The Selection and Treatment Effects of Loan Modifications: Evidence from Rejected Modification Applicants

by

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Abstract

Evaluating the effectiveness of a modification program involves contrasting the modified loan's credit performance with a counterfactual case of what the loan's performance would have been had there been no modification given. Empirical studies usually employ a pooled sample with modified and non-modified loans, control for the observable credit characteristics, and compare their performance. The effect thus estimated is a combination of treatment effect and selection effect. While the former captures the effectiveness of the modification program, the latter reflects the intrinsic difference between borrowers who apply for loan modification and those who don't, typically not captured by observable variables. Omitting the selection effect leads to biased estimate, possibly over-estimation, of the actual treatment effect of the modification programs. Our paper uses a unique dataset that identifies the borrowers who applied for, but was rejected from a modification, in addition to those who obtained loan modification successfully and those who did not apply for loan modifications. We find significant selection effect that seriously delinquent borrowers who applied for loan modifications are more likely to self-cure than those who did not apply for loan modifications, after controlling for other credit characteristics. Even those rejected for negative credit reasons still perform similarly to those that never applied. The effect is further substantiated by the fact that those who were rejected for modification are less likely to reach serious delinquency or a default event than those who did not apply. In addition, modified loans also show significant performance improvement over the applied-but-rejected loans, indicating the effectiveness of the modification treatment independent from the selection effect.

1. Introduction

Default is costly to both borrowers and lenders. Loan modification is a type of loss mitigation practice aimed at helping borrowers work out solutions and keep their homes. It results in a change in a mortgage's contract terms that is not specified in the original contract, intended to offer payment relief in various forms to help borrowers experiencing near-term payment difficulties, but who show determination to keep their homes and the capacity to afford the new payment plan. These changes may include one or more of the following: capitalization of arrears, extension of contract terms, reduction in mortgage coupon rates, and principal write-down. Historically conditions and terms of these modifications are designed and carried out at the institute level. In the most recent housing cycle, the government implemented the Home Affordable Modification Program (HAMP), which is a uniform modification program aimed at helping eligible delinquent or at-risk borrowers to relieve their mortgage burden and reinstate their loan to current status. Different from traditional modifications typically given to homeowners, this program is more aggressive at changing the terms of the mortgage contract and reducing the payment burden.

Evaluating the effectiveness of a modification program involves contrasting the modified loan's credit performance with a hypothetical case of what the loan's performance would have been had there been no modification given. Empirical studies usually employ a pooled sample with modified and non-modified loans, control for the observable credit characteristics, and estimate the magnitude of the modification effect through the estimated coefficient on the indicator variable separating modified and non-modified loans. An important assumption of this approach is that there is no selection effect, in the sense that there is no intrinsic systematic difference between the borrowers who seek modification and those who do not. This difference could have positive indication for their credit performance, such as the attachment to their home, financial knowledge, and the willingness to fulfill their debt. It may have negative bearing as well, in cases where the borrower seeks strategic modification in place of strategic default, and if the modification does not go through, they may go into default at a faster pace than those who did not seek modification at all. This systematic difference is typically not captured by observable credit variables. Omitting the selection effect leads to biased estimate, possibly over-estimation, of the actual treatment effect of the modification programs.

Our paper uses a unique dataset that identifies the borrowers who applied for, but was rejected from a modification, in addition to those who obtained loan modification and those who did not apply for loan modifications. It includes both credit characteristics and loan performance information. In addition, we also have information regarding the reason for rejection – whether it is for positive credit reasons, such as the borrower's income being too high, or for negative credit reasons, such as the borrower's income being too low. Distinguishing between loans rejected for positive or negative reasons offers a range of potential outcomes. In addition, we distinguish between loans that go through the government modification and institution modifications; and loans that start from a serious delinquency status and those starting from performing loans. We find significant selection effect that those who applied for loan modifications, even those rejected for negative credit reasons, still performed better than those who did not apply for loan modifications. In addition, the modified loans also show significant performance improvement over the applied-but-rejected loans, indicating the effectiveness of the modification treatment independent from the selection effect.

Given that loans that were modified are conceivably different than those whose applications were rejected, our analysis is not a perfect estimate of the selection effect on the modified versus non-modified loans. Yet, by observing the outcome of both those rejected for positive and negative reasons, it offers a boundary of potential selection effects for modification applicants. The strong positive effect of those who applied from serious delinquency, regardless of rejection reason, is consistent across modification programs. On the other hand, those who applied from performing loan stage indicate unobserved financial trouble, and the effect is also consistent regardless of rejection reason or modification program. These effects can be potentially used in default forecast models and evaluating the treatment effect of modification programs.

As loan modification is not a new phenomenon in itself, the performance of loans post modification has been the focal point of a number of studies, such as Ambrose et al. (2000), who find that post-modification performance is related to the delinquency stage the loan is modified from. Another line of research emphasize the role of the mortgage servicers in a loan's success through modification such as Cordell et al. (2008). The recent increases in the breadth and depth of modifications and their interaction with other market activity such as securitization and strategic default have brought about a variety of researches that explore the multiple dimensions

of this activity. Agarwal et al. (2010a, 2010b) and Piskorski et al. (2010) study the probability of a borrower getting a modification and find decreased incentive of a lender performing modification is the loan is securitized. Karikari (2011) and Mayer et al. (2012) study the incentive of borrowers seeking modifications and illustrate the negative effect of modification programs on borrowers staying current with their loans. In addition, recent empirical studies add to the existing literature of the performance of modified loans and revealed more factors contributing to the post-modification performance. Quercia et al. (2009) find different types of changes in loan contract have different effects on modification performance. Voicu et al. (2011) find modification program effect: they show that loan modifications done through the HAMP program perform better than other proprietary programs even after a variety of modification characteristics are controlled for. Agarwal et al. (2010a) find securitization effect: loans held in lenders' portfolio perform better post-modification than those securitized. Our paper incorporate the findings from the previous studies and contribute to the literature by adding the unique angle of the self-selection aspect of loan modifications and further exploring the reason behind the improved performance of loans post modification.

2. Data

Our data source is the loans in Freddie Mac's portfolio that applied for HAMP modification and were either successful in obtaining modification or were rejected. It includes loan modification applications that were approved or rejected between August 2009 and December 2012. We amplify the sample with similar modification applications from other modification programs over the same period and identify them separately to capture the different modification programs' individual selection effect, given that they are likely to differ in borrowers reached and concessions given. For each month's approved or rejected modifications, a control group is randomly selected based on those that never sought modification and with the same delinquency status. The group of modified, rejected, and never-applied sample is then tracked at loan level through January 2013 for their monthly performance.

We separately analyze loans with starting status as seriously delinquent (90-day delinquent or worse or in foreclosure) or performing (current or 30-day delinquent). The two groups should have different selection effect. For seriously delinquent loans, actively seeking modification is possibly a positive indicator of their performance, in that it reflects their attachment to the house

and willingness to seek alternatives to fulfill their debt burden. For performing loans, seeking modification is typically an indicator of unobserved hardship that is yet to be reflected in their delinquency status and therefore likely a negative indicator of future performance.

For each loan rejected, we find their detailed rejection reason and assign them a category of being rejected for positive reasons, neutral reasons, or negative reasons. The table in the Appendix lists the top 20 rejection reasons by their prevalence in the dataset as well as our classification of it being positive, neutral, or negative. Positive reasons typically indicate not qualifying for modification for too good credit quality, and include reasons such as "current DTI less than 31%". Negative reasons indicate not qualifying for too poor credit quality, and can include reasons such as "excessive forbearance". Neutral reasons do not indicate a credit quality issue, and can be due to incomplete documentation. The top 10 reasons roughly captures 95 percent of all the rejection cases.

Exhibit 1 shows the average credit characteristics of loans with starting status as seriously delinquent by sub-groups of modified, rejected for positive, neutral or negative reasons, and never-applied. Exhibit 2 shows the summary statistics of those with performing status.

3. Methodology and Results

To directly compare the cure and default behavior of the modified, rejected, and never-applied borrowers, we apply a hazard model to the panel data of monthly mortgage performance composed of the three types of borrowers. We separately examine the performance of seriously delinquent loans and performing loans. For the group of seriously delinquent loans, we examine the outcomes of cure, defined as returning to current status and keeping current for at least 6 consecutive months, and default, defined as reaching a loss-generating event such as becoming Real Estate Owned (REO) or liquidating through short sale or third party sale. For the group of performing loans, we examine the outcome of reaching serious delinquency. Explanatory variables include marked-to-market loan-to-value ratio (LTV), origination credit score (FICO), past 2-year house price growth, third-party origination indicator, origination occupancy type, origination year effect, geographical location effect, loan product, and loan age. As servicers play an important role in a loan's modification process, we put in fixed effects for individual large servicers. We also have a variable controlling for the current vacancy status for loans in

serious delinquency. This is important since if the property underlying the mortgage is abandoned, the mortgagee is less likely to apply for a modification. If not controlled, the modification application indicator may be only a proxy for the vacancy status. In addition, each group by modification type and application outcome, modified, rejected and never-applied borrowers, is identified by an indicator variable. The sign and magnitude of the indicator variable shows the relative performance difference between the groups controlling for the observable credit quality.

3.1 From Serious Delinquency to Cure

Exhibit 3 shows the result from the hazard model applied to loans that are seriously delinquent in the first month of observation. The outcome is the curing event, defined as returning to current and staying current for 6 months or longer. The 'group' variable is the indicator variable that controls for the loan modification program (HAMP or other) and application status (modified, rejected for positive reasons, neutral reasons, or negative reasons). The reference categories are the borrowers that had the same starting status as seriously delinquent but never applied for modification.

Exhibit 4 converts the coefficient into odds ratios, with all the odds expressed as relative to the group that never sought modification. It shows that for the overall sample, those that applied for a modification but were rejected, even for negative reasons, have a higher probability of curing without treatment, compared to those did not seek modification. Those who were rejected for negative reasons under HAMP are still twice as likely to cure as those who did not apply; and those who were rejected for negative reasons under other modification program are at least as likely to cure. Those that were rejected for positive reasons show higher probability of curing than those rejected for negative reasons, while those rejected for neutral reasons fall between positive and negative reasons in terms of cure rate. The likelihood of cure for those rejected from HAMP due to positive reasons is more than 28 times those that never applied, even higher than those that obtained a modification. This result is intuitive as these borrowers were turned down because they did not need a modification. Those rejected from HAMP for neutral reasons are 5 to 6 times more likely to cure than those who did not apply, and those rejected from other modifications for neutral reasons are nearly twice as likely to cure. Finally, those who obtained a modification are mostly likely to cure, indicating the treatment effect. Loan modified through

HAMP are 21 times more likely to cure, and loans modified through other programs 16 times more likely to cure. We further divide the population into those with marked-to-market LTV above 90%, indicating higher likelihood of having negative equity, and those with marked-to-market LTV below 90%. The overall results still hold in both sub-populations. It seems that modification and applying for modification make more of a difference among the underwater borrowers, those with marked-to-market LTV near or above 100%. The relative odds of curing is higher for those who had a modification or applied for a modification versus those who did not among the above 90% LTV group than those with marked-to-market LTV below 90%.

The control variables largely bear the signs and significance as expected. Loans with higher marked-to-market LTV are less likely to cure than those with lower LTV. Loans with higher origination FICO are more likely to cure than those with lower FICO. Loans with 'vacant' property occupancy status are less likely to cure than those that are occupied. Loans originated in years 2006 and 2007, years where the underwriting standard was at its loosest, are less likely to cure than loans originated before and afterwards.

The results indicate that borrowers rejected for their modification application are still more likely to cure than those who did not apply at all, whether the reason for rejection is positive or negative. This indicates the selection effect of borrowers who applied for a modification. As they were rejected for modification, if there were no selection effect, they would perform similarly as those who did not apply for a modification to begin with, after controlling for the observable credit attributes. Yet the observed better performance suggests that there is a self selection effect not captured by the observables. The reason could be their manifested preference for staying in their house, or their financial astuteness shown through applying for a modification. This also shows that the positive selection effect outweighs the negative incentive effect, that strategic modification is a substitute to strategic default.

3.2 From Serious Delinquency to Default

Exhibit 5 shows the result from a similar hazard regression on loans with starting status as seriously delinquent, but with the outcome defined as reaching a loss event of REO or foreclosure alternative. Exhibit 6 converts the estimation coefficients to odds ratios with those who never applied for modification as the reference group. The results here further confirm the

previous result with curing as outcome – the rejected modification applicants are less likely to reach a loss event than those who did not apply for modification, with the exception that those rejected for negative reasons under non-HAMP programs are 30% more likely to reach default than those we did not apply. In addition, those rejected for positive reasons are typically less likely to default than those rejected for negative reasons, and those who received modification are even less likely to default than those who were rejected. For HAMP modifications, those rejected for positive reasons are more than 80% less likely to reach a loss outcome, whereas those rejected for negative reasons are still 25% less likely to reach a loss outcome. If the loan goes through a modification successfully, the odds is further reduced to less than 10% as likely to reach a loss event. For other types of modification, the odds are slightly less: those rejected for positive reasons are 30% less likely to reach a loss event, and those rejected for neutral reasons are 3% less likely to reach a loss event.

The control variables show effects as expected. Higher marked-to-market LTV increases the probability of default, whereas higher house price growth in the past two years reduces the probability of default. Vacant properties tend to go to default with higher probability. Longer foreclosure timelines reduces the probability of a loan going from serious delinquency to default. Borrowers with higher origination FICO scores are also more likely to go to default. Recall from the previous section that they are also more likely to cure. This seemingly self contradictory evidence is actually consistent. Those with higher credit scores are more likely to maintain their credit standing, but at the same time, reaching a serious delinquency status indicates they are in more serious financial trouble than those with lower credit scores to begin with. This may also be an indication of strategic default.

The results confirm the conclusion in the previous section from a different angle, that borrowers seeking modification are less likely to have their house turned over, except that being rejected from non-HAMP modification programs for negative reasons does signal impending financial trouble for certain borrowers, and going through modification successfully further reduces the likelihood of defaulting.

3.3 From Performing Loan to Serious Delinquency

For loans with starting status as performing, defined as current or 30-day delinquent, we apply a similar hazard model with reaching serious delinquency (90 day delinquent or reaching foreclosure) as the outcome. We expect borrowers that seek modification while still making payments for the loan to stay performing to have encountered financial difficulty and that hardship is yet to be reflected in their delinquency status. So for those that applied but were rejected from modification, their performance after application should be comparable to borrowers that are not current or 30-day delinquent, but revealed to be worse in performance. So we include loans with starting status as 60-day delinquent as the control group.

Summarization of the model estimates is shown in Exhibit 7, and the odds ratios associated with the group indicators can be found in Exhibit 8. Here the odds are all relative to the performing loan group, those with current or d30 status and never applied for modification. Those with starting status as 60-day delinquent and never sought modification is the reference group, with an odds of near 4 times that of the performing loans to reach serious delinquency. All the modified groups and modification application groups should be compared with the performance of the 60-day delinquency group. Here the results are similar to what we observed for those with starting status as seriously delinquent. The rejected applicants performed much better than the borrowers with 60-day delinquency as their starting status. Typically those rejected for negative reasons are twice the likelihood of the performing and never-modified group, or half as likely to reach serious delinquency as those with 60-day delinquency as starting status. Different from the previous results, those rejected for positive or neutral reasons do not seem to perform differently than those rejected for negative reasons. Those who received modification performed better than those who were rejected, and also better than those that stayed as performing loans and never sought modification. Borrowers that received HAMP modification are more than 60% less likely to reach serious delinquency than those with current or d30 status and never sought modification, whereas borrowers that received modification other than HAMP have a more than 30% reduction in likelihood. This indicates that the benefits received from modification more than offset the potential financial trouble that caused the borrowers to seek modification in the first place.

Again the coefficients on other variables are intuitive. Higher marked-to-market LTV and lower FICO are associated with elevated probability of going into serious delinquency. Higher house

price growths in the most recent years reduce the probability of becoming seriously delinquent. Loans originated in 2006 and 2007 are more likely to become seriously delinquent.

4. Conclusion

In this paper we gauge the treatment and selection effect of loan modifications by looking at a unique dataset that contains the characteristics and loan performance outcomes from 3 distinct groups: approved modifications, rejected modification applicants, and those that never applied for modifications. Further we distinguish the rejected modifications by their reason of rejection into positive reasons, such as those that over qualify, or negative reasons, such as those that have too high loan to value ratio or not enough income to quality. The rejected applicants represent the selection effect of borrowers that sought modification as a signal of attachment to their house, financial astuteness, and willingness to fulfill their mortgage obligation. Comparing the outcome of the rejected borrowers and those that have never applied for modification shows the self selection effect on mortgage outcomes. The modified borrowers are those that are both self selected and treated through modification. The difference between the modified borrowers and the rejected borrowers show the average treatment effect of loan modification.

One may argue that there is a further selection effect between those that successfully go through modification and those that are rejected. By including both the positive and negative rejection reasons we bound this effect by the potential selection bias and show that the effect is consistent.

We find a significant positive selection effect on mortgage outcomes based on rejected modification applicants in that they are twice as likely to self cure from serious delinquency compared to other borrowers in the same delinquency status that did not seek modification, controlling for other factors such as marked-to-market LTV, recent house price growth, servicer effect, and the vacancy status of the property. This is true for both those rejected for positive as well as negative reasons. In addition, the rejected borrowers are less likely to reach a default event compared to other borrowers starting from the same serious delinquency stage. If the borrowers applied from a performing status, they are less likely to reach serious delinquency than borrowers that are 60-day past due on their payments but never applied for a modification.

In addition, those that received modifications show a large treatment effect on top of the selection effect, indicating that the modification program adds value to further stabilizing the economy and helping borrowers stay current.

Our research has important indications on evaluating the success of modification programs by separating the treatment and selection effect of modification. It also reveals the act of seeking modification as a strong indicator of future performance of the mortgage. In next steps, we will use alternative methods such as the matching methodology to further validate the similarity between the treatment, reject, and control group and test our results.

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Appendix

Top rejection reasons (ranked by frequency)

	Reason Description	**Categorization**
1	Ineligible Borrower / Current DTI Less than 31%	Positive
2	Ineligible mortgage	Neutral
3	Request Incomplete	Neutral
4	Offer Not Accepted by Borrower / Request Withdrawn	Neutral
5	Borrower Not Eligible	Neutral
6	Excessive Forbearance	Negative
7	Negative NPV	Negative
8	Borrower Requests HAMP/ Decline Standard Modification Terms	Negative
9	Property Not Owner Occupied	Neutral
10	Default Not Imminent	Positive
11	Curtailment Of Income	Negative
12	Trial Plan Default	Negative
13	Unable To Contact Borrower	Neutral
14	Ineligible property	Neutral
15	Excessive Obligation	Negative
16	Home Affordable Modf Program	Neutral
17	Borrower Failed Trial Period	Negative
18	Unemployment	Negative
19	Transfer Of Ownership Pending	Neutral
20	Illness Of Mortgagor	Negative

Exhibit 1

Summary Statistics – Modified, rejected, and never-applied borrower sample with initial delinquency status as seriously delinquent

Loan Group	Number of Observation		CTLTV	Current UPB	FICO at Origination	Loan Age (months)
HAMP Mods Accepted	4,577,764	Mean	1.26	229,662	680	65
		Std	0.46	102,445	58	25
HAMP Mods Rejected - Positive	154	Mean	1.32	243,133	638	65
		Std	0.42	65,205	27	19
HAMP Mods Rejected - Neutral	118,977	Mean	1.29	224,728	677	65
		Std	0.49	101,345	57	26
HAMP Mods Rejected - Negative	679	Mean	1.06	195,400	671	68
		Std	0.36	108,028	60	25
Classic Mods Accepted	2,486,044	Mean	1.12	190,049	668	74
		Std	0.41	99,283	57	30
Classic Mods Rejected - Positive	10,975	Mean	1.05	175,834	666	81
		Std	0.44	103,696	59	38
Classic Mods Rejected - Neutral	535,259	Mean	1.15	193,559	669	70
		Std	0.46	100,491	59	33
Classic Mods Rejected - Negative	8,058	Mean	1.10	190,186	670	76
		Std	0.49	106,591	57	39
Never Mods	1,995,538	Mean	1.07	169,758	679	74
		Std	0.45	99,608	58	36

Exhibit 2:

Summary Statistics – Modified, rejected, and never-applied borrower sample with initial delinquency status as performing loans

Loan Group	Number of Observation		CTLTV	Current UPB	FICO at Origination	Loan Age (months)
HAMP Mods Accepted	401,985	Mean	1.21	215,304	699	65
		Std	0.44	98,005	55	24
HAMP Mods Rejected - Positive	82	Mean	0.74	118,140	707	73
		Std	0.20	64,077	28	26
HAMP Mods Rejected - Neutral	17,550	Mean	1.07	196,670	696	66
		Std	0.42	100,107	58	28
HAMP Mods Rejected - Negative	772	Mean	0.85	133,626	691	68
		Std	0.31	81,054	55	31
Classic Mods Accepted	112,295	Mean	1.10	192,643	689	70
		Std	0.41	98,966	58	29
Classic Mods Rejected - Positive	13,166	Mean	1.10	200,570	708	63
		Std	0.41	101,167	53	29
Classic Mods Rejected - Neutral	148,163	Mean	1.08	195,574	699	64
		Std	0.41	101,677	58	29
Classic Mods Rejected - Negative	1,078	Mean	1.00	169,084	706	66
		Std	0.40	100,083	45	32
D60 Never Mods	90,867	Mean	0.86	137,759	668	81
		Std	0.37	89,002	55	43
Current/D30 Never Mods	15,573,986	Mean	0.73	139,350	715	71
		Std	0.35	95,514	61	43

Exhibit 3:
Hazard model with cure as outcome – Modified, rejected, and never-applied borrower sample with initial delinquency status as seriously delinquent

Variable	Value	Estimate	Pr>ChiSq
Intercept	Suppressed for confidentiality		
Vacancy status	Vacant (reference is occupied by owner/renter)	-0.92	<.0001
	Unknown (reference is occupied by owner/renter)	0.25	<.0001
	Occupied, occupant unknown (reference is occupied by owner/renter)	0.37	<.0001
Group	HAMP modified (reference is never-applied)	1.55	<.0001
	HAMP application rejected for positive reason (reference is never-applied)	1.84	0.0013
	HAMP application rejected for neutral reason (reference is never-applied)	0.22	0.0185
	HAMP application rejected for negative reason (reference is never-applied)	-0.66	0.1148
	Other modified (reference is never-applied)	1.28	<.0001
	Other application rejected for positive reason (reference is never-applied)	-0.38	0.0013
	Other application rejected for neutral reason (reference is never-applied)	-0.89	<.0001
	Other application rejected for negative reason (reference is never-applied)	-1.45	<.0001
	Never applied	-1.51	
Lender grade	Collectively significant		
region	Collectively significant		
Second lien at origination	Yes (reference is no)	-0.02	<.0001
Origination balance	<= $100 K (reference is >$250 k)	-0.05	<.0001
	$100 K to $250 K (reference is >$250 k)	0.01	0.0009
Loan age with splines	Collectively significant		
Marked to market LTV	60-70% (reference is 60% or below)	0.09	<.0001
	70-80% (reference is 60% or below)	0.03	0.0042
	80-90% (reference is 60% or below)	0.01	0.2264

	90-100% (reference is 60% or below)	-0.06	<.0001
	100-115% (reference is 60% or below)	-0.10	<.0001
	>115% (reference is 60% or below)	-0.18	<.0001
Loan product at origination	IOARM (reference is 30-year fixed rate)	0.03	0.0002
	Other (reference is 30-year fixed rate)	0.04	0.0004
	15-year fixed rate (reference is 30-year fixed rate)	0.001	0.9112
	Hybrid ARM (reference is 30-year fixed rate)	-0.002	0.874
Origination occupancy	Investor (reference is owner-occupied)	-0.11	<.0001
	Second home (reference is owner-occupied)	0.01	0.5646
Origination FICO	<530 (reference is >=780)	-0.32	<.0001
	<620 (reference is >=780)	-0.17	<.0001
	<670 (reference is >=780)	-0.04	<.0001
	<730 (reference is >=780)	0.08	<.0001
	<760 (reference is >=780)	0.18	<.0001
Third party origination?	Yes (reference is No)	0.003	0.2182
Property type	Condo (reference is other single-family)	0.01	0.1784
Origination year	2005 and prior (reference is 2008 and later)	0.10	<.0001
	2006 and 2007 (reference is 2008 and later)	-0.03	<.0001
Judicial state flag	Y (reference is non-judicial state)	-0.05	<.0001
Servicer effect	Collectively significant		
Average foreclosure length by state		0.004	0.01
Past 2-year house price growth		0.34	<.0001
Time dummy	Collectively significant		
Number of observations: 5,304,224			
Max-rescaled R-square: 0.54			

Exhibit 4

Odds ratio of probability of cure from serious delinquency cohort effect of modified, rejected for positive reasons and rejected for negative reasons relative to never-applied borrowers

	Full sample			Marked-to-market LTV <=90%			Marked-to-market LTV >90%		
	Point estimate	95% Wald confidence limits		Point estimate	95% Wald confidence limits		Point estimate	95% Wald confidence limits	
HAMP modified vs. never-applied	21.3	20.8	21.7	12.4	12.0	12.8	33.5	32.4	34.7
HAMP application rejected for positive reason vs. never-applied	28.3	8.1	99.3	N/A	N/A	N/A	36.7	9.3	146.0
HAMP application rejected for neutral reason vs. never-applied	5.6	5.3	5.9	4.0	3.6	4.4	8.3	7.8	8.9
HAMP application rejected for negative reason vs. never-applied	2.3	0.9	5.8	1.7	0.4	7.0	3.2	1.0	10.2
Other modified vs. never-applied	16.3	15.9	16.7	9.6	9.3	9.9	25.9	25.0	26.8
Other application rejected for positive reason vs. never-applied	3.1	2.6	3.7	2.5	1.9	3.2	4.0	3.1	5.0
Other application rejected for neutral reason vs. never- applied	1.9	1.8	1.9	1.8	1.7	1.9	2.2	2.1	2.3
Other application rejected for negative reason vs. never applied	1.1	0.8	1.4	1.0	0.6	1.5	1.2	0.8	1.9

Exhibit 5:
Hazard model with default as outcome – Modified, rejected, and never-applied borrower sample with initial delinquency status as seriously delinquent

Variable	Value	Estimate	Pr>ChiSq
Intercept	Suppressed for confidentiality		
Vacancy status	Vacant (reference is occupied by owner/renter)	1.05	<.0001
	Unknown (reference is occupied by owner/renter)	-0.75	<.0001
	Occupied, occupant unknown (reference is occupied by owner/renter)	-0.22	<.0001
group	HAMP modified (reference is never-applied)	-1.69	<.0001
	HAMP application rejected for positive reason (reference is never-applied)	-0.91	0.31
	HAMP application rejected for neutral reason (reference is never-applied)	0.15	0.19
	HAMP application rejected for negative reason (reference is never-applied)	0.53	0.04
	Other modified (reference is never-applied)	-1.24	<.0001
	Other application rejected for positive (reference is never-applied)	0.45	0.001
	Other application rejected for neutral reasons (reference is never-applied)	0.79	<.0001
	Other application rejected for negative reason (reference is never-applied)	1.09	<.0001
	Never applied	0.82	
Lender grade	Collectively significant		
region	Collectively significant		
Second lien at origination	Yes (reference is no)	-0.02	<.0001
Origination balance	<= $100 K (reference is >$250 k)	0.07	<.0001
	$100 K to $250 K (reference is >$250 k)	-0.04	<.0001
Loan age with splines	Collectively significant		
Marked to market LTV	60-70% (reference is 60% or below)	-0.29	<.0001
	70-80% (reference is 60% or below)	-0.11	<.0001

	80-90% (reference is 60% or below)	0.06	<.0001
	90-100% (reference is 60% or below)	0.22	<.0001
	100-115% (reference is 60% or below)	0.34	<.0001
	>115% (reference is 60% or below)	0.61	<.0001
Loan product at origination	IOARM (reference is 30-year fixed rate)	0.14	<.0001
	Other (reference is 30-year fixed rate)	-0.09	<.0001
	15-year fixed rate (reference is 30-year fixed rate)	-0.07	<.0001
	Hybrid ARM (reference is 30-year fixed rate)	0.07	<.0001
Origination occupancy	Investor (reference is owner-occupied)	0.02	0.07
	Second home (reference is owner-occupied)	0.04	0.0001
Origination FICO	<530 (reference is >=780)	-0.09	<.0001
	<620 (reference is >=780)	-0.05	<.0001
	<670 (reference is >=780)	0.001	0.93
	<730 (reference is >=780)	0.01	0.26
	<760 (reference is >=780)	0.04	<.0001
Third party origination?	Yes (reference is No)	-0.01	0.00
Property type	Condo (reference is other single-family)	0.12	<.0001
Origination year	2005 and prior (reference is 2008 and later)	-0.12	<.0001
	2006 and 2007 (reference is 2008 and later)	0.004	0.49
Judicial state flag	Y (reference is non-judicial state)	0.21	<.0001
Servicer effect	Collectively significant		
Average foreclosure length by state		-0.14	<.0001
Past 2-year house price growth		-0.47	<.0001
Time dummy	Collectively significant		
Number of observations: 9,733,448			
Max-rescaled R-square: 0.19			

Exhibit 6:
Odds ratio of probability of reaching a loss event from serious delinquency cohort effect of modified, rejected for positive reasons, and rejected for negative reasons relative to never-applied borrowers

	Full sample			Marked-to-market LTV <=90%			Marked-to-market LTV >90%		
	Point estimate	95% Wald confidence limits		Point estimate	95% Wald confidence limits		Point estimate	95% Wald confidence limits	
HAMP modified vs. never-applied	0.081	0.080	0.083	0.070	0.065	0.075	0.079	0.077	0.081
HAMP application rejected for positive reason vs. never-applied	0.18	0.02	1.29	N/A	N/A	N/A	0.19	0.03	1.35
HAMP application rejected for neutral reason vs. never-applied	0.51	0.49	0.54	0.52	0.45	0.61	0.50	0.48	0.52
HAMP application rejected for negative reason vs. never-applied	0.75	0.45	1.24	0.28	0.07	1.14	0.99	0.57	1.71
Other modified vs. never-applied	0.128	0.125	0.131	0.117	0.110	0.124	0.128	0.125	0.131
Other application rejected for positive reason vs. never-applied	0.69	0.60	0.79	0.50	0.36	0.70	0.75	0.65	0.87
Other application rejected for neutral reason vs. never- applied	0.97	0.95	0.98	0.96	0.91	1.00	0.96	0.94	0.98
Other application rejected for negative reason vs. never applied	1.32	1.18	1.47	1.35	1.06	1.72	1.27	1.12	1.43

Exhibit 7:
Hazard model with reaching serious delinquency as outcome – Modified, rejected, and never-applied borrower sample with initial delinquency status as performing

Variable	Value	Estimate	Pr>ChiSq
Intercept	Suppressed for confidentiality		
group	HAMP modified (reference is never-applied current or D30)	-1.27	<.0001
	HAMP application rejected for positive reason (reference is never-applied current or D30)	0.79	0.2225
	HAMP application rejected for neutral reason (reference is never-applied current or D30)	0.16	0.0818
	HAMP application rejected for negative reason (reference is never-applied current or D30)	0.24	0.3802
	Other modified (reference is never-applied current or D30)	-0.82	<.0001
	Other application rejected for positive reason (reference is never-applied current or D30)	-0.07	0.4786
	Other application rejected for neutral reason (reference is never-applied current or D30)	0.18	0.0348
	Other application rejected for negative reason (reference is never-applied current or D30)	0.29	0.1817
	Never applied – D60 (reference is never-applied current or D30)	0.94	<.0001
	Never applied current or D30	-0.43	
Lender grade	Collectively significant		
region	Collectively significant		
Second lien at origination	Yes (reference is no)	-0.05	<.0001
Origination balance	<= $100 K (reference is >$250 k)	-0.04	<.0001
	$100 K to $250 K (reference is >$250 k)	-0.06	<.0001
Loan age with splines	Collectively significant		
Marked to market LTV	60-70% (reference is 60% or below)	-0.36	<.0001
	70-80% (reference is 60% or below)	-0.22	<.0001

	80-90% (reference is 60% or below)	-0.03	0.0008
	90-100% (reference is 60% or below)	0.18	<.0001
	100-115% (reference is 60% or below)	0.41	<.0001
	>115% (reference is 60% or below)	0.74	<.0001
Loan product at origination	IOARM (reference is 30-year fixed rate)	0.09	<.0001
	Other (reference is 30-year fixed rate)	0.43	<.0001
	15-year fixed rate (reference is 30-year fixed rate)	-0.51	<.0001
	Hybrid ARM (reference is 30-year fixed rate)	-0.14	<.0001
Origination occupancy	Investor (reference is owner-occupied)	0.10	<.0001
	Second home (reference is owner-occupied)	-0.17	<.0001
Origination FICO	<530 (reference is >=780)	0.49	<.0001
	<620 (reference is >=780)	0.38	<.0001
	<670 (reference is >=780)	0.23	<.0001
	<730 (reference is >=780)	0.01	0.1367
	<760 (reference is >=780)	-0.29	<.0001
Third party origination?	Yes (reference is No)	0.04	<.0001
Origination year	2005 and prior (reference is 2008 and later)	-0.19	<.0001
	2006 and 2007 (reference is 2008 and later)	0.15	<.0001
Servicer effect	Collectively significant		
Average foreclosure length by state		0.02	<.0001
Past 2-year house price growth		-1.05	<.0001
Time dummy	Collectively significant		
Number of observations: 16,359,944			
Max-rescaled R-square: 0.08			

Exhibit 8:
Odds ratio of probability of reaching serious delinquency from performing loans cohort effect of modified, rejected for positive reasons, and rejected for negative reasons relative to never-applied borrowers

	Full sample			Marked-to-market LTV <=90%			Marked-to-market LTV >90%		
	Point estimate	95% Wald confidence limits		Point estimate	95% Wald confidence limits		Point estimate	95% Wald confidence limits	
HAMP modified vs. never-applied with current or d30 status	0.44	0.42	0.45	0.70	0.63	0.77	0.40	0.38	0.41
HAMP application rejected for positive reason vs. never-applied with current or d30 status	3.41	0.83	14.03	7.03	1.65	30.02	N/A	N/A	N/A
HAMP application rejected for neutral reason vs. never-applied with current or d30 status	1.81	1.65	2.00	3.08	2.54	3.73	1.54	1.38	1.72
HAMP application rejected for negative reason vs. never-applied with current or d30 status	1.96	1.11	3.48	1.30	0.48	3.47	2.34	1.16	4.75
Other modified vs. never-applied with current or d30 status	0.68	0.64	0.72	0.96	0.84	1.10	0.62	0.58	0.67
Other application rejected for positive reason vs. never-applied with d30 status	1.44	1.26	1.64	2.11	1.61	2.78	1.24	1.07	1.44
Other application rejected for neutral reason vs. never- applied with current or d30 status	1.84	1.78	1.90	2.83	2.64	3.03	1.57	1.51	1.63
Other application rejected for negative reason vs. never applied with current or d30 status	2.06	1.33	3.17	2.18	0.90	5.27	1.97	1.19	3.24
never applied with d60 status vs. never applied with current or d30 status	3.95	3.74	4.17	6.11	5.65	6.61	2.89	2.68	3.12