Not all prepayment penalties are created equal

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ABSTRACT

The study was an examination of prepayment and default of subprime mortgages in Cleveland, Ohio during the subprime mortgage boom. Using borrower-, loan-, and mortgage-market characteristic variables, the varying factors that impacted the likelihood of default and prepayment were identified in models that segregated mortgages according to their purpose for origination. Multinomial logit models of financially-motivated refinance, home purchase, and consumption-smoothing refinance loans found that the change in home value and loan age were the most significant factors associated with loan outcome regardless of the purpose for the loan.

However, loan purpose had implications on loan outcome by influencing the signs of the coefficients of various loan- and borrower-characteristic variables across the purpose groups. It was found that the presence of prepayment penalties increased the log-likelihood of prepayment in home purchase loans, decreased it in consumption-smoothing refinances and was not significant in financially-motivated refinances. It was concluded that when the purpose for the loan is known, whether to lower monthly payments, to extract equity, or to purchase a home, there are implications for how different features will impact the loan's termination or survival potential.

Keywords: prepayment penalty, subprime mortgage, default, prepayment

INTRODUCTION

Broadly, there are three reasons why borrowers enter into new mortgage contracts: Most obvious is to purchase a home for which there are insufficient funds at the time of purchase. Second, is as a consequence of a refinancing decision; when interest rates decline, borrowers prepay existing loans, refinance at new, lowered-interest rates, and walk away with the benefit of lower monthly mortgage payments. This action terminates the original mortgage and results in a new mortgage on the property. Third, is to gain access to accumulated home equity to be used for various purposes. This form of refinancing has been referred to as "consumption-smoothing," while the former is said to be "financially-motivated" (Hurst & Stafford, 2004, p. 986).

At the height of the lending boom, the subprime mortgage market prompted a significant amount of research evidencing predatory lending practices that targeted low income and minority borrowers. One of the loan characteristics that received much attention was prepayment penalties. Crews Cutts and Van Order (2005) and Quercia, Stegman, and Davis (2007) identified the loan characteristic as among those most often cited as predatory in nature. Pennington-Cross and Chomsisengphet (2007) and Ding, Quercia, Ratcliffe, and Lei (2008) associated prepayment penalties with higher rates of foreclosures than found in subprime loans without them. Other researchers, on the other hand, found the presence of prepayment penalties to have little impact on foreclosure rates (Elliehausen, Staten, & Steinbuks, 2008; LaCour-Little & Holmes, 2008). Importantly, the majority of such research has lumped together the borrowers who entered subprime mortgages for the above three reasons, or at best, examined refinance loans as distinctive from home purchase but did not differentiate between consumption-smoothing and financially-motivated refinances.

Following the subprime mortgage crisis, the Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank) was signed into law to specifically protect borrowers from predatory lending practices and loan features, such as prepayment penalties. The aim was to reduce the use of loan characteristics that were identified as predatory in nature by empowering the Bureau of Consumer Financial Protection (CFPB) to establish regulations that would provide a minimum level of consumer protection nationally and by authorizing states to supplement CFPB's rulemaking and enforcement efforts at the state level (Wilmarth, 2011).

In the aftermath of the subprime mortgage crisis, research attention has turned to the interaction of predatory lending practices and macro-economic factors, especially the decline in home values that compounded the impact of prepayment penalties and high loan-to-value ratios (Foote, Gerardi, Goette, & Willen, 2008). While finding evidence that predatory loan features were related to default rates, Neuenschwander and Proffitt (2014) found that housing price changes had the largest impact on default in multivariate models. However, these studies too, grouped all subprime borrowers together, without accounting for how the purpose of borrowers' entering into the mortgages may impact the loan performance in light of the presence of various loan features.

Although much of the formal academic research and the popular press have given attention to the high default rates of subprime mortgages, much less is known about what drives subprime mortgages to be prepaid, despite the fact that it is known that, like default, subprime mortgages tend to prepay at higher rates than prime mortgages and they tend to extract equity at greater rates (Pennington-Cross & Chomsisengphet, 2007). Looking at termination of subprime loans, rather than simply defaults, fills the gap regarding what is known about subprime

mortgages' long-term return potential and the impact of such predatory lending variables as prepayment penalties.

This study will examine how borrowers' motivation for obtaining subprime loans, coupled with the presence of prepayment penalties, impacts mortgage outcomes, accounting for both default and prepayment terminations. The remainder of the paper has the following structure: A review of the literature examining subprime mortgage default and prepayment tendencies is presented, followed by the methodology employed to examine the data and the results of the multinomial logit regression models. Finally, the implications of the findings, limitations of the study, and suggestions for further research are provided.

LITERATURE REVIEW

Necessity of Prepayment Penalties in Subprime Loans

Prepayment of subprime mortgages is, in many respects, quite different from prepayment of prime mortgages. Pennington-Cross and Chomsisengphet (2007) reported that most prime refinances are able to reduce their interest rate in the process of refinancing, while significantly fewer subprime loans are able to obtain such a rate reduction. Demyanyk and Van Hemert (2008) reported that most subprime loans were originated specifically for the purpose of extracting cash. The distinction between consumption-smoothing and financially-motivated refinances is important because extracting equity has implications not only for the loan quality (directly impacting loan-to-value ratios), but it may serve as an indication of other borrower qualities.

Moreover, it has been shown that lower-income borrowers are less likely to take advantage of refinance opportunities to reduce the interest rates (financially-motivated) and more likely to refinance than other households when negative income shocks are experienced (consumption-smoothing), such as in the case of unemployment (Nothaft & Chang, 2004; Van Order & Zorn, 2002; Hurst & Stafford, 2004). Yet, consumption-smoothing refinances are only a viable option *if* there is equity available for extraction. Considering that the majority of subprime loans had hybrid rate structures in the form of 2/28s and 3/27s, where the mortgages were issued with either low, introductory-offer rates or interest-only periods for the purpose of allowing borrowers to enjoy low monthly payments for an initial period, the question arises as to why subprime loans need prepayment penalties?

The answer may come from studies such as Pennington-Cross and Chomsisengphet (2007) who found that in fixed-rate subprime mortgages, consumption-smoothing refinances were less likely to prepay and more likely to default in the first two years after origination, while financially-motivated refinances were more likely to terminate because of prepayment. This supports the theory that there is a segment of the subprime market where prepayment penalties can benefit lenders without having abusive impacts on borrowers; however, differentiating borrowers according to the purpose of origination is required. The present study expands on Pennington-Cross and Chomsisengphet's study by including fixed rate, adjustable rate, and hybrid loan structures and by looking at loan data from a more recent time frame.

Prepayment Penalties in Models of Default

Numerous research studies have specifically identified prepayment penalties as a loan characteristic associated with default high rates in subprime mortgages. For example, in a nation-

wide study that estimated the impact of predatory lending practices on foreclosures, Quercia, Stegman, and Davis (2007) found that long prepayment penalty periods increased the likelihood that a subprime refinance loan would foreclose, even when borrower risk factors were accounted for. They found that the presence of prepayment penalties with durations of 36 months or longer increased the likelihood of default by 20%. Neuenschwander and Proffitt (2014); Quercia, Stegman, and Davis, 2007; and Demyanyk (2009) had similar conclusions regarding the negative impact of such loan features on default rates.

Rose (2008) likewise found that in Chicago subprime originations, long prepayment penalty periods were associated with greater probabilities of foreclosure. Rose's study suggested a complex relationship between loan features and the likelihood of foreclosure when interest rate structure and loan purpose were also accounted for. Rose found that long prepayment penalty periods were associated with greater likelihood of foreclosure in home purchase, fixed-rate mortgages and lesser likelihoods of foreclosure in refinance, fixed-rate mortgages, while having no real impact on an adjustable-rate mortgages' probability of foreclosure. Rose concluded that loan features often characterized as 'predatory' do not uniformly drive higher foreclosure rates. Due to the complex relationship that was found, any proposal to address rising foreclosure rates through restricting or prohibiting particular loan features, such as was intended through Dodd Frank, would likely not have the direct result of reducing subprime foreclosure rates and could potentially limit valuable contractual possibilities from subprime loans.

Both Demyanyk (2009) and Rose (2008) used relatively short timeframes over which subprime mortgages in their samples were allowed to season; as such, the results in these studies may not be reflective of long-term mortgage performance. Demyanyk's study examined loans through the first 17 months after origination. What happened to these mortgages after 17 months, when prepayment penalties were still in effect is unknown. The present study overcomes this specific limitation by using an extended timeframe that allows for a more complete picture of subprime mortgage terminations.

Prepayment Penalties have Less Impact on Termination than Changes in Home Prices

In more recent studies, prepayment penalties have shown a smaller impact on termination (prepayment and default) of subprime mortgages when compared to the impact of changing home values. This is likely a result of the phenomenon identified by Amromin and Paulson (2009) who found a notable difference in the sensitivity to changes in home prices in subprime and prime mortgages. The Case Shiller Home Price Index reported that, nationwide, home prices depreciated 32% from spring 2006 through spring 2011; thus, the impact of home price volatility and subsequent negative equity on default rates cannot be dismissed quickly.

Laufer (2011), who estimated the likelihood that a subprime mortgage will default, prepay to extract equity, prepay for relocation, or to stay current found that home price appreciation was strongly associated with equity extraction, a finding that was consistent with those of Milan and Sufi (2010). Laufer also found that home price depreciation was associated with a greater propensity to default, which is consistent with the findings of Bajari, Chu, and Park (2008).

Likewise, Demyanyk and Van Hemert (2008) claimed that loan and borrower characteristics, such as the presence of prepayment penalties, balloon payments, and low FICO scores were important in terms of explaining the cross-section of loan performance, but the extent of these characteristics did not vary in loans made over time. Thus, loan and borrower

characteristics did not explain why subprime loans defaulted so much more quickly in 2006 and 2007 than what they had earlier. House price depreciation, however, had the largest marginal effect on default and the greatest explanatory power of cross-sectional differences in loan performance.

Supporting the separation of financially-motivated and consumption smoothing is Pennington-Cross and Chomsisengphet (2007) who found that consumption-smoothing refinances were less likely to prepay and to default in the first two years after origination and financially-motivated refinances were more likely to terminate because of prepayments than default. However, they found that consumption-smoothing loans were more sensitive to declining house-prices than financially-motivated refinances.

METHODOLOGY

In this study the factors that are associated with default and prepayment of subprime mortgages were examined with special attention paid to the purpose for the original mortgage contract. The objective was to identify if prepayment penalties had the same impact on outcome in subprime mortgages originated for different reasons.

Data

The study used loan-level data for Cleveland, Ohio for all subprime loans that originated between 2001 and 2008, and tracking them through August 2011. It was fitting to examine the metropolitan statistical area of Cleveland, Ohio, as it was one of the harder-hit cities during the mortgage crisis (Mortgage Bankers Association, 2008).

Data regarding loan and borrower characteristics were licensed from CoreLogic Information Solutions, Inc.'s (CoreLogic) LoanPerformance database. Data regarding the real estate market were obtained from Standard and Poor's Case Shiller Home Price Indices. Loans records with incomplete data were excluded from analysis resulting in a total N of 71,474 individual loan records. The dataset was divided into three groups according to original purpose for the loan: 10,031 loans were refinances that were financially-motivated (F/M Refi), 27,283 loans were originated for home purchase (HP), and 34,205 loans were refinances that extracted equity to smooth consumption (C/S Refi). Table 1 (Appendix), Variable Definitions contains a list of the variables used to model default and prepayment for each of the three groups.

Model

Because the central purpose of the study was to examine factors that drove borrowers to terminate subprime mortgages, multinomial logistic regression (MNL) was used, allowing the impact of borrower, loan, and market variables in mortgages that were defaulted upon, prepaid, and kept current to be evaluated (Simonoff, 2003). Because there were three mutually-exclusive categories for which the dependent variable could take, the model produced two sets of logits for the dependent variable, default and prepaid. For each set of logits, the log of the ratio of the probability of termination due to default/(prepayment) compared to the probability of being in the baseline group of the loan remaining current was estimated. Thus, with the baseline category mortgages that remain current, the log-likelihood of default was modeled as

$$\text{Log}\left(\frac{\text{P(default)}}{\text{P(current)}}\right) = \beta_{\text{Default}} + \beta_{\text{Default,pp\_pen}}X_{\text{pp\_pen}} + \beta_{\text{Default,orig\_amt}}X_{\text{orig\_amt}} + \beta_{\text{Default,initial\_int}}X_{\text{initial\_int}} + \beta_{\text{Default,rate\_strucutre}}X_{\text{rate\_structure}} + \beta_{\text{Default,int\_only}}X_{\text{int\_only}} + \beta_{\text{Default,term}}X_{\text{term}} + \beta_{\text{Default,serv\_fee\_r}}X_{\text{serv\_fee\_r}} + \beta_{\text{Default,age}}X_{\text{age}} + \beta_{\text{Default,FICO}}X_{\text{FICO}} + \beta_{\text{Default,ltv}}X_{\text{ltv}} + \beta_{\text{Default,lien}}X_{\text{lien}} + \beta_{\text{Default,document}}X_{\text{document}} + \beta_{\text{Default,hom\_val}}X_{\text{hom\_val}} + \beta_{\text{Default,unemploy}}X_{\text{unemploy}},$$

where β_{Default} is the y-intercept for the default logit model and the independent variables are defined as in Table 1 (Appendix), Variable Definitions. A corresponding set of coefficients corresponding to the likelihood of prepayment was also examined.

The form of the probabilities took the S-shape found in all logistic relationships (Simonoff, 2003, p. 428):

$$p_j = \frac{\exp(\beta_{0j}+\beta_{1j}x_1+\ldots+\beta_{kj}x_k)}{\sum_{l=1}^{J}\exp(\beta_{0l}+\beta_{1l}x_1+\ldots+\beta_{kl}x_k)}.$$

Here, p_j is the probability of an outcome falling in category J (default), exp represents the irrational number *e* raised to the power of the values in the parentheses, and $\beta_1, \ldots, \beta_{J-1}$ are the estimated logit coefficients. The estimates of the coefficients ($\beta_1, \ldots, \beta_{J-1}$) were found by using the maximum likelihood, where the log-likelihood is

$$L = \sum_{j=1}^{J}\sum_{yi=j}\log p_{j,(i)}.$$

The probability of the observed results, given the parameter estimates, is the likelihood and is used to test the null hypothesis that all of the coefficients in the model are 0. The measure used to indicate how well the estimated model fits the data is found by multiplying -2 by the log of the likelihood (*-2LL*). A good model is one that results in a small value of the *-2LL*. The *-2LL* of the reduced model is the amount to which the *-2LL* would increase if the variable was excluded from the full model, similar to the change in the R^2 statistic in linear regression. The smaller the increase in the *-2LL*, the less of an impact the variable has on the overall model (Norusis, 2012).

Model Fit

Model fit was examined in two ways for each of the multinomial logit models. First, the full model was compared to the intercept-only model. The difference in the *-2LL* values for these models provided the chi-square value with degrees of freedom equal to the difference between the number of parameters in the two models. The null hypothesis that the likelihood ratio tests is that the coefficients of the terms that are excluded from the full model are 0 (Norusis, 2012).

Second, the models were evaluated for fit to the data by Deviance χ^2 goodness-of-fit tests and by pseudo-R^2. The Deviance χ^2 compares the full-estimated model to an intercept-only model, to determine if the full-estimated model produces a more explanatory-powerful model

than an intercept-only model. The Deviance χ^2 is $2(L_1 - L_0)$, where L_0 is the value of the log-likelihood function when the only explanatory variable is the constant term and L_1 is the log-likelihood function when all of the explanatory variables are included and the degrees of freedom are equal to the number of coefficients that are estimated (Borooah, 2002).

Finally, to examine the models' ability to discriminate between mortgage outcomes, pseudo-R^2 statistics were identified. The pseudo-R^2 value in logit regression can be interpreted in a similar manner as the R^2 value is in linear models. That is, it represents the proportion of variability in the dependent variable that can be explained by the independent variables (Norusis, 2012). The pseudo-R^2 values were derived from the following equations:

$$\text{Cox and Snell } R^2 = R^2_{CS} = 1 - \left(\frac{L(B^{(0)})}{L(\hat{B})}\right)^{2/n}$$

$$\text{Nagelkerke's } R^2 = R^2_N = \left(\frac{R^2_{CS}}{1 - L(B^{(0)})^{2/n}}\right)$$

$$\text{McFadden's } R^2 = R^2_M = 1 - \left(\frac{L(\hat{B})}{L(B^{(0)})}\right),$$

where, L(B-*hat*) is the log-likelihood function for the model with the estimated parameters, $L(B^{(0)})$ is the log-likelihood equation of the intercept-only model less its error term, and N is the sample size (Norusis, 2012).

RESULTS

Though the change in home value and loan age were most impactful in predicting termination, a finding consistent with Neuenschwander and Proffitt (2014), a different combination of independent variables had significance in determining outcome for each of the three groups. In financially-motivated refinance mortgages, origination amount, initial interest rate, term, FICO score, loan-to-value ratio, servicer-fee rate, interest rate structure, lien position, and degree of documentation required were factors associated with the outcome of mortgages at the .01 significance level, while the change in unemployment level was significant at the .05 level. However, the presence of prepayment penalties, in addition to interest-only payments, was a not factor associated with the outcomes of these mortgages. In home-purchase and cash-out refinance mortgages, all of the independent variables with the exception of interest-only payments were significant in the models of mortgage outcomes at the .01 level. However, in both models, the variable for interest-only payments was a significant factor at the .05 level.

Importantly, it was found that the signs of the coefficients for many of the loan- and borrower-characteristic variables changed across the three groups. Specifically, the presence of prepayment penalties, the servicer-fee rate, the initial interest rate, an interest-only period, and loan age were variables that had opposing signs when examined across the three groups. In addition, the coefficients for lien position and documentation level had opposing signs across the groups. This finding has significant implications on the drivers of outcome in subprime loans originated for various purposes.

Descriptive Statistics

Descriptive statistics for all variables, including the categorical dependent variable, were identified in each group. Means and standard deviations for the continuous variables (FICO score, loan-to-value, origination amount, term, loan age, and initial interest rate) and frequencies and percentages for the categorical variables (product type, documentation required, negative amortization, lien position, and presence of a prepayment penalty) are contained in Table 2 (Appendix), Descriptive Statistics and Table 3 (Appendix), Frequency, respectively.

As indicated in Table 3 (Appendix), Frequency – Dummy Variables, prepayment penalties were common in subprime mortgages originated during the period of study. The overall rate of prepayment penalties in the dataset (76.6%) is only slightly higher than the rate of occurrence for prepayment penalties reported by Mayer, Pence and Sherlund (2009), who suggested that, nationally, 72% of subprime mortgages originated during 2003 through mid-2007 contained a prepayment penalty.

The data were also examined for the rate of default and prepayment across the three groups. As indicated in Table 4 (Appendix), Mortgage Outcome, the rate of default was consistent across the groups, while the rate of prepayment had greater differences. Of the home-purchase mortgages, 70.7% were prepaid, while only 60.5% of financially-motivated refinance mortgages ended in a subsequent prepayment. With a Pearson chi-square test, it was confirmed that mortgage outcome is associated with loan purpose ($p = .000$).

Tests for Differences in Descriptive Statistics

Following the example of Rose (2008), the differences in the means across the three groups were evaluated for statistical significance using two-tailed difference of the means t-tests. Table 5 (Appendix), Results from t-tests for Differences in Means Tests reports the test statistics and significance levels from these differences of the means t-tests. Finding differences in the means of explanatory variables was an important precursor to finding differences in the logit models for the groups and further supported the decision to divide the records according to purpose.

Multinomial Logistic Regression Models

The results of the multinomial logit model for the financially-motivated refinance mortgages are presented in Table 6 (Appendix), MNL Model – F/M Refi. Here it is evident that neither the presence of prepayment penalties nor interest-only periods were significant in the model. The especially large *-2LL* of the reduced model value for the change in home price and loan age are indicative that these variables play an extremely important role in explaining mortgage outcome in the model, consistent with the findings of Neuenschwander and Proffitt (2014).

The parameter estimates for the financially-motivated refinance model are provided in Table 7 (Appendix), MNL Coefficients – F/M Refi. The estimated coefficients (*B*) indicate the change in the log odds that are associated with a one-unit change in each of the variables when all other variables are held constant (Norusis, 2012). The logit equation for default in the financially-motivated refinance group takes the form:

$$\text{Log}\left(\frac{\text{P(default)}}{\text{P(current)}}\right) = -.328 - .035\text{X}_{\text{pp}_{\text{pen}}} + .0000013\text{X}_{\text{orig}_{\text{amt}}} + .059\text{X}_{\text{init}_{\text{rate}}} - .308\text{X}_{\text{rate}_{\text{structure}}} + .092\text{X}_{\text{interest}_{\text{only}}} + .003\text{X}_{\text{term}} + .092\text{X}_{\text{serv}_{\text{fee}_{\text{r}}}} + .001\text{X}_{\text{age}} - .007\text{X}_{\text{FICO}} + .012\text{X}_{\text{ltv}} + .994\text{X}_{\text{lien}} - .295\text{X}_{\text{document}} - .017\text{X}_{\text{home}_{\text{value}}} + 9.126\text{X}_{\text{unemploy}}$$

The signs of the coefficients provide an indication of the direction of the relationship between the independent variables and the odds of default, and it can be seen that when a loan does not include a prepayment penalty, the log odds of default decreases, while the presence of a prepayment penalty increases the likelihood of default. While this is consistent with much academic and popular press, caution must be used in interpreting the impact of prepayment penalties as they were not a significant factor in the model.

The logit equation for prepayment in the financially-motivated refinance group takes the form:

$$\text{Log}\left(\frac{\text{P(prepay)}}{\text{P(current)}}\right) = 15.448 - .152\text{X}_{\text{pp}_{\text{pen}}} + .00000126\text{X}_{\text{orig}_{\text{amt}}} - .046\text{X}_{\text{init}_{\text{rate}}} - .103\text{X}_{\text{rate}_{\text{structure}}} - .064\text{X}_{\text{interest}_{\text{only}}} + .002\text{X}_{\text{term}} - .415\text{X}_{\text{serv}_{\text{fee}_{\text{r}}}} - .089\text{X}_{\text{age}} - .006\text{X}_{\text{FICO}} + .002\text{X}_{\text{ltv}} - .778\text{X}_{\text{lien}} + .252\text{X}_{\text{document}} + .350\text{X}_{\text{home}_{\text{value}}} + 19.000\text{X}_{\text{unemploy}}$$

The results of the multinomial logit model for the home purchase group are presented in Table 8 (Appendix), MNL Model – Home Purchase. Similar to the financially-motivated refinance model, the large *-2LL* of the reduced model values for the change in home price and loan age indicate much of the change in the log odds of default and prepayment is highly dependent on the movement of home prices and the age of the loan.

The parameter estimates for the home purchase model are provided in Table 9 (Appendix), MNL Coefficients – Home Purchase. Here it is evident that when a loan included a prepayment penalty, the log odds of default increased. However, like the logit equation for financially-motivated refinance, it was found that loans that had a prepayment penalty had a higher probability of prepayment, just the opposite of their intended impact.

The results of the multinomial logit model for the consumption-smoothing refinance group are presented in Table 10 (Appendix), MNL Model – C/S Refinance and the parameter estimates for the model are provided in Table 11 (Appendix), MNL Coefficients – C/S Refi. As was seen in the financially-motivated refinance and home-purchase models, when a mortgage did not have a prepayment penalty, the log odds of default decreased. However, an important distinction from the previous prepayment logit equations was found for the consumption-smoothing refinance group. In this model, the sign of the dummy variable for the presence of a prepayment penalty had the expected sign. That is, in this model, the log odds of prepayment decreased with the presence of a prepayment penalty.

Differences in Multinomial Logit Models

The central question was to identify if loan characteristics such as prepayment penalties had the same impact on outcome in subprime mortgages originated for different reasons. It was indeed found that not only did the impact of some variables play more or less prominent roles on mortgage outcome, but the signs of the coefficient varied among models.

Table 12 (Appendix), Comparison of Significant Variables compares the significant variables in the three models. Here it is evident that while the home purchase and consumption-smoothing refinance models behaved similarly with regards to the significant variables, the outcomes of financially-motivated refinance loans were not impacted by the same variables, especially in regards to the prepayment penalties. Prepayment penalties were significant in predicting outcome in home purchase and cash-out refinance loans, but were not significant in financially-motivated refinance loans. .

Even more than the significance of the predictor variables, the signs of the coefficients varied among the models in their impact on mortgage outcome. Table 13 (Appendix), Comparison of Coefficient Signs provides a side-by-side comparison of the sign of the coefficients for the default and prepayment equations. Of the loan characteristic variables, four of the predictor variables had inconsistent signs when predicting default and two had inconsistent signs when predicting prepayment. As expected, with regards to the prepayment equation, prepayment penalties lowered the likelihood of prepayment in financially-motivated refinance and home purchase loans, but had the opposite effect in consumption-smoothing refinances.

Like comparing the signs of the coefficients across the models, comparing the effect of a change in the independent variables on the odds of default and prepayment across the groups is quite telling, as examining the impact of the independent variables on the odds of each outcome provides a measure of sensitivity across the three groups. As previously described, the effect of adding one unit to the independent variables multiplies the original odds by Exp(B). As Table 14 (Appendix), Exp(B) Odds Multiplier indicates, home purchase borrowers were 1.537 times more likely to default if the loan had a prepayment penalty than without, while cash-out refinance borrowers were about as likely (1.058 times) to default with or without a prepayment penalty provision. Similarly, home purchase borrowers were about as likely to prepay their loans with or without a prepayment penalty (the presence of a prepayment penalty increased the odds of prepayment by 1.018 times), while consumption-smoothing refinance borrowers were .767 times less likely to prepay with a prepayment penalty than without. Thus, it is evident that for home purchase borrowers, a prepayment penalty had a larger impact on the odds of default than on the odds of prepayment, while for cash-out refinance borrowers, their odds of default with a prepayment penalty were about the same but their odds of prepayment are impacted by a greater magnitude.

Model Fit

Model fit was confirmed when the full models were compared to the intercept-only models. Table 15 (Appendix), Model Fit – Likelihood Ratio Test suggest that the full models fit the data better than the intercept-only models. Moreover, goodness-of-fit of the models were tested with deviance chi-square; Table 16 (Appendix), Goodness-of-Fit confirms the models fit the data. More than half of the variability in the outcomes of these mortgages was explained by the models. Table 17 (Appendix), Pseudo-R^2 indicates the variable in mortgage outcome that can be explained by the models.

Multinomial logit regression requires non-collinearity of the predictor variables, which was confirmed by Davis' (1971) guidelines for interpreting correlation coefficients. Also required in MNL regression is that there are no significant outliers between the plotted standardized residual values and the standardized predicted values (Norusis, 2012). Plots of the predicted and residual values confirmed that there were no outliers. Finally, MNL requires a

linear relationship between the continuous predictor variables and the logits (Norusis). Linearity was checked by visual banding, where categorical variables that corresponded to equal intervals of each covariate were created. MNL was rerun using the factors and the created categorical variables. The estimated coefficients were examined to see whether they increased or decreased monotonically.

For the significant variables in the financially-motivated refinance model, all of the logits were linear across the categories with the exception of servicer-fee-rate and change in unemployment rate for the odds of prepayment. In the home-purchase model, the logits were linear across the categories with the exceptions of loan-to-value and the change in unemployment rate for both the log odds of default and prepayment. The servicer-fee rate and change in unemployment rate were also not linear for default, while the initial interest rate was not linear for prepayment. In the consumption-smoothing refinance model, all of the logits were linear across the categories with the exception of the unemployment and age variables in the default logit and servicer-fee rate, change in unemployment, and the origination amount variables in the prepayment logit. When MNL regression was rerun without the non-linear covariates, the decline in the chi-square of the likelihood ratio test was insignificant, and the models fit the data at the .000 level. Similarly, the Cox and Snell pseudo-R^2 value declined by .004, .001, and .006, respectively. Therefore, it was concluded that the non-linear covariates had very little impact on the full models.

CONCLUSION

When each of the groups was examined individually, the change in home value and loan age were the most significant factors associated with loan outcome across the models. However, beyond these two predictor variables, different loan-characteristic variables were significant in determining outcome for the groups. Specifically, the home-purchase and consumption-smoothing refinance groups were modeled similarly in that the presence of prepayment penalties, origination amount, initial interest rate, interest rate structure, interest-only periods, term, servicer-fee rate, and loan age significantly impacted outcome. In the financially-motivated refinance model, however, the presence of prepayment penalties and interest-only payments were not associated with loan outcome, while the remaining loan-characteristic variables were significant. In regards to the borrower- and market-characteristic variables, all of the predictor variables were significant across the models.

The implications of loan purpose on the termination or survival of subprime loans are most evident when the signs of the coefficients are examined across the groups. Both change in home price and change in the unemployment rate impacted the probability of default and prepayment similarly across the purpose groups. This was not surprising as, by definition, forces that impact the marketplace will impact all loans, regardless of why there were originated. However, several of the loan- and borrower-characteristic variables impacted outcome (default and/or prepayment) differently when examined by purpose. In the coefficients for prepayment, the presence of prepayment penalties and interest-only payments increased the log-likelihood of prepayment in home purchase loans, but decreased it in cash-out refinances.

The differences in the models make it evident that not all subprime loans were impacted by loan provisions and borrower characteristics in the same way. Thus, when the purpose for the loan is known, whether to lower monthly payments, to extract equity, or to purchase a home,

there are implications for how different features will impact the loan's termination or survival potential, and by extension, the lender's profit potential.

Limitations and Subsequent Research

One limitation of the study was that only data for the MSA of Cleveland, Ohio was licensed from CoreLogic. Limiting the scope of the research to one MSA also limited the generalizability of the findings. However, due to the extent of subprime mortgage terminations that have been documented for Cleveland, Ohio, the results of the study suggest a worst-case-scenario for the impact of the various loan, borrower, and market characteristics on subprime mortgage terminations.

A second limitation of the study was that, while some lending practices identified as predatory in nature were included as independent variables in the study, other predatory lending practices could not be examined with the purchased dataset. For example, some studies have identified borrower income, race, education level, and gender as having explanatory power in default models while also being predatory features (Squires, 2004). The data purchased from CoreLogic, however, did not contain borrower information of this nature.

A necessary continuation of the study is to examine loan characteristics that have been labeled predatory on the outcome of subprime mortgages in other MSAs, accounting for the purpose of the originations to see if consistent results are found.

Discussion

The models of outcome in this study do not support previous subprime mortgage research that suggested mortgage lenders and brokers were predatory in their lending practices during the subprime lending boom. In all models, it was shown that the two factors most associated with loan outcome were the change in the home value and loan age, neither of which have predatory lending implications. This is consistent with the findings of Neuenschwander and Proffitt (2014) who also found that nearly all of the explanatory power of the models stems from these two predictor variables.

Among other lending practices, Squires (2004) specifically identified higher than necessary interest rates, fees for services that may or may not be provided, and high prepayment penalties as predatory in nature. When these loan features were examined in this study, it was found that they impacted outcome differently when examined in light of the purpose for origination. Prepayment penalties, which are included in loan contracts to discourage borrowers from prepaying loans early on, were found to only achieve their intended purpose in consumption-smoothing refinance loans. In home purchase loans they did the opposite and increased the likelihood of prepayment, while they were not significant in the model of outcome in financially-motivated refinance loans. The varying impacts of predatory loan features such as this across the groups suggest that a straight-forward, legislative ban on such loan features and implementation of specific lending standards would do little to alter the outcome of subprime loans. Rather, there exists a complicated web of loan-, borrower-, and market features that impact loan outcome.

Rose (2008) proposed that prepayment penalties serve as a sorting device with regards to borrowers' self-perception of their ongoing ability to keep a mortgage current. Borrowers who recognize that their future to stay current with mortgage payments in the future are strong,

regardless of what is documented in their loan applications, may accept long prepayment penalty periods to serve as a signal to lenders that they are worthwhile credit risks. This study supports the application of borrow signaling theory.

Using loans originated in Cleveland, Ohio, the results of multinomial logit models bring to light two traits about subprime mortgages: First, subprime mortgages *terminate*, and they terminate through both prepayment and default. The obvious result is that, generally speaking, an individual subprime loan is not likely to mature. Either the subprime borrower will make the required payments, improve his or her credit quality, and prepay into a prime-rate loan, or the subprime borrower will be unable to make the required payments and (if unable to prepay the mortgage with the sale of the property) default on the loan.

Second, it is clear that the purpose for the original loan makes a difference in the impact of loan features and borrower characteristics on outcome. While prepayment penalties do not impact the outcome of financially-motivated refinance loans, they do impact home purchase and consumption-smoothing refinance loans.

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APPENDIX

Table 1 Variable Definitions

Variable		Definition
Loan Characteristics		
	PP_Pen	Equals 1 if the loan had a prepayment penalty clause; equals 0 otherwise
	Orig_Amt	Loan origination amount in dollars
	Initial_Int	Interest rate as of deal closing date
	Rate_structure	Equals 1 if the loan had a variable interest rate; equals 0 otherwise
	Int_only	Equals 1 if the loan was interest only; equals 0 otherwise
	Term	Number of months until maturity
	Serv_Fee_R	Servicer fee rate
	Age	Age of loan in months from origination to termination of loan or last date of information, whichever applies
Borrower Characteristics		
	FICO	FICO score at origination
	Lien	Equals 1 if second lien; equals 0 if first lien
	LTV	Original loan-to-value
	Document	Equals 1 if low- or no-documentation was required; equals 0 if full documentation was required
Market Characteristic		
	Home_Val	Change in Case Shiller home price index value from origination to termination of loan or last date of information, whichever applies
	Unemploy	Change in unemployment rate from origination to termination of loan or last date of information, whichever applies

Table 2 Descriptive Statistics – Continuous Variables

		Minimum	Maximum	Range	Mean	Std. Dev.	Median	Q1	Q3
Origination Amount	F/M Refi	$4,300	$3,322,000	$3,317,700	$134,209	$110,008	$111,350	$83,000	$152,000
	HP	$3,000	$1,760,000	$1,757,000	$107,652	$ 89,147	$ 91,200	$66,300	$127,200
	C/S Refi	$3,900	$2,500,000	$2,496,100	$115,484	$ 85,139	$ 97,500	$71,250	$135,800
Initial Interest Rate	F/M Refi	.000	14.880	14.88	7.527	2.228	7.57	6.50	8.75
	HP	.000	16.467	16.47	8.362	1.944	8.20	7.13	9.41
	C/S Refi	.000	17.500	17.50	8.204	1.969	8.00	7.05	9.06
Term	F/M Refi	96	480	384	338.14	58.167	360	360	360
	HP	60	480	420	336.97	59.574	360	360	360
	C/S Refi	60	480	420	331.75	64.808	360	360	360
Servicer Fee Rate	F/M Refi	.000	3.410	3.410	.311	.348	.26	.00	.50
	HP	.000	3.733	3.733	.355	.350	.50	.00	.50
	C/S Refi	.000	4.056	4.056	.315	.359	.38	.00	.50
Age	F/M Refi	2	127	125	50.61	27.12	53	27	71
	HP	1	127	126	44.24	23.86	42	25	62
	C/S Refi	1	127	126	49.50	27.41	50	26	71
FICO	F/M Refi	429	880	451	631.67	69.744	630	580	679
	HP	414	895	481	637.31	63.922	629	593	676
	C/S Refi	351	866	515	613.95	63.354	611	565	655
Loan-to-Value	F/M Refi	6.3	125.0	118.8	83.8	11.4	85.0	79.9	90.0
	HP	19.4	125.0	105.6	89.0	9.8	90.0	80.0	100.0
	C/S Refi	5.7	126.0	120.3	83.5	14.7	85.0	78.2	90.0
Change in Home	F/M Refi	-25	19	44	-8.89	12.472	-13	-21	3
Value	HP	-25	19	44	-9.62	11.623	-13	-21	1
	C/S Refi	-25	19	44	-8.22	12.632	-11	-21	4
Change in	F/M Refi	-.009	.054	.063	.015	.013	0.020	0.003	0.024
Unemployment rate	HP	-.009	.055	.064	.015	.013	0.016	0.003	0.024
	C/S Refi	-.009	.056	.066	.015	.013	0.019	0.003	0.024

Table 3 Frequency – Dummy Variables

	F/M Refi		HP		C/S Refi		Total	
	Count	%	Count	%	Count	%	Count	%
Fixed Interest Rate	4565	45.5	9919	36.4	17031	49.8	31515	44.1
Adjustable Interest Rate	5466	54.5	17319	63.6	17174	50.2	39959	55.9
Total	10031	100	27238	100	34205	100	71474	100
No Prepayment Penalty	2578	25.70	6758	24.81	7412	21.67	16748	23.43
Prepayment Penalty	7453	74.30	20480	75.19	26793	78.33	54726	76.57
Total	10031	100.0	27238	100.0	34205	100.0	71474	100.0
No Interest Only	8704	86.8	24178	88.8	32182	94.1	65064	91.0
Interest Only	1327	13.2	3060	11.2	2023	5.9	6410	9.0
Total	10031	100	27238	100	34205	100	71474	100
First Lien	9182	91.5	22572	82.9	30700	89.8	62454	87.4
Second Lien	849	8.5	4666	17.1	3505	10.2	9020	12.6
Total	10031	100	27238	100	34205	100	71474	100
Full Documentation	7148	71.3	18224	66.9	26079	76.2	51451	72.0
Low or No	2883	28.7	9014	33.1	8126	23.8	20023	28.0
Total	10031	100	27238	100	34205	100	71474	100

Table 4 Mortgage Outcome

	F/M Refi		HP		C/O Refi		Total	
	Count	%	Count	%	Count	%	Count	%
Current	2652	26.4	4572	16.8	7865	23.0	15089	21.1
Default	1311	13.1	3419	12.6	4377	12.8	9107	12.7
Prepaid	6068	60.5	19247	70.7	21963	64.2	47278	66.2
Total	10031	100.0	27238	100.0	34205	100.0	71474	100.0

Table 5 Results from t-tests for Differences in Means Tests

	F/M Refi vs. HP	F/M Refi vs. C/O Refi	H/P vs. C/O Refi
Prepayment Penalty	-1.748 *	-8.228 ***	-9.141 ***
Origination Amount	-21.697 ***	-15.723 ***	-11.036 ***
Initial Interest Rate	-33.149 ***	-27.431 ***	-9.944 ***
Interest Rate Structure	-15.775 ***	-7.566 ***	-33.637 ***
Interest Only	-5.132 ***	-20.232 ***	-23.134 ***
Term	-1.715 *	-9.426 ***	-10.378 ***
Service-Fee Rate	-10.584 ***	-0.886	-13.766 ***
Age	-20.737 ***	-3.574 ***	-25.419 ***
FICO	-7.071 ***	-22.841 ***	-45.179 ***
Lien Position	-24.096 ***	-5.526 ***	-24.489 ***
Loan-to-Value	-40.559 ***	-1.652 *	-54.841 ***
Documentation Level	-8.146 ***	-25.482 ***	-25.482 ***
Change in Home Value	-5.116 ***	-4.703 ***	-14.270 ***
Change in Unemployment	-1.988 **	-2.068 **	-0.005

*, **, and *** indicate 10 percent, 5 percent, and 1 percent significance levels, respectively.

Table 6 MNL Model - F/M Refi

	Model Fitting Criteria	Likelihood Ratio Tests		
	-2LL of the Reduced Model	Chi-Square	df	Sig.
Intercept	8460.4	.0	0	.
Loan Characteristic Variables				
Prepayment Penalty	8462.6	2.2	2	.339
Origination Amount	8477.1	16.7	2	.000
Initial Interest Rate	8472.2	11.8	2	.003
Interest Rate Structure	8475.0	14.6	2	.001
Interest-Only Period	8461.7	1.3	2	.527
Term	8474.4	14.0	2	.001
Servicer-Fee Rate	8471.4	11.0	2	.004
Age	10458.6	1998.2	2	.000
Borrower Characteristic Variables				
FICO	8572.6	112.2	2	.000
Lien Position	8503.5	43.1	2	.000
Loan-to-Value	8472.1	11.7	2	.003
Documentation	8485.3	24.9	2	.000
Market Characteristic Variables				
Change in Home Price	11051.2	2590.8	2	.000
Change in Unemployment	8467.8	7.4	2	.025

Table 7 MNL Coefficients - F/M Refi

	B	Std. Error	Exp(B)	95% Confidence Interval for Exp(B) L.B.	U.B
Default Equation					
Intercept	-.328	.963			
Prepayment Penalty	-.035	.083	.966	.821	1.137
Origination Amount	.000	.000	1.000	1.000	1.000
Initial Interest Rate	.059	.024	1.060	1.012	1.111
Interest Rate Structure	-.308	.080	.735	.628	.861
Interest Only	.092	.108	1.096	.888	1.353
Term	.003	.001	1.003	1.001	1.005
Service-Fee Rate	.092	.102	1.096	.898	1.338
Age	.001	.003	1.001	.995	1.007
FICO	-.007	.001	.993	.992	.995
Lien Position	.994	.226	2.701	1.734	4.208
Loan-to-Value	.012	.004	1.012	1.005	1.020
Documentation Level	-.295	.082	.744	.633	.875
Change in Home Price	-.017	.012	.983	.960	1.007
Change in Unemployment	9.126	8.701	9194.449	.000	2.34E+11
Prepayment Equation					
Intercept	15.448	1.025			
Prepayment Penalty	-.152	.104	.859	.701	1.053
Origination Amount	.000	.000	1.000	1.000	1.000
Initial Interest Rate	-.046	.028	.955	.904	1.009
Interest Rate Structure	-.103	.100	.902	.742	1.097
Interest Only	-.064	.127	.938	.732	1.202
Term	.002	.001	1.002	1.000	1.003
Service-Fee Rate	-.415	.148	.660	.494	.882
Age	-.089	.003	.915	.910	.920
FICO	-.006	.001	.994	.992	.996
Lien Position	-.778	.219	.459	.299	.705
Loan-to-Value	.002	.004	1.002	.993	1.010
Documentation Level	.252	.102	1.287	1.053	1.572
Change in Home Price	.350	.012	1.419	1.387	1.452
Change in Unemployment	19.000	6.867	1.78E+08	254.970	1.25E+14

Table 8 MNL Model - Home Purchase

	Model Fitting Criteria	Likelihood Ratio Tests		
	-2LL of the Reduced Model	Chi-Square	df	Sig.
Intercept	19418.7	.0		.
Loan Characteristic Variables				
Prepayment Penalty	19468.8	50.1	2	.000
Origination Amount	19445.7	27.0	2	.000
Initial Interest Rate	19520.6	101.9	2	.000
Interest Rate Structure	19442.4	23.8	2	.000
Interest-Only Period	19425.6	7.0	2	.031
Term	19435.6	17.0	2	.000
Servicer-Fee Rate	19445.1	26.4	2	.000
Age	24320.8	4902.1	2	.000
Borrower Characteristic Variables				
FICO	19946.2	527.6	2	.000
Lien Position	19500.7	82.1	2	.000
Loan-to-Value	19456.8	38.2	2	.000
Documentation	19433.7	15.0	2	.001
Market Characteristic Variables				
Change in Home Price	25100.6	5681.9	2	.000
Change in Unemployment	19456.6	38.0	2	.000

Table 9 MNL Coefficients- Home Purchase

	B	Std. Error	Exp(B)	95% Confidence Interval for Exp(B) L.B.	U.B
Default Equation					
Intercept	1.681	.707			
Prepayment Penalty	-.430	.064	.651	.574	.737
Origination Amount	.000	.000	1.000	1.000	1.000
Initial Interest Rate	.144	.021	1.155	1.108	1.204
Interest Rate Structure	-.262	.055	.769	.691	.856
Interest Only	-.191	.074	.826	.715	.955
Term	.003	.001	1.003	1.001	1.004
Service-Fee Rate	-.144	.071	.866	.753	.996
Age	.001	.002	1.001	.997	1.005
FICO	-.009	.001	.991	.990	.992
Lien Position	.980	.131	2.665	2.061	3.446
Loan-to-Value	.005	.003	1.005	.999	1.011
Documentation Level	-.082	.056	.921	.826	1.028
Change in Home Price	-.024	.009	.976	.960	.993
Change in Unemployment	18.498	6.265	1.08E+08	501.839	2.33E+13
Prepayment Equation					
Intercept	18.370	.718			
Prepayment Penalty	-.017	.070	.983	.856	1.128
Origination Amount	.000	.000	1.000	1.000	1.000
Initial Interest Rate	-.093	.022	.911	.872	.951
Interest Rate Structure	-.103	.100	.902	.742	1.097
Interest Only	-.123	.087	.885	.746	1.049
Term	.001	.001	1.001	1.000	1.003
Service-Fee Rate	-.467	.090	.627	.526	.748
Age	-.098	.002	.907	.903	.910
FICO	-.011	.001	.989	.988	.990
Lien Position	-.280	.138	.756	.577	.990
Loan-to-Value	.022	.004	1.022	1.015	1.029
Documentation Level	-.244	.063	.783	.692	.886
Change in Home Price	.345	.008	1.412	1.391	1.435
Change in Unemployment	30.352	4.823	1.52E+13	1.19E+09	1.94E+17

Table 10 MNL Model-C/S Refinance

	Model Fitting Criteria -2LL of the Reduced Model	Likelihood Ratio Tests Chi-Square	df	Sig.
Intercept	26256.3	.0		.
Loan Characteristic Variables				
Prepayment Penalty	26279.8	23.5	2	.000
Origination Amount	26322.2	65.8	2	.000
Initial Interest Rate	26286.2	29.8	2	.000
Interest Rate Structure	26293.8	37.4	2	.000
Interest Only Period	26263.5	7.1	2	.029
Term	26278.6	22.3	2	.000
Service Fee Rate	26309.2	52.8	2	.000
Age	34795.2	8538.9	2	.000
Borrower Characteristic Variables				
FICO	26582.7	326.3	2	.000
Lien Position	26321.0	64.7	2	.000
Loan-to-Value	26349.1	92.8	2	.000
Documentation	26280.0	23.7	2	.000
Market Characteristic Variables				
Change in Home Price	35871.2	9614.8	2	.000
Change in Unemployment	26367.2	110.8	2	.000

Table 11 MNL Coefficients-C/S Refi

	B	Std. Error	Exp(B)	95% C. I. for Exp(B) L.B.	U.B.
Default Equation					
Intercept	1.791	.533	.000	.000	.000
Prepayment Penalty	-.056	.049	.945	.859	1.041
Origination Amount	.0000011	2.36E-07	1.00	1.00	1.00
Initial Interest Rate	.032	.016	1.033	1.002	1.065
Interest Rate Structure	-.250	.045	.778	.713	.850
Interest Only	-.106	.080	.899	.769	1.051
Term	.002	.000	1.002	1.001	1.003
Service-Fee Rate	-.036	.051	.965	.873	1.066
Age	-.008	.002	.992	.988	.995
FICO	-.007	.000	.993	.992	.994
Lien Position	.971	.124	2.640	2.069	3.369
Loan-to-Value	.009	.002	1.009	1.005	1.012
Documentation Level	-.226	.048	.798	.726	.877
Change in Home Price	-.002	.007	.998	.984	1.011
Change in Unemployment	8.194	5.124	3620.668	.158	8.32E+07
Prepayment Equation					
Intercept	14.458	.578	.000	.000	.000
Prepayment Penalty	.265	.062	1.304	1.154	1.473
Origination Amount	-.0000016	3.60E-07	1.00	1.00	1.00
Initial Interest Rate	-.078	.018	.925	.892	.959
Interest Rate Structure	-.233	.058	.792	.708	.887
Interest Only	.195	.106	1.215	.986	1.497
Term	.001	.001	1.001	1.000	1.002
Service-Fee Rate	-.567	.080	.567	.485	.664
Age	-.103	.002	.902	.899	.905
FICO	-.006	.001	.994	.993	.995
Lien Position	.372	.134	1.451	1.115	1.887
Loan-to-Value	.0208	.0023	1.0211	1.0165	1.0257
Documentation Level	-.164	.062	.849	.751	.959
Change in Home Price	.362	.007	1.437	1.418	1.456
Change in Unemployment	44.702	4.356	2.59E+19	5.09E+15	1.32E+23

Table 12 Comparison of Significant Variables

	F. M. Refi	Home Purchase	C.S. Refi
Loan Characteristic Variables			
Prepayment Penalty	Not Significant	***	***
Origination Amount	***	***	***
Initial Interest Rate	***	***	***
Interest Rate Structure	***	***	**
Interest-Only Period	Not Significant	**	***
Term	***	***	***
Servicer-Fee Rate	***	***	***
Age	***	***	***
Borrower Characteristic Variables			
FICO	***	***	***
Lien Position	***	***	***
Loan-to-Value	***	***	***
Documentation	***	***	***
Market Characteristic Variables			
Change in Home Price	***	***	***
Change in Unemployment	**	***	***

*, **, and *** indicate 10 percent, 5 percent, and 1 percent significance levels, respectively.

Table 13 Comparison of Coefficient Signs

	Default			Prepayment		
	F/M Refi	H.P	C/O Refi	F/M Refi	H.P	C/O Refi
Loan Characteristic Variables						
Prepayment Penalty (No PPP)	(-)	-	-	(-)	-	+
Origination Amount	+	+	+	+	+	+
Initial Interest Rate	+	+	-	-	-	-
Interest Rate Structure (Fixed)	-	-	-	-	-	-
Interest-Only Period (None)	(+)	-	-	(-)	-	+
Term	+	+	+	+	+	+
Servicer-Fee Rate	+	-	-	-	-	-
Age	+	+	-	-	-	-
Borrower Characteristic Variables						
FICO	-	-	-	-	-	-
Lien Position (First)	+	+	+	-	-	+
Loan-to-Value	+	+	+	+	+	+
Documentation (Full Doc)	-	-	-	+	-	-
Market Characteristic Variables						
Change in Home Price	-	-	-	+	+	+
Change in Unemployment	+	+	+	+	+	+

( ) indicates variable was insignificant in the model. These signs were included for comparison purposes only.

Table 14 Exp(B) Odds Multiplier

	Default			Prepayment		
	F/M Refi	HP	C/O Refi	F/M Refi	HP	C/O Refi
Prepayment Penalty	1.035	1.537	1.058	1.164	1.018	.767
Origination Amount	1.000	1.000	1.000	1.000	1.000	1.000
Initial Interest Rate	1.060	1.155	1.033	.955	.911	.925
Interest Rate Structure	1.361	1.300	1.285	1.109	1.109	1.262
Interest Only	.912	1.210	1.112	1.066	1.130	.823
Term	1.003	1.003	1.002	1.002	1.001	1.001
Service-Fee Rate	1.096	.866	.965	.660	.627	.567
Age	1.001	1.001	.992	.915	.907	.902
FICO	.993	.991	.993	.994	.989	.994
Lien Position	.370	.375	.379	2.177	1.323	.689
Loan-to-Value	1.012	1.005	1.009	1.002	1.022	1.021
Documentation Level	1.343	1.085	1.253	.777	1.277	1.178
Home Price Change	.983	.976	.998	1.419	1.412	1.437
Unemployment Change	9.1E+3	1.1E+8	3.6E+3	1.8E+8	1.5E+13	2.6E+19

Table 15 Model Fit-Likelihood Ratio Test

		Model Fitting Criteria	Likelihood Ratio Tests		
	Model	-2 Log-Likelihood	Chi-Square	df	Sig.
F/M Refi	Intercept Only	18491.92			
	Final	8460.399	10031.52	28	0.000
Home Purchase	Intercept Only	43876.96			
	Final	19418.68	24458.28	28	0.000
C/S Refi	Intercept Only	60580.37			
	Final	26256.34	34324.03	28	0.000

Table 16 Goodness-of-Fit

	Chi-Square	df	Sig.
F/M Refi	8460.4	20032	1.000
Home Purchase	19418.7	54446	1.000
C/S Refi	26256.3	68380	1.000

Table 17 Pseudo-R^2

	F/M Refi	Home Purchase	C/S Refi
Cox and Snell	0.632	0.593	0.633
Nagelkerke	0.751	0.74	0.763
McFadden	0.542	0.557	0.567