoring, we will need more data on these recent modifications to draw more conclusive inferences.

Another interesting observation from Table 3 is that the incidence of principal reductions is quite low in our data. This is likely due to two factors. First, the LPS data under-represents the subprime mortgage market.[7] A few servicers that focus almost exclusively on subprime mortgages have recently begun modification programs that involve principal reduction.[8] In addition, from a theoretical perspective, principal reduction plans suffer from the severe incomplete-information problem noted earlier. Balance reductions are appealing to both borrowers in danger of default and those who are not. In a recent paper, we argued that to avoid such moral hazard concerns, lenders have a strong incentive to only provide modifications to those borrowers who are most likely to default.[9] Table 3 contains summary statistics regarding the characteristics at origination of both the sample of modified mortgages and the sample of all loans in the LPS dataset. The patterns that emerge from the table are consistent with such an argument. The sample of modified mortgages is characterized by substantially lower credit scores, higher ltv ratios, and slightly higher debt-to-income ratios. The discrepancy in ltv ratios may be underestimated, as the percentage of mortgages with an ltv ratio of exactly 80% is significantly higher in the modification sample compared to the full sample. As we argued above, this likely implies a larger fraction of highly leveraged loans, for which the second liens are not observable in the data. In addition, the modification sample includes a higher fraction of mortgages with non-traditional amortization schedules, such as interest-only loans, option ARMS, hybrid-ARMs, and subprime/alt-a loans.

[7]The majority of subprime mortgages are securitized by non-agency firms, and the LPS data includes approximately 35 percent of mortgages securitized by non-agency corporations.

[8]According to an October report by Credit Suisse, Ocwen Loan Servicing, LLC and Litton Loan Servicing LP were the only subprime servicers that had performed a nontrivial number of principal reduction modifications. Both of these servicers do not contribute to the LPS dataset.

[9]See Foote, Gerardi, and Willen (2008) for a more detailed discussion.

3.2 Duration Analysis

While the summary statistics presented above provide support for the conclusion that the incidence of modification does not seem to be greatly impeded by the process of securitization, a more formal analysis is necessary, in which other observable differences between securitized and portfolio-held loans are controlled for, and in which right-censoring is also taken into account. Censoring is an especially important issue, as there are currently many delinquent loans that are or will soon be good candidates for modification as the housing market continues to decline. In this section we will estimate a Cox proportional hazard model of the transition from delinquency to modification. The Cox model is very common in the survival analysis literature, and has the advantage of being both flexible in terms of functional form considerations, as the baseline hazard function can be treated as an incidental parameter, and easy to estimate in terms of computational considerations.

Before turning to the Cox model however, it is instructive to look at the Kaplan-Meier, non-parametric estimator. While the Kaplan-Meier estimator does not control for other, observable differences in mortgage characteristics, it does account for right-censored observations.

Figure 4 displays Kaplan Meier estimates of the survival function with respect to the transition from delinquency to modification, broken down by investor type. The figure contains two panels with each panel containing two graphs. The top panel corresponds to the transition from 30 days delinquent (one mortgage payment behind) to modification, while the bottom panel corresponds to the transition from 60 days delinquent to modification. Within each panel, the first graph encompasses all mortgages in the LPS data originated after 2004, while the second graph encompasses only subprime and Alt-A mortgages originated after 2004. There are a few notable patterns contained in Figure 4. First, looking at the universe of all mortgages, privately securitized loans and GNMA loans are more likely to have been modified compared to loans held in portfolio and FNMA loans over a fairly long horizon. Conditional on 30-day delinquency, a privately securitized loan has a 12% probability of being modified after 2 years, and a 20% probability after 3 years, compared to 7% and 10% for loans held in portfolio, respectively. These probabilities increase substantially for loans that become 60 days delinquent (panel 2), but the relative patterns are similar, with the exception of FHLMC loans, which are less likely to be modified than privately securitized and GNMA loans conditioning on 30 days delinquency, but more likely to be modified when conditioning on 60 days delinquency. Conditional on 60-day delinquency, a privately securitized loan has a 21% probability of being modified after 2 years, and a 33% probability after 3 years, compared to 16% and 22% for loans held in portfolio, respectively.

Over a shorter horizon, (less than one year), there is very little difference across different types of loans when conditioning on 30 day delinquency. When conditioning on 60 day delinquency however, some differences do start to emerge, with FHLMC loans being the most likely to be modified, FNMA the least likely, and a negligible difference between privately securitized, GNMA, and loans held in portfolio. The patterns are very similar for the sample of subprime/Alt-A loans.[10] Privately securitized subprime loans are more likely to be modified compared to subprime loans held in portfolio, although the difference is smaller compared to the sample of all mortgages.

Table 5 contains estimation results from a Cox proportional hazard model of the transition from 30-day delinquency to modification.[11] The purpose of this table is to see if the results from Figure 4 hold up in an econometric model, in which a host of observable, mortgage and borrower characteristics can be controlled for. The table is divided into two panels, with the first panel corresponding to the sample of all mortgages in the LPS dataset, and the second panel corresponding to the sample of subprime/Alt-A mortgages in the LPS dataset. Within each panel, there are a number of columns containing results that differ in the set of explanatory variables included in the estimation. Our strategy is to begin with a baseline specification that involves only the explanatory variables of interest, and to then add additional variables that are likely to be important in determining the decision to modify a loan.[12] The table reports hazard ratios and corresponding Wald statistics (in parentheses). Column (1) includes only the type of investor in the set of covariates, with the group of portfolio-held loans omitted from the estimation, and thus assumed to be the reference group. According to the estimates, privately securitized loans are about 67% *more* likely to be modified compared with loans held in portfolio. Loans securitized by GNMA are also more likely to be modified, while loans securitized by FNMA are less likely. Column (2) includes a number of additional loan characteristics that are important in the underwriting process, and thus, likely to play an important role in the modification decision. The list of variables includes a measure of the borrower's credit score at origination ($FICO$)[13]; the ltv ratio at origination; an indicator for mortgages with ltv ratios of exactly 80% as our experi-

[10] There are a trivial number of GNMA subprime loans in the data, and thus we drop GNMA from the graphs. In addition, there are only a small number of FNMA and FHLMC subprime loans that are seasoned beyond 2 years, and thus we decided to truncate the graphs for these types of loans after 2 years.

[11] We also estimated similar models of the transition from 60-day delinquency to modification, and found the results to be very similar to those reported below.

[12] Unfortunately, the LPS dataset does not contain full coverage of many loan characteristics, which explains why the number of mortgages included in the estimation declines with the addition of certain explanatory variables.

[13] We include the square of $FICO$ to account for non-linearities in the relationship between modification and credit score.)

ence with other, more complete datasets suggests that many of these borrowers are likely to have second mortgages that bring the cumulative ltv ratio up to 100%; the original amount of the loan (specified in logs); an indicator for mortgages that exceed the conforming GSE loan limits, *Jumbo*; an indicator for interest-only loans; an indicator for loans that allow for negative amortization, which include mortgages commonly referred to as option-ARMs; an indicator for a hybrid-ARM (loans for which the interest rate is fixed for a few years, and then resets, usually to a higher value); and an indicator for a borrower that does not use the corresponding property as a principal residence (this includes both properties used strictly for investment purposes, as well as vacation homes).

The first observation to make regarding the results reported in column (2) is that the difference between the incidence of modification for portfolio-held loans and privately securitized loans decreases substantially when these variables are controlled for in the estimation. This implies that privately securitized loans are more likely to be modified than portfolio-held loans, in large part because they have a different set of characteristics. becomes much lower compared to portfolio-held loans with the extra control variables. The results in column (2) imply that loans with higher credit scores are modified less[14], loans with higher ltv ratios are modified more, larger loans are modified more, although non-conforming mortgages are modified less, all else equal, interest-only loans are modified more, loans that allow for negative amortization are modified less, and mortgages on properties that are not principal residences are modified substantially less. In column (3) we distinguish between purchase-money mortgages and refinances, but the estimated effect is not statistically different from zero. In column (4) we distinguish between prime loans and subprime/Alt-A loans, and find a sizeable difference in terms of the frequency of modification. Conditional on being 30-days delinquent, subprime and Alt-A loans are modified almost 80% more than prime loans. In addition, when we control for these types of loans, the difference in modification frequency between privately securitized and portfolio-held loans is virtually eliminated. Column (5) contains estimation results in which the debt-to-income ratio of the borrower at the time of origination is included as a control. Borrowers with higher dti ratios are more likely to receive a modification, all else equal. In column (6) we control for loans that did not involve full documentation of income or assets, but do not find a statistically significant effect. Finally, in column (7) we include the contemporaneous amount of equity in the property, specified as a percentage of the original loan balance, and updated by state-level house price indexes, calculated by the Federal Housing Finance Agency (FHFA), and unemployment rates at the county-level, calculated by the Burea of Labor Services (BLS). Equity and periods of unemployment are very important determinants of a borrower's de-

[14]The squared term actually dominates the linear term for all values of FICO.

cision to default, and thus should also be important factors in the modification decision. However, because we only have limited, aggregate measures of these variables, we chose not to include them in the other columns. We find a small, positive effect on the frequency of modification from the unemployment rate, but do not find a statistically significant effect from equity. With the full set of controls in column (7), the difference between privately securitized and portfolio-held loans becomes effectively zero. The difference between prime and subprime/Alt-A loans actually increases, so that subprime and Alt-A delinquent loans are more than twice as likely to be modified, all else being equal.

Since the subprime/Alt-A indicator seems to be such a powerful predictor of modification conditional on delinquency, we re-estimated the Cox models for only the sample of subprime/Alt-A loans to see if there are different effects from the explanatory variables for this sample compared to the full sample of mortgages. The results are displayed in columns (8) through (13) and are largely consistent with the results from the full sample. The difference in modification frequency between privately securitized and portfolio-held subprime and Alt-A mortgages is not statistically different from zero. There are a few notable differences between the subprime/Alt-A estimates and the estimates from the full sample. Subprime and Alt-A mortgages with less than full documentation are modified significantly less. Subprime and Alt-A refinances are also modified significantly less.

An overarching lesson of this entire exercise is that if there is a principal-agent problem limiting the modification of securitized mortgages, it is not of first-order importance. Portfolio loans are modified at about the same rate as securitized loans. The rate of modifications for all loans — even troubled ones — is relatively small, which may reflect some other friction faced by servicers. For example, at the start of the housing crisis, no large servicer was set up to evaluate and modify massive numbers of troubled loans. Thus, as a policy matter, there may well be large payoffs to facilitating borrower contact with servicers, in order to maximize the chances that welfare-enhancing modifications are performed.[15] But making appropriate modifications will always be a labor-intensive affair, due to the incomplete-information problem discussed above. Servicers must verify not only that the borrower is truly in need of help but also that he is in not such dire financial straits that foreclosure is the most profitable option. This informational requirement holds no matter what type of investor ultimately receives the payments on the loan.

Another lesson from the analysis of loan modifications is that while principal-balance reductions are often held up as the canonical adjustment a lender can make — and can be useful if the main driver of foreclosures is the walk-away channel – they are exceedingly

[15]Foreclosure-prevention workshops, at which large numbers of servicers meet face-to-face with large numbers of borrowers, are examples of how this facilitation can take place.

rare in practice. Apparently servicers believe that balance reductions are either too costly or ineffective. The next section suggests why this might be, by showing that walk-away defaults are not very common. Most people who are entering foreclosure do so after a protracted period in which they tried to keep their homes.

4 Performance Differences conditional on Modification

5 Overall performance of the loans

The concern about modification rates of privately securitized loans stems, at least in part, from an observed difference in foreclosure rates of borrowers that become delinquent. This difference has been observed by Piskorski, Seru, and Vig (2009), who show that conditional on delinquency privately securitized loans go into foreclosure with higher probability than loans held by banks in portfolio. The conclusion drawn from this result is that servicers of privately securitized loans renegotiate with borrowers less often than banks who hold loans in portfolio. Using national LPS data, as well as data for Massachusetts we attempt to confirm that there are significant differences between loans held by different investors in their transition from 60-day delinquency to foreclosure, even after accounting for all available observable mortgage and borrower characteristics. The Massachusetts data are crucial for this exercise, as we have the full loan-to-value ratio (i.e. including all liens taken out at the time of purchase) for a subset of the purchase mortgages in the state (by using a matched sample of the LPS dataset with data from the Warren Group that come from Massachusetts county-level, Registry of Deeds office). This allows us to fill in the gaps for the ltv variable in LPS, which does not have information regarding second or third liens, and thus, introduces an important source of measurement error in the calculation of equity.

Our results weakly confirm the findings by Piskorski, Seru, and Vig (2009). We find that privately securitized loans are more likely to experience a foreclosure compared to loans held in portfolio, however the difference is highly sensitive to the set of control variables. With virtually no controls, we find a large, statistically significant difference in the probability of foreclosure for each type of loan, but when we control for more borrower and loan characteristics, this difference is largely eliminated. We find similar results when we use the more complete Massachusetts data, although surprisingly, when we control for the full ltv ratio, the difference in foreclosure probabilities increases (but is only marginally significant). We show in the following sections that these differences between investors cannot, however, be attributed to differences in modification rates and the true mechanism for their persistence

remains a mystery.

Our national sample includes 10% of all loans in the LPS dataset originated after 2004 that were either held in a bank's portfolio, bought by a GSE such as Freddie Mac or Fannie Mae, or securitized by a non-agency, private entity and that later became 60 days delinquent. Figure 2 shows Kaplan-Meier non-parametric, survival estimates of the transition from 60-day delinquency to default for the different investors. The investor variable is defined as the investor who holds the mortgage at the time of the first 60-day delinquency of the loan. Privately securitized loans show a much larger probability of transition into foreclosure than both agency loans and loans held in portfolio. Two years after origination, the probability that 60-day delinquent loans transition into foreclosure is about XX percentage points higher for privately securitized loans relative to portfolio loans and XX-XX p.p. higher relative to Fannie Mae or Freddie Mac held mortgages.

The above differences may be due to observable differences in the type of borrowers or the type of contracts in each investor's pool, rather than due to differences in servicing or other possible explanations. To address this issue, we run a Cox proportional hazard model of the transition of 60 day delinquency to foreclosure. The results are shown in Table 8. The univariate regressions confirm the Kaplan-Meier estimates - privately securitized loans have a 40% higher hazard ratio than portfolio loans. As expected, part of the differences in transition probabilities are due to observable characteristics of borrowers (higher loan-to-value is associated with higher transition into foreclosure while lower credit scores are associated with lower probability of transition into foreclosure) and of contracts (interest only contracts are associated with higher hazard of foreclosure, as are negative amortization contracts and hybrid ARM contracts). To account for the effect of house prices we include a house equity variable, as well as a dummy for negative equity and an interaction between the two. We define equity as the difference between the estimated house price and the original mortgage amount divided by the mortgage amount. To estimate the value of the house we use OFHEO state-level prices. Negative equity is strongly positively correlated with foreclosure for delinquent loans, as is unemployment in the county the house is located in. In column (3) we repeat our basic specification (from column (2)) using Case-Shiller house price indices at the MSA level and results remain unchanged. The initial interest rate of the mortgage captures an important part of the variation in the differences between investors (coefficients on column (4) vs column(5)), possibly by accounting for unobservable differences between borrowers that the loan underwriter was aware of. The differences between investors in the probability of transition from 60-day delinquency to foreclosure persist in all our specifications using the 10% national sample (the point estimate ranges from a 5-25% higher hazard ratio).

Using the LPS dataset alone one cannot, however, fully account for the impact of loan-to-value on future foreclosure probability. For this we restrict our analysis to Massachusetts and use a matched sample of LPS and data from the Warren Group that includes data on second (and possibly third) mortgages that were taken out at the same time. We limit our analysis to mortgages taken out at the time of purchase (we exclude refinances) because we can only calculate full LTV reliably for this type of loans. Results are shown in Table **??**. The left half of the table repeats the regressions in Table 8 for Massachusetts purchase mortgages and shows consistent results with the national data (the point estimate for the difference between portfolio and privately securitized loans is higher at between 22% and 69% higher hazard of transition into foreclosure). The right half of the table shows the results for the merged LPS-Warren sample and takes into account the full LTV. The coefficients for the investor dummy variables are largely unchanged despite a significant drop in the sample size due to the merging procedure between LPS data and the Warren data. Privately securitized loans are still significantly more likely to go into foreclosure relative to loans held in a bank' portfolio after accounting for all observables. The coefficients for the GSEs are also, to a large extent, of the same direction as before. The differences between investors cannot, then, be attributed to mis-measured LTV. This leaves room for alternative explanations for these differences, including potential differences in servicing procedures and in frequency of modifications. We discuss these issues further in the next sections.

6 Conclusion

There is widespread concern that an inefficiently low number of mortgages have been modified during the current crisis, which leads to excessive foreclosure levels and leaves both families and investors worse off. We use data on loans originated between 2005 and 2007 to shed more light on the determinants of mortgage modification, with a special focus on the claim that delinquent loans have different probabilities of renegotiation depending on whether they are securitized or held in a bank's portfolio. We also look at other determinants of modifications, including differences between different types of borrowers and the role played by house prices in renegotiation outcomes.

We show that there are significant differences in the probability of transition of delinquent loans into foreclosure when we compare loans held in banks' portfolios with privately securitized ones even after accounting for all available observable characteristics (including the full loan-to-value. We then compare the relative frequency of modification between securitized and non-securitized mortgages, and thus shed some light on the question of whether institutional frictions in the secondary mortgage market are playing an important role in

generating differences in performance of delinquent loans held by different investors and in fact inhibiting the modification process from taking place.

Our answer to this question is a resounding no. First, we find very low frequencies of renegotiation for both securitized and non-securitized mortgages. Second, we do not find a statistical difference in the incidence of loan modification between loans securitized by private corporations and loans held on the balance sheets of financial institutions. In fact, unconditional means in the data actually suggest that privately securitized loans are actually modified more frequently than loans held in portfolio, although this difference disappears when we control for a comprehensive set of mortgage and borrower characteristics. While these findings are certainly not proof of, they are consistent with the hypothesis that investors simply view foreclosure as yielding a higher expected return compared to modification. These findings imply that differences in modification rates are not the reason we observe differences in performance of delinquent loans held by securitization trusts. These results also suggest that the important question to focus on is not whether the securitization process is impeding the renegotiation process, but rather why *all* types of mortgage investors are reluctant to renegotiate the terms of troubled mortgages.

7 Appendix A – Identifying Modifications in the LPS Dataset

In this section we discuss in detail the assumptions that we used to identify modified loans in the LPS dataset. The LPS dataset is updated on a monthly basis, and the updated data include both new mortgages originated, as well as a snapshot of the current terms and delinquency status of outstanding mortgages. Essentially, for a given mortgage, we compare the updated terms to the terms at origination, as well as the change in terms from the proceeding month, and if there is a material change over-and-above the changes stipulated in the mortgage contract, then we assume that the contract terms of the mortgage have been modified.

7.1 Interest Rate Reductions

We use a different set of rules to identify reduced interest rates for fixed-rate mortgages (FRM) and adjustable-rate mortgages (ARM). In principle, identifying a rate change for an FRM should be easy, since by definition the rate is fixed for the term of the mortgage. However, after a detailed inspection of the LPS data, it became apparent that some of the smaller rate fluctuations were likely due to measurement error rather than to an explicit modification. Thus, we adopt a slightly more complex criteria: The difference between the rate at origination and the current rate must be greater than 50 basis points; *and* the difference between the rate in the previous month and the current rate must be greater than 50 basis points; *and* either the mortgage must be 30-days delinquent, the loans is currently in loss mitigation proceedings (as reported by the servicer), or the difference between the rate in the previous month and the current rate must be greater than 300 basis points (which allows for the possibility that a loan that is current could feasibly qualify for a modification).

Identifying interest rate reductions for ARMs is slightly more complicated since by definition the interest rate is variable and can move both up and down. The LPS data contain the information necessary to figure out how much the interest rate should move from month to month. This rate is often referred to as the fully-indexed rate, as it is normally specified to be a fixed spread above a common nominal interest rate. The LPS contains information regarding the initial rate, the appropriate index rate, and the spread between the index and the mortgage rate. In addition, the majority of ARMs are characterized by a period at the beginning of the contract in which the interest rate is held constant (these mortgages are often referred to as hybrid ARMs). At the end of this period, the interest rate adjusts (or resets) to a certain spread above an index rate, and then subsequently adjusts at a specific

frequency. The LPS dataset contains information regarding the length of the initial fixed period, and thus we can identify this period in the data and determine at the point at which the interest rate should begin to adjust (we refer to this period as the reset date). Our criteria for identifying an interest rate reduction for an ARM is as follows: The difference between the rate at origination and the current rate must be greater than 50 basis points; *and* the difference between the rate in the previous month and the current rate must be greater than 50 basis points; *and* if the reset date has passed then the difference between the fully-indexed rate and the current rate must be at least 100 basis points ; *and* either the mortgage must be 30-days delinquent, the loans is currently in loss mitigation proceedings (as reported by the servicer), or the difference between the rate in the previous month and the current rate must be greater than 300 basis points (which allows for the possibility that a loan that is current could feasibly qualify for a modification). In addition, we allow for more modest month-to-month decreases in the interest rate (200 to 300 basis points) as long as there is also a positive change in the delinquency status of the loan (i.e. the loan is reported to be less delinquent). Our inspection of the data suggests that the majority of modifications involve a resetting of the delinquency status back to current, or minor delinquency, so conditioning on this change likely eliminates many false positives.

7.2 Term Extensions

Term extensions, in theory, should be straightforward to identify in the LPS data, but due to possible measurement error in the variable that measures the remaining maturity of each loan. We defined a term extension in the LPS dataset to be a case in which the loan was at least 30-days delinquent at some point; and the remaining number of years left increases by at least 20 months *or* the change in number of years left is greater than the difference between the original term of the loan and the remaining term (for example, if the original maturity is 360 months, and the loan has 350 months remaining, then the increase in length must be at least 10 months); and finally, either the monthly payment must decrease, *or* the principal balance must increase, *or* the loan must be in loss mitigation.

7.3 Principal Balance Reductions

Reductions in the remaining balance of a mortgage is perhaps the most difficult modification to identify because of the prevalence of "curtailment" or partial prepayment among mortgage borrowers. For example, it is common for borrowers to submit extra mortgage payments in order to pay down the loan at a faster rate. For this reason, we were forced to adopt strict criteria to limit the number of false positives. Our criteria for identifying a principal

balance reduction is as follows: The month-to-month decrease in the remaining principal balance must be at least -10% and cannot be more than -30% (the upper bound does not matter as much as the lower bound – we experimented with -40% and -50%, but did not find a substantial difference); the principal balance recorded in the previous month must be greater than $25,000 (since we throw second liens out, and are looking at only mortgages originated after 2004, this cutoff does not bind often); the month-to-month payment change must be negative (there are only a few cases in which the principal balance is reduced without corresponding decrease in the payment, but in these cases the term is extended, and thus is picked up in our code for identifying term extensions); and finally, the mortgage must be either 30-days delinquent or currently in loss mitigation proceedings (as reported by the servicer).

7.4 Principal Balance Increases

For interest-only and fully-amortizing mortgages, identifying an increase in the principal balance due to the addition of arrears is relatively straightforward. It becomes trickier for mortgages that allow for negative amortization, as the principal balance is allowed to increase over the course of the contract, by definition. For interest-only and fully-amortizing mortgages our criteria are: The month-to-month principal balance must increase by at least 0.5% (to rule out measurement error in the data); the loan must have been at least 30-days delinquent at the time of the balance increase; and finally, the month-to-month payment change must be positive unless their is also a corresponding increase in the term of the loan. For mortgages that allow for negative amortization, the criteria are similar except that the balance increase must be at least 1% and there must be a positive change in the delinquency status of the loan.

References

Asquith, P., R. Gertner, and D. Scharfstein (1994). Anatomy of financial distress: An examination of junk-bond issuers. *Quarterly Journal of Economics 109*(3), 625–658.

Bolton, P. and D. S. Scharfstein (1996). Optimal debt structure and the number of creditors. *Journal of Political Economy 104*(1), 1–25.

COP (2009). Foreclosure crisis: Working toward a solution. *Congressional Oversight Panel Report* March 6.

Cordell, L., K. Dynan, A. Lehnert, N. Liang, and E. Mauskopf (2008). The incentives of mortgage servicers: Myths and realities. *Federal Reserve Board Finance and Economics Discussion Series* 2008-46.

Cutts, A. and R. Green (2005). Innovative servicing technology: smart enough to keep people in their houses? *Building Assets, Building Credit: Creating Wealth In Low-Income Communities*, 348–377.

Cutts, A. and W. Merrill (2008). Interventions in Mortgage Default: Policies and Practices to Prevent Home Loss and Lower Costs. Technical report, Working Paper.

Gan, Y. H. and C. Mayer (2006). Agency conflicts, asset substitution, and securitization. *NBER Working Paper No. 12359*.

Gerardi, K., A. Lehnert, S. Sherlund, and P. Willen (2009). Making sense of the subprime crisis. *Forthcoming in Brookings Papers on Economic Activity*.

Gerardi, K. and P. Willen (2009). Assessing high house prices: bubbles, fundamentals and misperceptions. *The B.E. Journal of Economic Analysis & Policy 9*(3 (Symposium).

Levitin, A. (2009). Helping homeowners: Modification of mortgages in bankruptcy. *Harvard Law & Policy Review Online 3*.

Mason, J. (2007). Mortgage Loan Modification: Promises and Pitfalls.

Pennington-Cross, A. (2009). The duration of foreclosures in the subprime mortgage market: a competing risks model with mixing. *The Journal of Real Estate Finance and Economics*, 1–21.

Piskorski, T., A. Seru, and V. Vig (2009). Securitization and distressed loan renegotiation: Evidence from the subprime mortgage crisis. *Chicago Booth School of Business Research Paper No. 09-02*.

Stegman, M., R. Quercia, J. Ratcliffe, L. Ding, W. Davis, W. Li, K. Ernst, A. Aurand, and S. Van Zandt (2007). Preventive Servicing Is Good for Business and Affordable Homeownership Policy. *Housing Policy Debate 18*(2).

White, A. M. (2009). Deleveraging the American Homeowner: The Failure of 2008 Voluntary Mortgage Contract Modifications. *Connecticut Law Review forthcoming*.

Zingales, L. (2008). Plan b. *Economists' Voice 5*(6), 4.

Table 1: Examples of Modifications in the data.

Example 1: Servicer cuts interest rate, capitalizes arrears in the balance of the loan and extends term to 40 years.

Date	MBA Delinq. Stat.	Interest Rate	Monthly Payment	Outstanding Balance	Remaining Term in Months
2008m10	9	6.5	907	141,323	340
2008m11	9	6.5	907	141,323	339
2008m12	9	6.5	907	141,323	338
2009m1	C	4.5	660	146,686	479

Example 2: Servicer capitalizes arrears into the balance of the loan but otherwise leaves the loan unchanged.

Date	MBA Delinq. Stat.	Interest Rate	Monthly Payment	Outstanding Balance	Remaining Term in Months
2008m5	6	9.25	1,726	208,192	346
2008m6	9	9.25	1,726	208,192	346
2008m7	9	9.25	1,726	208,192	346
2008m8	C	9.25	1,815	218,316	341
2008m9	C	9.25	1,815	218,184	340

Table 2: Robustness of our algorithm. We test our algorithm on a dataset of securitized mortgages in which the trustee has identified modifications. The lower panel shows that about 17.2% of our modifications are false positives, meaning that we identify modifications but the trustee does not and about 16.9% are false negatives, meaning that the trustee identifies a modification but we do not.

False Positives by type of modifications

	# of Modifications Using WF CTS Data	False Positives
FRM Rate Reduction	5,381	8.0%
ARM Rate Reduction	8,951	22.0%
Principal Reductions	470	1.9%
Principal Increases	13,010	12.8%
Term Increases	394	2.3%

Overall success of algorithm

	No Mod Using Our Algorithm	Mod Using Our Algorithm	Total
No Mod in WF Data	2,329,187	3,559	2,332,746
Mod in WF Data	3,627	17,514	21,141
Total	2,332,814	21,073	2,353,887

Table 3: Modification Statistics

(1) By Type of Modification: 2007:Q1–2008:Q4

	# Loans Modified	Interest Rate Reductions		Principal Balance Reductions		Principal Balance Increases		Term Extensions	
		#	(% total)	#	(% total)	#	(% total)	#	(% total)
2007:Q1	10,940	600	5.3	700	6.2	8,660	76.4	1,380	12.2
2007:Q2	14,600	820	5.4	550	3.7	11,630	77.3	2,050	13.6
2007:Q3	17,720	770	4.1	810	4.3	15,170	81.2	1,940	10.4
2007:Q4	27,150	2,990	9.7	700	2.3	22,520	72.8	4,740	15.3
2008:Q1	36,230	6,010	13.8	900	2.1	32,100	73.8	4,500	10.3
2008:Q2	44,750	9,050	16.4	1,300	2.4	39,750	72.1	5,030	9.1
2008:Q3	62,190	16,280	20.3	940	1.2	56,940	70.9	6,110	7.6
2008:Q4	74,800	28,630	26.7	1,450	1.4	65,960	61.5	11,230	10.5

Notes: These statistics were computed using a 10% random sample of the LPS data. Quantities obtained from the data are multiplied by a factor of 10. The percentages are taken with respect to the total number of modifications, and *not* loans modified. Thus, there is double-counting in the sense that some loans received multiple types of modifications in a given quarter.

(2) By Payment Change

	Payment Decreases					Payment Increases				
	#	mean Δ		median Δ		#	mean Δ		median Δ	
		$	%	$	%		$	%	$	%
2007:Q1	2,080	-492	-13.2	-157	-10.0	5,020	106	6.7	62	4.4
2007:Q2	2,060	-464	-12.7	-141	-9.6	7,710	120	7.0	63	4.4
2007:Q3	2,470	-290	-12.9	-125	-9.7	10,380	110	6.7	60	4.3
2007:Q4	5,600	-367	-15.3	-159	-11.7	14,540	100	5.9	59	3.9
2008:Q1	11,500	-358	-14.0	-210	-13.2	18,720	108	6.5	62	4.3
2008:Q2	18,660	-425	-16.1	-239	-14.1	20,770	124	7.4	69	4.1
2008:Q3	31,770	-562	-21.5	-365	-20.2	26,400	124	6.3	63	3.6
2008:Q4	48,000	-503	-22.9	-315	-21.7	22,520	104	6.0	53	3.6

Notes: These statistics were computed using a 10% random sample of the LPS data. Quantities obtained from the data are multiplied by a factor of 10.

(3) Loan Characteristics of Modified Mortgages

	All Loans					Modifications				
	#	mean	p25	p50	p75	#	mean	p25	p50	p75
FICO (at origination)	1,892,777	706	660	713	762	17,533	622	580	621	662
LTV (at origination)	2,250,162	75	67	79	85	21,675	82	78	80	90
DTI (at origination)	1,346,093	37	28	38	45	13,945	41	35	41	47
Mortgage balance (at origination)	2,267,497	231K	121K	185K	288K	21K	234K	121K	186K	294K
% characterized as										
LTV = 80	14.4					21.7				
Subprime/Alt-a	6.8					47.4				
Fixed	71.2					39.7				
Hybrid ARM	7.7					26.2				
IO-ARM	11.3					13.1				
IO-Fixed	2.1					2.7				
Option-ARM	5.1					12.0				
Option-Fixed	0.3					1.4				
Owner	89.3					96.0				
Investor	7.1					2.6				
Vacation Home	3.7					1.1				
Purchase	51.9					49.0				
Low/no documentation	29.2					20.4				

Notes: These statistics were computed using a 10% random sample of the LPS data. The sample includes mortgages originated after 2004.

Table 4: Cox Proportional Hazard Estimates: Transition from 30-Day Delinquency to Modification

	All Loans								
GNMA	0.934	0.747	0.811	0.782	0.923	0.932	0.916	0.716	0.714
	-2.53	-8.06	-5.42	-6.13	-1.93	-1.40	0.05	-4.72	-4.72
FNMA	0.385	0.359	0.519	0.517	0.554	0.747	0.744	0.678	0.667
	-33.69	-31.47	-19.33	-19.20	-16.88	-7.20	-7.32	-7.27	-7.52
FHLMC	0.732	0.674	1.055	1.037	1.101	1.042	1.037	1.104	1.080
	-10.94	-12.00	1.54	1.01	2.64	0.88	0.78	1.55	1.21
Privately Securitized	1.485	1.343	1.103	1.122	1.023	1.089	1.071	1.026	1.019
	19.26	12.86	4.22	4.84	0.93	2.88	2.31	0.63	0.46
Initial Interest Rate	.	.	1.144	1.144	1.111	1.092	1.072	1.037	1.035
	.	.	21.96	21.56	16.27	11.06	8.80	3.14	2.95
FICO	.	.	1.017	1.017	1.015	1.007	1.006	1.002	1.002
	.	.	7.61	7.27	6.69	2.74	2.23	0.61	0.49
$FICO^2$	.	.	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	.	.	-8.90	-8.54	-7.85	-3.87	-3.42	-1.55	-1.42
FICO < 620		.	1.418	1.420	1.236	1.240	1.237	1.250	1.248
		.	7.21	7.06	4.27	3.63	3.57	2.38	2.37
620 < FICO = 680		.	1.211	1.211	1.171	1.177	1.171	1.171	1.168
		.	5.41	5.28	4.33	3.71	3.60	2.21	2.17
LTV	.	.	1.000	1.000	1.000	1.012	1.008	1.009	1.270
	.	.	15.79	17.01	18.70	13.94	3.41	2.54	8.50
LTV = 80	.	.	1.019	1.023	1.010	1.003	1.007	0.985	1.009
	.	.	1.03	1.23	0.56	0.14	0.29	-0.43	2.46
Mortgage Amount (log)	.	.	1.329	1.326	1.363	1.362	1.269	1.291	0.983
	.	.	19.72	19.01	20.61	16.94	12.48	9.19	-0.50
Jumbo	.	.	0.784	0.798	0.830	0.840	0.875	0.891	0.906
	.	.	-8.45	-7.63	-6.31	-4.98	-3.82	-2.16	-1.86
Interest-Only	.	.	1.131	1.126	1.143	1.136	1.107	1.176	1.171
	.	.	5.07	4.77	5.44	4.33	3.43	3.43	3.34
Negatively Amortizing	.	.	1.918	1.880	1.720	1.732	1.771	1.370	1.360
	.	.	29.43	28.00	23.48	19.69	20.45	7.97	7.60
Hybrid-ARM	.	.	1.148	1.164	1.075	1.092	1.115	1.026	1.030
	.	.	7.33	7.79	3.63	3.70	4.58	0.68	0.79
Non-Occupant Owner	.	.	0.604	0.611	0.663	0.698	0.688	0.588	0.592
	.	.	-14.30	-13.63	-11.36	-8.37	-8.65	-6.43	-6.33
Condo	.	.	0.882	0.878	0.877	0.899	0.885	0.929	0.928
	.	.	-4.96	-5.05	-5.04	-3.51	-4.02	-1.75	-1.78
Multi-family	.	.	0.794	0.785	0.793	0.789	0.822	0.901	0.894
	.	.	-4.94	-5.06	-4.86	-4.10	-3.39	-1.09	-1.17
Refinance	.	.	.	.	0.932	0.988	0.977	0.948	0.952
	.	.	.	.	-4.45	-0.63	-1.18	-1.81	-1.67
Subprime/Alt-A	.	.	.	.	1.692	1.656	1.711	1.992	1.951
	.	.	.	.	24.73	20.03	21.34	15.56	14.99
Equity	.	.	.	.	.	.	0.993	0.996	0.996
	.	.	.	.	.	.	-0.89	-0.36	-0.36
Negative Equity Dummy	.	.	.	.	.	.	1.013	1.016	1.015
	.	.	.	.	.	.	6.40	5.26	5.20
Equity Interaction	.	.	.	.	.	.	0.963	0.962	0.964
	.	.	.	.	.	.	-2.13	-1.51	-1.46
Cumulative Unemployment Change	.	.	.	.	.	.	1.028	1.029	1.029
	.	.	.	.	.	.	13.98	9.73	9.80
DTI ratio	.	.	.	.	.	.	.	.	1.004
	.	.	.	.	.	.	.	.	4.26
Low/No Document	.	.	.	.	.	.	.	.	0.995
	.	.	.	.	.	.	.	.	-0.17
# Mortgages	433,280	352,375	314,095	294,698	294,698	145,900	145,900	121,582	121,582

Note:Hazard ratios shown. T-stats reported below hazard ratios

Table 5: Cox Proportional Hazard Estimates: Transition from 60-Day Delinquency to Modification

	All Loans								
GNMA	0.877	0.684	0.712	0.677	0.816	0.914	0.908	0.650	0.671
	-4.54	-9.93	-8.34	-9.22	-4.66	-1.67	-1.79	-5.83	-5.38
FNMA	0.437	0.393	0.522	0.521	0.556	0.779	0.777	0.689	0.701
	-26.64	-26.20	-17.51	-17.33	-15.39	-5.54	-5.60	-6.33	-6.00
FHLMC	1.110	0.995	1.382	1.339	1.391	1.342	1.335	1.275	1.273
	3.37	-0.15	8.76	7.60	8.48	5.77	5.69	3.57	3.54
Privately Securitized	1.072	0.986	1.015	1.033	0.944	1.004	0.996	1.037	1.040
	2.99	-0.56	0.56	1.21	-2.10	0.13	-0.12	0.76	0.82
Initial Interest Rate	.	.	1.024	1.026	1.001	0.987	0.979	0.962	0.966
	.	.	4.07	4.21	0.21	-1.69	-2.75	-3.34	-2.90
$FICO$	.	.	1.009	1.009	1.008	1.003	1.003	1.004	1.004
	.	.	3.84	3.51	3.33	1.07	0.97	0.78	0.86
$FICO^2$	.	.	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	.	.	-4.60	-4.26	-3.82	-1.52	-1.45	-1.21	-1.26
FICO $<$ 620	.	.	1.400	1.414	1.294	1.292	1.290	1.307	1.273
	.	.	6.34	6.36	4.75	3.90	3.87	2.57	2.31
620 $<$ FICO $=$ 680	.	.	1.197	1.201	1.177	1.176	1.173	1.178	1.167
	.	.	4.63	4.60	4.07	3.31	3.26	2.05	1.93
LTV	.	.	1.000	1.000	1.000	1.006	1.004	1.004	1.004
	.	.	-0.15	-0.51	0.15	6.59	2.69	1.89	1.55
LTV $=$ 80	.	.	0.898	0.902	0.896	0.888	0.892	0.898	0.903
	.	.	-5.57	-5.21	-5.56	-4.98	-4.75	-2.99	-2.84
Mortgage Amount (log)	.	.	1.199	1.200	1.200	1.223	1.174	1.223	1.226
	.	.	12.25	11.94	11.77	10.76	8.36	7.29	7.24
Jumbo	.	.	0.812	0.828	0.858	0.847	0.867	0.826	0.843
	.	.	-6.89	-6.08	-4.94	-4.47	-3.82	-3.38	-3.01
Interest-Only	.	.	0.970	0.965	0.990	0.982	0.967	1.039	1.023
	.	.	-1.14	-1.31	-0.36	-0.55	-1.02	0.73	0.43
Negatively Amortizing	.	.	1.861	1.818	1.682	1.747	1.769	1.284	1.339
	.	.	26.54	25.02	21.11	18.75	19.16	6.00	6.87
Hybrid-ARM	.	.	1.016	1.022	0.977	0.994	1.009	0.937	0.947
	.	.	0.77	1.07	-1.09	-0.22	0.38	-1.64	-1.35
Non-Occupant Owner	.	.	0.614	0.617	0.663	0.679	0.672	0.650	0.648
	.	.	-12.57	-12.10	-10.29	-7.91	-8.10	-4.65	-4.69
Condo	.	.	0.842	0.843	0.863	0.885	0.875	0.935	0.930
	.	.	-6.34	-6.17	-5.30	-3.71	-4.01	-1.48	-1.59
Multi-family	.	.	0.799	0.797	0.807	0.786	0.807	0.871	0.862
	.	.	-4.58	-4.52	-4.27	-3.94	-3.50	-1.37	-1.47
Refinance	.	.	.	.	1.099	1.145	1.138	1.109	1.102
	.	.	.	.	5.65	6.62	6.31	3.41	3.19
Subprime/Alt-A	.	.	.	.	1.563	1.581	1.610	1.670	1.605
	.	.	.	.	21.06	18.00	18.69	11.28	10.29
Equity	.	.	.	.	.	.	0.997	0.995	0.995
	.	.	.	.	.	.	-0.65	-0.49	-0.52
Negative Equity Dummy	.	.	.	.	.	.	1.010	1.010	1.010
	.	.	.	.	.	.	4.07	2.81	2.77
Equity Interaction	.	.	.	.	.	.	0.981	0.967	0.971
	.	.	.	.	.	.	-0.76	-0.92	-0.82
Cumulative Unemployment Change	.	.	.	.	.	.	1.023	1.022	1.021
	.	.	.	.	.	.	9.60	5.96	5.88
DTI ratio	.	.	.	.	.	.	.		1.002
	.	.	.	.	.	.	.		1.85
Low/No Document	.	.	.	.	.	.	.		0.842
	.	.	.	.	.	.	.		-5.05
# Mortgages	244,929	181,564	181,564	170,220	170,220	132,528	132,528	60,546	60,546

Table 6: Subsample analysis

	Transition from 30DQ to Mod			Transition from 60DQ to Mod		
	All loans	Subprime and Alt-A	Payment Decrease	All loans	Subprime and Alt-A	Payment Decrease
GNMA	0.714	–	1.25	0.650	–	0.85
	-4.72	–	1.55	-5.83	–	-1.39
FNMA	0.667	0.551	0.69	0.689	0.564	0.61
	-7.52	-5.3	-3.33	-6.33	-2.82	-5.31
FHLMC	1.08	1.076	3.15	1.275	3.137	2.65
	1.21	0.57	11.27	3.57	7.13	11.87
Privately Securitized	1.019	1.102	1.13	0.996	0.912	0.87
	0.46	1.62	1.74	0.76	-1.11	-2.35
# Mortgages	121,582	34,074	121,582	132,528	43,019	132,528

Table 7: Cox Proportional Hazard Model. Transitions from Modification to Foreclosure.

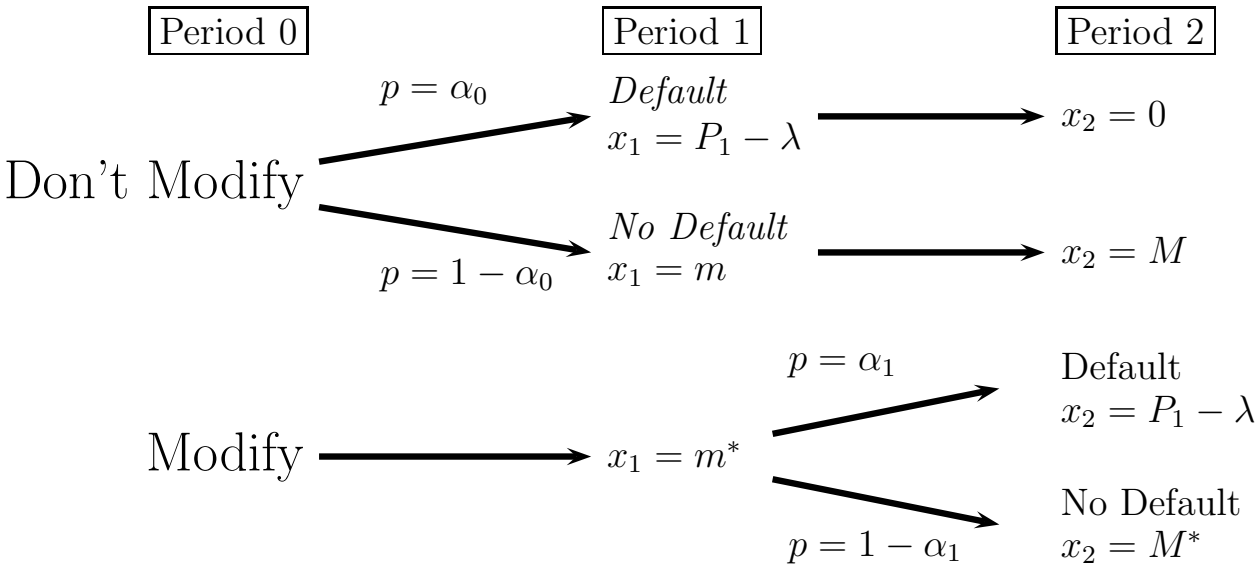
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
FNMA	0.975	0.979	1.131	1.127	1.140	1.031	1.047	1.083	1.038
	-0.50	-0.31	1.74	1.65	1.83	0.36	0.55	0.70	0.32
FHLMC	0.924	0.983	1.199	1.132	1.165	1.036	1.056	1.082	1.060
	-1.15	-0.19	1.93	1.24	1.54	0.28	0.43	0.42	0.31
Privately Securitized	1.255	1.296	1.159	1.139	1.251	1.130	1.102	0.898	0.903
	6.36	5.16	2.77	2.37	3.87	1.82	1.43	-1.09	-1.04
Initial Interest Rate			1.072	1.074	1.080	1.069	1.057	1.024	1.023
			5.60	5.56	5.91	4.29	3.64	1.05	1.02
LTV			1.000	1.000	1.000	1.010	1.000	1.004	1.005
			25.72	26.67	27.73	4.67	-0.02	0.85	0.92
LTV = 80			1.119	1.127	1.145	1.158	1.122	1.279	1.280
			2.73	2.81	3.17	2.85	2.18	3.17	3.18
Credit Score			1.030	1.029	1.027	1.020	1.018	1.027	1.026
			5.57	5.25	4.87	3.08	2.76	2.66	2.50
Credit Score^2			1.000	1.000	1.000	1.000	1.000	1.000	1.000
			-5.78	-5.47	-5.25	-3.48	-3.13	-2.73	-2.58
Credit Score $<$ 620			0.912	0.923	0.932	0.857	0.905	0.922	0.951
			-0.83	-0.70	-0.61	-1.11	-0.72	-0.36	-0.22
620$\leq$ Credit Score $\leq$680			0.932	0.946	0.947	0.946	0.966	0.866	0.870
			-0.87	-0.67	-0.65	-0.57	-0.35	-0.81	-0.79
Mortgage Amount (log)			1.048	1.029	1.063	1.125	1.045	1.018	0.990
			1.32	0.77	1.63	2.60	0.96	0.27	-0.15
Jumbo			1.033	1.053	1.034	1.058	1.096	1.220	1.230
			0.48	0.75	0.48	0.69	1.12	1.58	1.64
Interest-Only			0.977	1.033	1.007	1.032	1.008	0.947	0.955
			-0.37	0.51	0.11	0.38	0.10	-0.40	-0.34
Negatively Amortizing			1.553	1.592	1.637	1.722	1.714	1.816	1.724
			8.94	9.26	9.66	8.89	8.86	6.84	6.08
Hybrid-ARM			1.042	1.006	1.017	0.997	0.994	0.914	0.915
			0.89	0.12	0.33	-0.05	-0.10	-0.90	-0.88
Non-Occupant Owner			1.114	1.102	1.071	0.988	0.983	1.132	1.148
			1.41	1.24	0.86	-0.12	-0.17	0.63	0.69
Condo			0.963	0.949	0.901	0.884	0.864	0.929	0.934
			-0.65	-0.88	-1.72	-1.67	-1.96	-0.71	-0.66
Multi-Family			0.975	1.018	1.004	1.083	1.173	0.977	0.975
			-0.22	0.15	0.04	0.59	1.19	-0.10	-0.10
Refinance					0.754	0.834	0.810	0.858	0.876
					-7.54	-3.91	-4.51	-2.23	-1.93
Subprime/Alt-A					0.826	1.142	1.173	1.690	1.715
					-3.78	2.13	2.55	5.04	5.03
DTI ratio									1.004
									1.33
Low/No Document									1.240
									2.81
Equity							0.945	0.969	0.970
							-2.80	-1.04	-0.99
Negative Equity							1.005	1.004	1.005
							0.68	0.36	0.44
Neg Equity * Equity							1.084	0.958	0.953
							1.14	-0.42	-0.47
Cum Unemployment							1.035	1.032	1.032
							4.68	2.84	2.81
# Mortgages	27,624	18,513	18,513	17,523	17,523	12,666	12,666	6,178	6,178
Chi-Squared	77	51	1,863	2,151	3,185	386	448	320	332

Table 8: Cox Proportional Hazard Estimates: Transition from 60-Day Delinquency to Foreclosure

	Whole US		Massachusetts	
	All loans	Purchase Only	Purchase Only	Purchase Only with Accurate LTV
GNMA	0.8		0.894	0.821
	-6.94		-0.65	-0.71
FNMA	0.957		1.451	1.56
	-1.83		3.15	2.26
FHLMC	1.053		1.480	1.364
	1.7		2.79	1.2
Privately Securitized	1.074		1.384	1.188
	3.51		2.45	0.73
Refinance	0.876	–	–	–
	-9.39	–	–	–
# Mortgages	77,606		4,079	1067

Figure 1:

(1) Model of loan modification



(2) Understanding the gains to modification

Share of borrowers	$1 - \alpha_0$	$\alpha_0 - \alpha_1$	α_1
Description	Borrower always repays Lender loses because borrower would have paid in full	Modification effective Lender gains because modified payments worth more than foreclosure	Borrower never repays Foreclosure is delayed May or may not help lender
Net gain	$m^* + \frac{1}{R}M^* - (m + \frac{1}{R}M)$	$m^* + \frac{1}{R}M^* - (P_1 - \lambda)$	$m^* + \frac{1}{R}(P_2 - \lambda) - (P_1 - \lambda)$
Error	"Type II error" Costly assistance to borrowers who can pay	"Type I error" Don't help borrowers who would have defaulted	"Type III error" Lender loses if R is large or if $P_1 - P_2$ is big

Figure 2: Kaplan Meier Survival Estimates: Transition from 60-day delinquency to Foreclosure

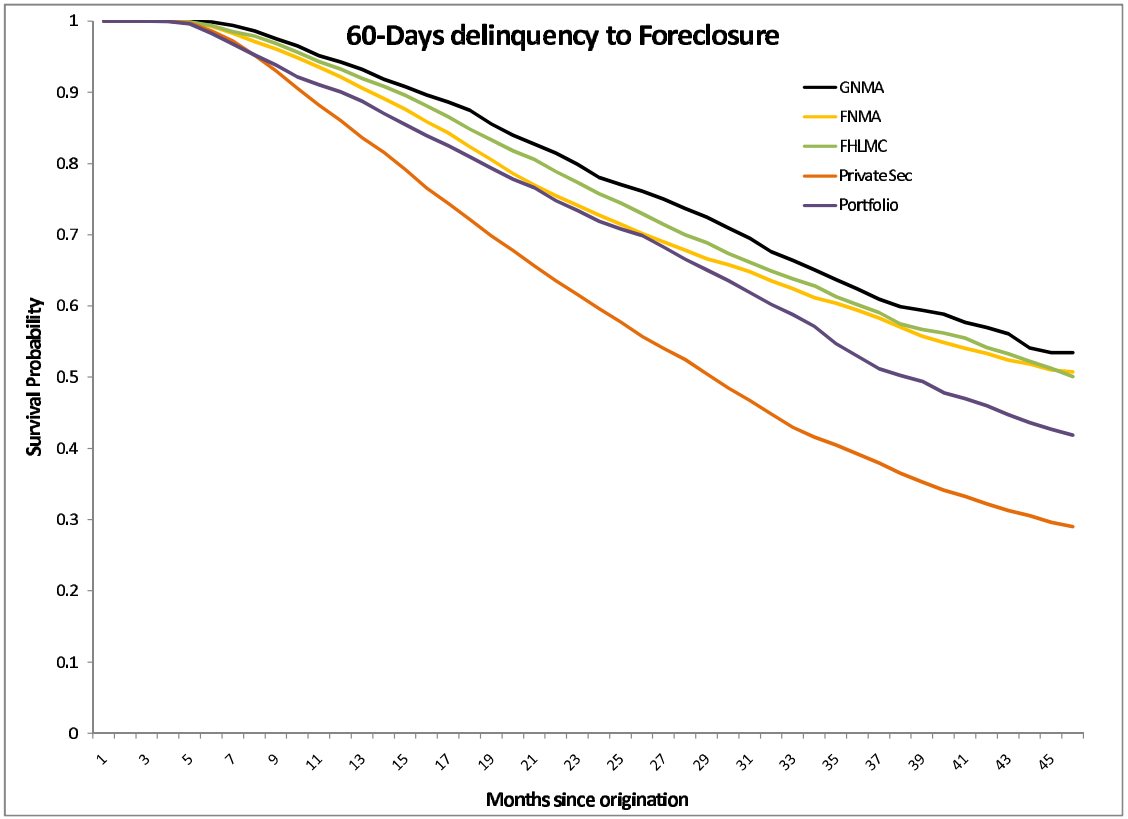


Figure 3: Kaplan Meier Survival Estimates: Transition from Modification to Default

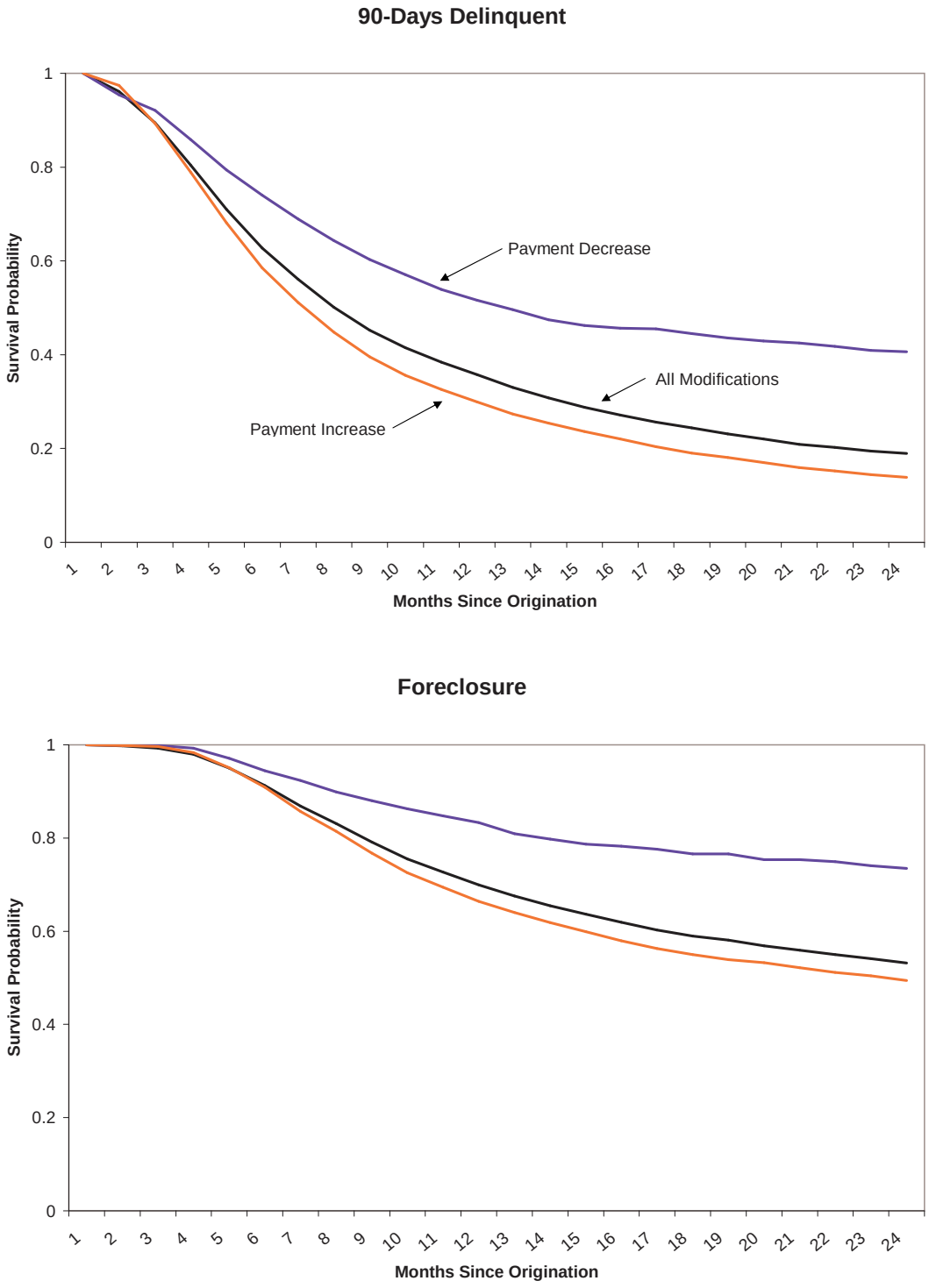


Figure 4: Kaplan Meier Survival Estimates: Transition from Delinquency to Modification