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GEOGRAPHIC VARIATION IN SUBPRIME LOAN FEATURES, FORECLOSURES, AND PREPAYMENTS

Morgan J. Rose*

Abstract—Using data on subprime mortgages from ten cities, I examine geographic variation in the effects of prepayment penalties, balloon loans, and reduced documentation on the probabilities of foreclosure and prepayment. Results indicate that across cities, reduced documentation is consistently related to higher probabilities of foreclosure, and prepayment penalties are consistently related to lower probabilities of prepayment. Prepayment penalties and balloon loans are more sporadically associated with foreclosures, and reduced documentation and balloon loans are more sporadically associated with prepayments. These results are robust to controls for several state antipredatory lending law provisions, whose effects are also tested.

I. Introduction

ONE frequently offered explanation for the rise in foreclosures beginning in 2007 is a proliferation of a variety of subprime loans with features that, it is argued, are unfair to borrowers and make foreclosure more likely. In 2010, the Dodd-Frank Wall Street Reform and Consumer Protection Act placed new restrictions on the use of certain of these loan features. While the crisis is a national one, residential housing markets are segmented by their nature—for most people, a house in Saint Petersburg is not a close substitute for an identical house in Saint Louis—and the effects of a given loan feature in one locale need not be the same in another locale. The main goal of this paper is to use loan-level data from ten American metropolitan statistical areas (MSAs) to evaluate how consistent the effects of certain loan features are on foreclosures and prepayments across MSAs.

This paper examines the effects of three subprime loan features: prepayment penalties, balloon payments, and reduced documentation. A prepayment penalty requires a borrower to pay a fee if he or she repays a loan within a pre-specified length of time after origination. A balloon loan is one that does not fully amortize over the term of the loan and so requires a large balloon payment at maturity. Reduced documentation refers to loans that are underwritten with key economic information about the borrower either self-reported by the borrower or omitted entirely.

These features, among others, are frequently labeled “predatory,” meaning that unscrupulous lenders can use

them to place borrowers in loans that the borrowers cannot afford or whose terms the borrowers do not fully understand, or to extract large fees from borrowers. A prepayment penalty directly raises the cost of repaying a loan through a refinancing or sale. With a prepayment penalty in effect, a financially distressed borrower having difficulty with his or her mortgage payment may find prepayment prohibitively expensive, making a foreclosure more likely. The final payment of a balloon loan is usually far too large for a borrower to pay out of pocket, requiring a prepayment through potentially costly refinancing or the sale of the property to meet the loan terms. Reduced documentation fosters ambiguity in a borrower’s ability to repay a loan and can be used to place a borrower in a more expensive loan than the borrower can afford.

Each of these features can also bring substantial benefits to borrowers. Because a prepayment penalty transfers some of the prepayment risk from the lender to the borrower, a loan with a prepayment penalty usually features a lower interest rate than an otherwise similar loan, making the loan more affordable. Similarly, a balloon loan will have lower monthly payments than a fully amortizing one, making it more attractive for a borrower who places a high probability on either selling the house or refinancing the loan prior to the scheduled balloon payment. In both cases, the greater affordability associated with these two loan features can be the difference for some borrowers between being able or unable to purchase a home. Reduced documentation can be useful for people with incomes that are highly variable or otherwise difficult to document and who might be shut out of the housing credit market if full documentation were required.

These three loan features have been the subject of both longstanding and recent federal-level regulation. Since 1994, the Home Ownership and Equity Protection Act (HOEPA) has restricted many lending practices for “high-cost loans,” including a prohibition against prepayment penalties imposed beyond the fifth year after a loan’s origination and a prohibition against balloon loans in which the final payment is due within five years of origination.¹ In 2008, the Federal Reserve Board’s amendment to Regulation Z banned prepayment penalties on “higher-priced mortgage loans” in which the monthly payment can change in the first four years of the loan and limited prepayment

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* Office of the Comptroller of the Currency, and University of Maryland, Baltimore County.

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¹ HOEPA defines high-cost loans as those in which either the APR exceeds the yield on comparable Treasury securities plus 8% for first-lien mortgages (10% for subordinate liens) or the total points and fees exceed the greater of 8% of the total loan amount or an annually indexed dollar figure (\$579 in 2010). In addition to the prohibition of all prepayment penalties five years after origination, prepayment penalties are prohibited entirely on loans in which the borrower’s total monthly debts exceed 50% of the borrower’s monthly gross income.

penalties to the first two years of other higher-priced loans.² The rule change also prohibits lenders from making a higher-priced loan without regard to a borrower's ability to repay based on the borrower's income and assets and requires lenders to verify all income and assets on which the lender relies to determine the ability to repay. Title XIV of the Dodd-Frank Act prohibits prepayment penalties on all adjustable rate mortgages (ARMs) and certain high-priced fixed rate mortgages (FRMs). On all other mortgages, prepayment penalties are prohibited three years after origination, while the amount of the penalty in the first, second, and third year after origination is limited to 3%, 2%, and 1%, respectively, of the outstanding loan balance. Title XIV requires originators to verify a borrower's ability to repay based on a payment schedule that fully amortizes the loan over the loan term and sets standards for the verification of borrower income or assets. Title XIV also prohibits balloon payments on high-priced mortgages.

The implicit rationale for specifically federal-level regulation (rather than regulation at a lower level or no regulation) of these loan features rests on three premises: (a) there are negative externalities associated with foreclosures, (b) the negative effects of the restricted loan features (including greater probabilities of foreclosure, extraction of fees, costly refinancings and house sales that might otherwise have been unnecessary) outweigh the positive effects (including lower monthly payments and greater access to credit for lower-income borrowers), and (c) the effects are on net consistently negative in mortgage markets across the country. The first premise justifies government regulation in mortgage lending in general, and the second premise justifies regulation of specific loan features. The third premise is necessary to justify regulatory decision making at the federal level, as opposed to the state or municipal level. Because real estate markets are geographically segmented, mortgage lending practices may develop differently in different markets. Differences in the prevalence of brokers versus bank originators, standards set by different locally dominant lenders, the industry mix (affecting workers' income levels and stabilities), and prior state and local lending laws can all influence how and how often various loan features are used from one market to the next. If the effects of a given feature are on net negative in some markets but positive in others, then federal-level regulation is suboptimal compared to an approach in which the presence or restrictiveness of regulation concerning a particular loan feature is determined at lower governmental levels.

The following section provides an overview of the literature relevant to the first two premises. This paper contributes to the existing literature examining the validity of the second premise; more important, it is the first paper (to my

knowledge) to address the third premise, and so makes a significant contribution to the subprime lending literature. It does so by evaluating the relationships between prepayment penalties, balloon loans, and reduced documentation, on the one hand, and the probabilities of foreclosure and prepayment, on the other, for ten MSAs, and analyzing how consistent those relationships are across MSAs. The findings indicate that reduced documentation is consistently related to greater probabilities of foreclosure, and prepayment penalties are consistently related to lower probabilities of prepayment. Prepayment penalties and balloon loans are more sporadically associated with foreclosures, and reduced documentation and balloon loans are more sporadically associated with prepayments. The results also generally show greater cross-MSA variation in these relationships for FRMs than for ARMs and for home purchase mortgages than for refinancing mortgages.

There is more to consider in the total positive and negative effects of a loan feature than changes in the probabilities of different loan outcomes, important though those are. Increased access to credit, financial gains from lower monthly payments, and financial losses from fees, refinancing, or forced home sales are all potential additional effects attributable to the examined loan features, but are not addressed here. As such, this paper's findings provide a useful first step in evaluating the geographic variation in the total effects of subprime loan features, but not a complete or definitive answer.

Given that a major potential source for variation in the relationships described is variation in state antipredatory lending laws (APLs), I incorporate the effects of a variety of state APL provisions on the probabilities of foreclosure and prepayment. Although a thorough examination of the efficacy of state APLs is outside the scope of this paper, the results indicate that in general, several of the specific state APL provisions tested are negatively related to the probability of foreclosure and positively related to the probability of prepayment. There is very little previous research on the relationship between state APLs and loan outcomes, so these findings represent another contribution to the literature on subprime mortgage lending. More relevant to the main goal of this paper, the cross-MSA variation in the relationships between the examined loan features and the probabilities of foreclosure and prepayment is robust to the inclusion of state APL provisions in the analysis.

The remainder of this paper is structured as follows. Section II discusses the relevant previous literature. Section III describes the paper's data sources and the econometric methodology employed. Section IV presents results from the empirical analysis, and section V concludes.

II. Previous Literature

The primary negative externality associated with foreclosures in the academic literature is a contagion effect in which foreclosures cause nearby house prices to fall. In

² Under the amendment to Regulation Z, a first-lien loan is "higher-priced" if its APR is 1.5 percentage points higher than the average prime offer rate determined by a Freddie Mac mortgage rate survey. For subordinate liens, the APR threshold is 3.5 percentage points. See Federal Reserve Board (2008).

recent research, Immergluck and Smith (2006), Lin, Rosenblatt, and Yao (2009), and Harding, Rosenblatt, and Yao (2009) identify a reduction in prices for homes near foreclosed properties. Because causality could run the other way, with general declines in local house values triggering foreclosures in some neighborhood homes, Harding et al. (2009) simultaneously estimate local house price trends and the price impact of nearby foreclosures and still find a significant contagion effect.

The years leading up to and following the subprime foreclosure crisis have witnessed a number of papers examining the relationships between prepayment penalties, balloon loans, or reduced documentation and the probability of default in subprime mortgages, with default variously defined as a loan being sixty days delinquent, ninety days delinquent, or entering foreclosure or "real estate owned" (REO) status. Quercia, Stegman, and Davis (2007), Danis and Pennington-Cross (2008), Rose (2008), Demyanyk and Van Hemert (2011), and Pennington-Cross and Ho (2010) all find that prepayment penalties are associated with greater probabilities of default, although in Rose (2008) and Pennington-Cross and Ho (2010), this result is somewhat dependent on the specification and type of loan used. All of these papers except Demyanyk and Van Hemert (2011) use competing risk models that jointly consider the probabilities of prepayment and default, and they all find a negative relationship between prepayment penalties and the probability of prepayment, as one would expect. These papers generally also find that reduced documentation is associated with greater probabilities of default, with inconsistent results regarding the probability of prepayment. Two additional papers focusing specifically on reduced documentation, Jiang, Nelson, and Vytlačil (2009) and LaCour-Little and Yang (2010), find that it is associated with greater default risk and present evidence that the increased default risk is associated with income exaggeration or other falsification of borrower information. Balloon loans have received less attention than the other loan features. Quercia et al. (2007) find balloon loans to be associated with greater probabilities of foreclosure and prepayment in a sample of purchase FRMs and ARMs. Rose (2008) finds a positive relationship with the probability of foreclosure for refinance FRMs but not purchase FRMs and that balloon loans are negatively associated with the probability of prepayment for purchase FRMs but not refinance FRMs.

Prepayment penalties have received additional attention from researchers analyzing their potential benefits and costs to borrowers beyond their effects on the probabilities of foreclosure and prepayment. Elliehausen, Staten, and Steinbuks (2008), using a simultaneous equation approach controlling for endogeneity among loan interest rates, loan-to-value (LTV) ratios, and prepayment penalties, find that prepayment penalties are associated with lower interest rates and that state laws restricting prepayment penalties are associated with higher interest rates. Rose (2012) uses a similar approach and finds that prepayment penalties are generally associated with lower initial loan interest rates

but are associated with significantly higher ARM interest rate margins. LaCour-Little and Holmes (2008) compare the benefit to borrowers of reduced interest rates to the costs based on the probability of prepayment and the size of the prepayment penalty under various scenarios, and find that the expected benefits are not enough to outweigh the expected costs. The results of a theoretical model and empirical analysis by Mayer, Piskorski, and Tchistyi (2010) suggest that the least credit-worthy borrowers receive the largest benefits from prepayment penalties in the form of lower interest rates that both reduce the likelihood of default and allow access to residential credit that would otherwise be unavailable.

Existing studies of the regulation of subprime lending through state and municipal APLs mostly focus on the impact of such laws on the volume of subprime lending and on loan interest rates. Harvey and Nigro (2003) investigate loan volumes following the enactment of an APL in Chicago, and Quercia et al. (2004) and Harvey and Nigro (2004) both examine the effects of a North Carolina APL. Taken together, these studies suggest that those APLs did not substantially reduce subprime lending in the affected locales, with such reductions that did occur being attributable to a decline in loans with features, like prepayment penalties and balloon loans, which were targets of the legislation. Subsequent studies on state APLs develop joint measures or indices of the strength of various common APL provisions to test the impacts of different states' APLs. Pennington-Cross and Ho (2006) find that state APLs with more restrictions on specific loan features reduce the probability of origination, while APLs that cover a broader range of loans increase that probability. Bostic et al. (2008) find similar results and also find that an index of the enforcement provisions in state APLs is not consistently associated with the volume of subprime lending. Rather than create state law indices, Li and Ernst (2007) create dummy variables for each unique combination of provisions found in state APLs and find that APLs generally reduce the frequency of loans with targeted loan features but do not reduce subprime lending overall. They also find that for FRMs, state APLs are associated with modest decreases in subprime interest rates. This contrasts with Pennington-Cross and Ho (2008), who find that state APLs are associated with slightly higher interest rates for FRMs and slightly lower ones for ARMs. A research report by Ding et al. (2010) is the only previous paper to test the impact of state APLs on loan outcomes. Using a pooled sample of prime and subprime loans, they find lower probabilities of delinquency and prepayment associated with state APLs that have broader coverage of loans (based on loan points and fees), more restrictions on prepayment penalties, and requirements that lenders verify borrowers' abilities to repay loans.

This paper extends this literature on several fronts. Most important, it is the first to examine geographic variation in the relationships between the subprime loan features and the probabilities of foreclosure and prepayment. As discussed earlier, this has clear implications for the optimality

TABLE 1.—SAMPLE MSAs

MSA	Abbreviation	Foreclosure Rate (%)	Population		Sample Loans		Sample Observations	
			Number	%	Number	%	Number	%
Miami, FL	Mia	2.7	2,382,961	4.6%	62,268	7.7	1,567,651	8.0
Atlanta, GA	Atl	2.5	5,261,296	10.2	84,060	10.4	2,260,693	11.5
Phoenix, AZ	Pho	1.9	4,165,921	8.1	82,908	10.2	1,931,039	9.9
Chicago, IL	Chi	1.6	7,929,840	15.4	158,398	19.5	3,342,349	17.1
Los Angeles, CA	LA	1.4	9,807,870	19.1	184,578	22.8	4,329,922	22.1
San Antonio, TX	SA	1.1	1,984,921	3.9	22,119	2.7	751,397	3.8
Minneapolis, MN-WI	Minn	0.8	3,197,620	6.2	64,131	7.9	1,523,284	7.8
Baltimore, MD	Balt	0.7	2,663,805	5.2	51,218	6.3	1,048,754	5.4
New York City, NY-NJ	NYC	0.5	11,627,931	22.6	70,472	8.7	1,831,455	9.4
Pittsburgh, PA	Pitt	0.4	2,354,159	4.6	30,347	3.7	996,885	5.1
Total			51,376,324		810,499		19,583,429	

Foreclosure rates (percentages of total households entering some stage of foreclosure) for 2007 for the selected MSAs are from RealtyTrac (2008). Population figures are from the U.S. Census Bureau's annual estimates for July 1, 2007.

of federal-level regulation of subprime lending. The results here showing significant differences in those relationships across MSAs also suggest that the results of previous papers based on nationwide samples may mask considerable geographic heterogeneity. This paper conducts loan-level multivariate analysis using 2002–2006 subprime originations, more recent data than the papers I have cited. The sample periods of most of these papers do not extend beyond 2004, implying that their samples do not reflect subprime originations from the years immediately preceding the mortgage crisis. Exceptions include Pennington-Cross and Ho (2008, 2010), a large portion of whose 1998–2005 sample period substantially predates the mortgage crisis; Ding et al. (2009), who pool prime and subprime loans; Demyanyk and Van Hemert (2011), who do not account for the competing risks of default and prepayment, and Jiang, Nelson, and Vytlačil (2009), who both pool prime and subprime loans and do not account for competing risks. This paper is also only the second to examine the impact of state APLs on loan outcomes and is the first to do so for several types of APL law provisions and for subprime loans exclusively.

III. Data and Methodology

The data set for this paper is from First American CoreLogic LoanPerformance (henceforth LoanPerformance) and consists of monthly loan-level data on purchase and refinance mortgages for owner-occupied single-family residences originated between 2002 and 2006 and followed through October 2008.³ These are loans that have been packaged into private-label mortgage-backed securities and include loans from both the higher-cost (B and C grade) and near-prime (Alt-A grade) segments of subprime. The data cover ten MSAs, listed in table 1. The selection of

these MSAs was based on a report from RealtyTrac (2008), providing 2007 foreclosure rates for the one hundred largest metropolitan areas in the United States. To ensure that the sample MSAs represent both a substantial number of American households and a diverse range of mortgage market difficulties, I divided the MSAs with populations over 1 million inhabitants into deciles based on the reported foreclosure rates. From each decile, I selected the MSA with the highest population, with the condition that only one MSA from any given state be included to ensure geographic diversity.⁴ For specifications that pool loans from all ten MSAs, random samples of each MSA's loans were taken to make the analyses computationally more tractable.⁵

There are few or no ARMs featuring balloon payments for most selected MSAs until 2005, so all balloon ARMs are dropped from the sample to avoid distortions. To simplify the construction of ARM-specific variables, the sample ARMs are limited to those for which the interest rates adjust every 6 months, with the first scheduled rate adjustment occurring in the 24th or 36th month after origination and the interest rate indexed to the six-month London Interbank Offered Rate (84% of the total ARM sample). FRMs are limited to loans with terms of fifteen or thirty years (96% of the total FRM sample) to ensure that FRM-specific variables are constructed using market FRM rates of the appropriate maturities.

The LoanPerformance data contain loan-level information: loan type (FRM or ARM); purpose (purchase or refinance); origination date; dates when a loan is prepaid, enters REO status, or a foreclosure process is initiated; the loan interest rate, LTV, and borrower FICO score at origination; whether the borrower withdrew cash out (for refi-

³ Mayer and Pence (2009) compare the LoanPerformance data's coverage of subprime origination to the coverage of two other sources: loans originated by lenders appearing on the list of subprime lenders maintained by the Department of Housing and Urban Development and higher-priced loans identified since 2004 in data collected under the auspices of the Home Mortgage Disclosure Act. The authors conclude that during the mid-2000s, the LoanPerformance data likely provide the most reliable coverage of subprime originations.

⁴ Population figures are from the July 1, 2007, estimates of the U.S. Census Bureau. The highest-population MSA from each decile included two California MSAs (Los Angeles and Riverside) and two MSAs covering parts of New Jersey (New York City and Newark). In each case, the lower-population MSAs (Riverside and Newark) were replaced by the next most populous MSA in that decile (Miami and San Antonio, respectively).

⁵ A 50% random sample was taken from each MSA for purchase FRMs, a 20% random sample for refinance FRMs and purchase ARMs, and a 10% random sample for refinance ARMs.

TABLE 2.—VARIABLE DEFINITIONS

Variable	Definition
Loan features	
<i>PrepayPen</i>	Equals 1 if a prepayment penalty is in effect in the current month, 0 otherwise
<i>PrepayPenEnd</i>	Equals 1 in the month that a prepayment penalty ends and in the two following months, 0 otherwise
<i>Balloon</i>	Equals 1 if the loan features a balloon payment, 0 otherwise
<i>LowNoDoc</i>	Equals 1 if the loan is a low- or no-documentation loan, 0 otherwise
Controls (FRMs and ARMs)	
<i>FICO</i>	Borrower's FICO score at origination
<i>CLTV</i>	Current loan balance divided by current home value, where current home value is estimated as (1+ MSA home price appreciation since origination) multiplied by the loan amount at origination divided by the loan-to-value ratio at origination
<i>Cashout</i>	Equals 1 if the loan is a cashout refinancing, 0 otherwise (refinance loans only)
<i>LoanAge</i>	Months since loan origination
<i>RelLoanSize</i>	Ratio of loan origination amount to the average origination amount of all sample loans of the same type (FRM or ARM) and purpose (purchase or refinance) originated in the same MSA and year
<i>ChgUnempl</i>	Current monthly MSA unemployment rate minus the monthly MSA unemployment rate at origination
<i>VarHPI</i>	Standard deviation of quarterly MSA home price index over the previous eight quarters
<i>Judicial</i>	Equals 1 if the state is a judicial foreclosure state, 0 if a nonjudicial foreclosure state
Controls (FRMs only)	
<i>ReftPremium</i>	Loan interest rate minus current monthly fixed-rate mortgage PMMS interest rate (30 year or 15 year, depending on original loan term), divided by the loan interest rate
<i>VarFixed</i>	Standard deviation of monthly fixed-rate mortgage PMMS interest rate (30 year or 15 year, depending on original loan term) over the previous 24 months
Controls (ARMs only)	
<i>PaymentAdj</i>	Percentage change in monthly payment at the time of the most recent interest rate reset, constrained to be nonnegative and to equal 0 prior to the loan's first scheduled rate reset
<i>Adj1st</i>	Equals 1 in the month of the first scheduled rate reset and in the following two months, 0 otherwise
<i>PostAdj1st</i>	Equals 1 three months or more after the first scheduled rate reset, 0 otherwise
<i>Spread</i>	Current monthly 30-year fixed-rate mortgage PMMS interest rate minus current monthly 1-year adjustable-rate mortgage PMMS interest rate
<i>VarLIBOR</i>	Standard deviation of monthly 6-month London Interbank Offer Rate (LIBOR) over the previous 24 months

Quarterly MSA-level home price index values are from Freddie Mac's conventional mortgage home price indices. Monthly MSA-level unemployment rates are from the Bureau of Labor Statistics. Monthly fixed-rate and adjustable-rate mortgage interest rates are from Freddie Mac's Primary Mortgage Market Survey (PMMS). Information on state foreclosure laws is from Ghent and Kudlyak (2011).

nances); whether the loan was based on low or no documentation; the length of the prepayment penalty period (if any); and whether the loan required a balloon payment. These data were merged with quarterly MSA-level home price index values from Freddie Mac's conventional mortgage home price indices, monthly MSA-level unemployment rates from the Bureau of Labor Statistics, monthly FRM and ARM interest rates from Freddie Mac's Primary Mortgage Market Survey, and information on state foreclosure laws from Ghent and Kudlyak (2011).

Variables used in this paper are defined in table 2, with summary statistics presented in table 3. Here and throughout the rest of the paper, loans are divided into four categories by loan type and purpose. *PrepayPen* indicates whether a prepayment penalty is in effect for a loan in a given month, and *PrepayPenEnd* indicates loans in the month that a prepayment penalty period ends and the two following months. If prepayment penalties are binding constraints on prepayment, one would expect the probability of prepayment to increase sharply but temporarily immediately after the penalty period ends. *Balloon* and *LowNoDoc* indicate loans that require a balloon payment and were originated based on reduced documentation, respectively.

FICO measures the borrower's credit score at origination, which should be negatively related to defaults. *CLTV* is an estimate of the borrower's equity in the home in the current month. Low or negative equity (implying a high value of *CLTV*) is expected to increase the probability of foreclosure

as the option to default is more valuable to the borrower, while greater equity (lower *CLTV*) should increase the probability of prepayment as borrowers with significant equity find it easier to refinance their loans and can extract or cash out some of their equity through refinancing. *Cashout* indicates such a cashout refinancing. The expected relationship between it and foreclosure is ambiguous: extracting home equity can result in higher monthly payments, but a recent cashout suggests greater borrower liquidity, at least in the short term. The relationship between *Cashout* and prepayment is expected to be positive, as borrowers with the demonstrated understanding and willingness to refinance once are plausibly more likely to refinance again. Following Calhoun and Deng (2002), *RelLoanSize* is included on the premise that loan size may be correlated to borrower income or wealth, and so can indicate protection against financial distress. *RelLoanSize* is expected to be negatively related to foreclosure and positively related to prepayment (as qualifying for a refinancing becomes more likely). *ChgUnempl* measures the likelihood of an event causing financial distress, and so is expected to be positively related to foreclosures and negatively related prepayments. *VarHPI* captures volatility in house prices, with option theory suggesting that greater volatility makes borrowers likely to delay defaulting in case the option to default becomes more valuable. *Judicial* indicates whether state law requires lenders to go through a judicial foreclosure process rather than a quicker nonjudicial process, and so *Judicial* should be associated

TABLE 3.—SUMMARY STATISTICS BY LOAN CATEGORY

	Purchase FRMs						Refinance FRMs					
	Mean	StDev	Lowest MSA	Highest MSA			Mean	StDev	Lowest MSA	Highest MSA		
<i>PrepayPen</i>	0.314	0.464	0.118	Chi	0.634	Mia	0.438	0.496	0.111	SA	0.716	Mia
<i>PrepayPenEnd</i>	0.019	0.138	0.009	Balt	0.027	SA	0.025	0.155	0.006	SA	0.049	NYC
<i>Balloon</i>	0.043	0.204	0.017	SA	0.117	Chi	0.038	0.190	0.003	SA	0.063	Chi
<i>LowNoDoc</i>	0.559	0.496	0.305	Pitt	0.741	NYC	0.409	0.492	0.243	Pitt	0.490	LA
<i>FICO</i>	691.492	61.903	662.830	SA	708.202	Minn	650.428	67.232	610.460	SA	669.030	LA
<i>CLTV</i>	70.200	15.807	62.441	LA	79.595	Pitt	59.501	18.444	51.267	LA	72.156	Pitt
<i>Cashout</i>	0.000	0.000	0.000	—	0.000	—	0.807	0.394	0.751	Atl	0.876	Mia
<i>LoanAge</i>	22.378	14.778	20.760	Chi	24.236	Pitt	22.756	15.121	20.502	Balt	26.045	Pitt
<i>RelLoanSize</i>	0.998	0.575	0.961	Chi	1.039	LA	1.007	0.585	0.972	Chi	1.029	LA
<i>ChgUnempl</i>	-0.476	1.184	-1.044	Mia	0.193	Minn	-0.531	1.243	-1.018	NYC	0.035	Minn
<i>VarHPI</i>	17.189	13.830	5.046	Atl	34.345	Mia	20.944	15.006	5.071	Atl	35.586	Mia
<i>Judicial</i>	0.478	0.500	0.000	—	1.000	—	0.432	0.495	0.000	—	1.000	—
<i>RefiPremium</i>	0.114	0.145	0.058	LA	0.186	SA	0.107	0.219	0.038	LA	0.237	SA
<i>VarFixed</i>	0.298	0.087	0.285	SA	0.309	LA	0.297	0.086	0.291	Balt	0.300	Minn
% foreclosures	10.6%		4.1%	LA	18.0%	Atl	7.0%		3.1%	LA	14.8%	Pitt
% prepayments	48.3%		37.7%	SA	75.8%	Mia	50.4%		31.6%	Pitt	73.0%	LA
Loans	35,900		2,258	Pitt	9,103	LA	52,170		7,769	SA	56,123	LA
Observations	1,015,523		99,496	Balt	347,411	LA	1,479,473		304,376	SA	2,247,208	LA
	Purchase ARMs						Refinance ARMs					
	Mean	StDev	Lowest MSA	Highest MSA			Mean	StDev	Lowest MSA	Highest MSA		
<i>PrepayPen</i>	0.483	0.500	0.180	NYC	0.761	Mia	0.503	0.500	0.110	SA	0.801	Mia
<i>PrepayPenEnd</i>	0.042	0.202	0.022	Atl	0.068	SA	0.036	0.187	0.010	SA	0.057	Pitt
<i>LowNoDoc</i>	0.465	0.499	0.258	Pitt	0.728	NYC	0.344	0.475	0.229	Pitt	0.657	LA
<i>FICO</i>	633.751	55.055	613.306	SA	676.943	LA	589.167	53.386	572.902	SA	638.975	LA
<i>CLTV</i>	75.381	11.492	70.589	LA	81.885	Pitt	69.919	14.265	63.413	NYC	77.400	Atl
<i>Cashout</i>	0.000	0.000	0.000	—	0.000	—	0.878	0.327	0.805	SA	0.916	Mia
<i>LoanAge</i>	17.393	11.224	15.747	LA	21.017	Pitt	17.104	11.753	15.278	Balt	22.424	Pitt
<i>RelLoanSize</i>	0.974	0.466	0.955	Chi	1.019	NYC	0.981	0.475	0.946	SA	1.014	NYC
<i>ChgUnempl</i>	-0.383	0.962	-0.566	Mia	0.023	Minn	-0.405	0.943	-0.612	NYC	-0.013	Minn
<i>VarHPI</i>	17.640	13.821	5.289	Atl	36.855	Mia	18.639	13.773	5.325	Atl	37.175	Mia
<i>Judicial</i>	0.468	0.499	0.000	—	1.000	—	0.471	0.499	0.000	—	1.000	—
<i>PaymentAdj</i>	0.019	0.062	0.018	Pho	0.026	LA	0.017	0.056	0.016	Balt	0.034	LA
<i>Adj1st</i>	0.060	0.237	0.032	LA	0.072	SA	0.054	0.225	0.024	LA	0.064	Pitt
<i>PostAdj1st</i>	0.155	0.362	0.055	LA	0.234	Pitt	0.151	0.358	0.047	LA	0.276	Pitt
<i>Spread</i>	1.197	0.479	1.092	SA	1.277	LA	1.262	0.500	1.132	Balt	1.270	Minn
<i>VarLIBOR</i>	0.776	0.336	0.766	LA	0.804	NYC	0.771	0.344	0.769	Minn	0.800	Balt
% foreclosures	23.7%		12.9%	LA	38.1%	Atl	14.5%		8.0%	LA	23.4%	Pitt
% prepayments	64.7%		44.1%	Atl	83.7%	LA	75.2%		50.4%	Pitt	87.5%	LA
Loans	39,069		6,535	SA	43,427	Chi	39,313		5,019	SA	86,038	LA
Observations	833,436		175,971	Balt	1,062,936	Chi	759,957		141,639	SA	2,419,400	LA

The Mean and StDev columns provide figures for the pooled samples after random selections. The MSA columns provide means for the full samples from each MSA.

with a lesser probability of foreclosure. Specifications also include origination year and MSA indicator variables.

While the above variables are used for all specifications, following Pennington-Cross and Ho (2010) some variables are used exclusively in FRM or ARM specifications in recognition of the differences between the loan types. FRM specifications include *RefiPremium*, which uses the spread between the loan interest rate and the current market FRM rate, divided by the loan interest rate, as a proxy for the potential benefit to the borrower of refinancing, and as such should be positively related to prepayments.⁶ *VarFixed* captures the volatility of FRM mortgage rates, with option theory suggesting that greater volatility makes borrowers

likely to delay prepaying in case the option to refinance becomes more valuable.

The ARM-specific variables are based on those used by Ambrose, LaCour-Little, and Huszar (2005) and Pennington-Cross and Ho (2010). *PaymentAdj* measures the increase in monthly payment at a loan's most recent rate reset and should be positively associated with foreclosures and prepayments.⁷ *Adj1st* indicates the month of a loan's

⁶ Deng, Pavlov, and Yang (2005) include a similar variable but use the market rate at the time a loan was originated instead of the loan interest rate, with the rationale that the loan interest rate includes any risk premium or discount specific to the borrower that might be incorporated into the interest rate of a subsequent refinancing as well. When I replace *RefiPremium* with a similar variable using the market rate at origination, the results do not substantially differ.

⁷ Following Pennington-Cross and Ho (2010), *PaymentAdj* is constrained to be nonnegative and equals 0 prior to a loan's first scheduled rate reset. When I replace *PaymentAdj* with a similar variable without those constraints, that variable is positively related to the probability of foreclosure but negatively related to the probability of prepayment. This might be due to the introduction into the variable of loan modifications, the likeliest sources of reductions in monthly payments prior to a loan's first scheduled rate reset. A loan modification may be a temporary step until a distressed borrower can either refinance into a more affordable mortgage or sell his or her house, suggesting a positive relationship between loan modifications and prepayments. Replacing *PaymentAdj* with the altered variable noticeably changes the magnitudes of *Adj1st* and *PostAdj1st*, but other variables are largely unaffected.

first scheduled rate reset and the following two months, with the expectation that there should be a spike in foreclosures and prepayments during that window. *PostAdj1st* indicates all months following the *Adj1st* window to distinguish this period from the months before the first scheduled rate reset. *Spread* has a purpose analogous to *RefiPremium*, proxying for the potential benefit to a borrower of refinancing into an FRM, and *VarLIBOR* is the ARM analogue to *VarFixed*.

The empirical analysis employs a multinomial logit (MNL) model developed by Clapp, Deng, and An (2006) that incorporates unobserved heterogeneity by modeling individual borrowers as coming from a finite number of discrete groups with unobserved characteristics.⁸ The presented results assume that borrowers are distributed between two discrete groups.⁹ The model estimates the relative weight and a separate intercept term for each group but does not assign each observation to a group. The data are structured in event history format, with each observation representing one month in which a loan remains active. In each month, a loan remains active, is prepaid, or first enters foreclosure (which here includes entering REO status).¹⁰ A loan drops out of the sample after a first foreclosure start or prepayment. The model directly controls for the competing risks of foreclosure and prepayment by requiring that the probabilities of all three outcomes sum to 1. Standard errors are clustered by loan.

The MNL model with unobserved heterogeneity is econometrically preferable to the standard MNL model, which assumes there is no unobserved heterogeneity across observations, but the unobserved heterogeneity model is also vastly more time intensive and more prone to convergence problems.¹¹ Convergence problems did not arise for specifications that pooled loans from all ten MSAs (see tables 4, 8, and 11), but did in specifications analyzing each MSA individually (see table 6). For each MSA specification that did not converge, I employ a constant heterogeneity weight approach in which I performed ten additional specifications

⁸ The Clapp *et al.* (2006) model includes a separate indicator variable for every time period since loan origination, which for this paper's sample would require more than eighty additional variables. To reduce the computational burden, the model used here replaces the monthly indicators with indicators for each loan's origination year and variables for loan age (months since origination) and its square. The specifications here also include more time-varying explanatory variables than the specifications in Clapp *et al.* (2006).

⁹ When specifications were run assuming three groups, frequently two of the three were not significantly different from each other, and convergence problems became rampant.

¹⁰ Results based on alternative definitions of foreclosure are discussed in the next section.

¹¹ For example, the time required for each of the specifications with unobserved heterogeneity in table 4 was approximately three orders of magnitude greater than the time required for similar specifications without unobserved heterogeneity (using Stata 11). Gerardi, Shapiro, and Willen (2009) eschew incorporating unobserved heterogeneity into their proportional hazard model for their full samples specifically because it is "extremely computationally burdensome," and find no substantial differences in their results when they did so for very small subsets of their data (see their note 9).

for that MSA, the first constraining the groups' relative weights to be 50%-50%, the second constraining them to be 55%-45%, and so on through 95%-5%. From those ten specifications, table 6 presents results from the one that successfully converged with the greatest log-likelihood value.¹²

MNL models also assume that the odds ratio between any two outcomes is independent of any other possible outcomes. An alternative, the proportional hazard model, estimates the effects of explanatory variables on survival times without requiring assumptions about the underlying hazard function, but does assume that given two observations with different explanatory variable values, the ratio of the observations' hazard functions does not depend on time. As a robustness check, the analyses were also performed using a standard MNL model and a proportional hazard model, with similar results.¹³

IV. Empirical Analysis

The evidence presented in this section supports the following conclusions: (a) reduced documentation is consistently associated with a greater probability of foreclosure across the sample MSAs, (b) prepayment penalties are consistently associated with a lesser probability of prepayment across MSAs, and (c) other relationships among prepayment penalties, balloon loans, and reduced documentation are more sporadic across MSAs.

A. All Ten MSAs Pooled

Before examining geographic variation across MSAs, I first present in table 4 results for loans from all ten sample MSAs pooled. *PrepayPen* is associated with a 13% to 15% reduction in the probability of foreclosure for FRMs and a 38% to 42% reduction in the probability of foreclosure for ARMs.¹⁴ This contrasts with previous studies (see section II), which generally find prepayment penalties to be positively associated with foreclosures. This discrepancy may be explained through the finding of Mayer *et al.* (2010) that the benefits of prepayment penalties are greatest for the

¹² The individual MSA specifications that did not converge are noted in the captions of table 6. Complete results of all constant heterogeneity weight specifications are available in a supplement at http://www.umbc.edu/economics/wpapers/wp_10_119.pdf.

¹³ Several researchers use a proportional hazard model that controls for unobserved heterogeneity to examine competing mortgage risks (see Deng *et al.*, 2000; Clapp *et al.*, 2006; and Pennington-Cross & Ho, 2010). I do not use such a model here due to the time consideration described above. Clapp *et al.* (2006) use mortgage termination data to compare results using a standard MNL model, an MNL model with unobserved heterogeneity, a standard proportional hazard model, and a proportional hazard model with unobserved heterogeneity. They find similar results across the four models.

¹⁴ For a given coefficient estimate β , the percentage change in the probability of foreclosure or prepayment, relative to the probability of a loan remaining active, associated with a one-unit change in the explanatory variable is calculated as $e^\beta - 1$. For example, the -0.145 shown for *PrepayPen* in the first column of table 4 implies a relative change in the probability of a first foreclosure start of $e^{(-0.145)} - 1 = -0.13498$, a 13.5% decrease.

TABLE 4.—CHANGES IN THE PROBABILITY OF A FORECLOSURE START AND A PREPAYMENT: ALL TEN MSAs POOLED

	Purchase FRMs		Refinance FRMs		Purchase ARMs		Refinance ARMs	
	Foreclosure	Prepayment	Foreclosure	Prepayment	Foreclosure	Prepayment	Foreclosure	Prepayment
<i>PrepayPen</i>	-0.145** [0.0620]	-0.694*** [0.0242]	-0.160** [0.0777]	-0.314*** [0.0303]	-0.542*** [0.0438]	-1.224*** [0.0373]	-0.480*** [0.0526]	-0.956*** [0.0359]
<i>PrepayPenEnd</i>	0.238 [0.168]	0.566*** [0.0436]	-0.137 [0.147]	0.295*** [0.0403]	0.673*** [0.118]	1.024*** [0.0965]	1.004*** [0.162]	1.161*** [0.142]
<i>Balloon</i>	0.0872 [0.100]	-0.272*** [0.0429]	0.252** [0.0990]	-0.0974** [0.0415]				
<i>LowNoDoc</i>	0.474*** [0.0532]	0.0899*** [0.0194]	0.547*** [0.0545]	0.000165 [0.0157]	0.413*** [0.0315]	0.0779*** [0.0238]	0.570*** [0.0371]	-0.00192 [0.0243]
<i>Cashout</i>			0.203*** [0.0693]	0.0931*** [0.0190]			-0.128** [0.0520]	-0.0103 [0.0331]
<i>FICO</i>	-0.0103*** [0.000603]	0.0002 [0.000178]	-0.0122*** [0.00102]	-0.0019*** [0.000191]	-0.0065*** [0.000310]	-0.0007*** [0.000215]	-0.0096*** [0.000383]	-0.0025*** [0.000227]
<i>CLTV</i>	0.0420*** [0.00305]	-0.0079*** [0.000850]	0.0415*** [0.00362]	0.0035*** [0.000616]	0.0169*** [0.00161]	-0.0189*** [0.00137]	0.0278*** [0.00182]	-0.0073*** [0.00116]
<i>RefiPremium</i>	7.739*** [0.399]	4.578*** [0.120]	5.444*** [0.864]	2.907*** [0.653]				
<i>PaymentAdj</i>					1.441*** [0.302]	1.774*** [0.231]	1.907*** [0.388]	2.039*** [0.283]
<i>Adj1st</i>					0.301*** [0.107]	0.962*** [0.0885]	0.553*** [0.133]	1.328*** [0.108]
<i>PostAdj1st</i>					0.322*** [0.0849]	0.0990 [0.0753]	0.343*** [0.0976]	0.214*** [0.0826]
<i>Spread</i>					-0.689*** [0.0699]	-0.0701 [0.0572]	-0.411*** [0.0807]	-0.139** [0.0584]
<i>LoanAge</i>	0.131*** [0.00794]	0.0665*** [0.00278]	0.158*** [0.0191]	0.0529*** [0.00586]	0.142*** [0.00698]	0.155*** [0.00625]	0.180*** [0.00741]	0.132*** [0.00544]
<i>(LoanAge)²</i>	-0.0015*** [0.000119]	-0.0015*** [0.00005]	-0.0019*** [0.000291]	-0.0012*** [0.00009]	-0.0023*** [0.000139]	-0.0031*** [0.000128]	-0.0027*** [0.000148]	-0.0027*** [0.000112]
<i>RelLoanSize</i>	0.340*** [0.0448]	0.0817*** [0.0166]	0.179*** [0.0489]	0.0277 [0.0227]	0.421*** [0.0313]	0.263*** [0.0263]	0.203*** [0.0396]	0.210*** [0.0269]
<i>ChgUnempl</i>	0.0501* [0.0256]	-0.110*** [0.0103]	0.0499** [0.0242]	-0.121*** [0.0115]	0.0281 [0.0189]	-0.161*** [0.0155]	-0.0265 [0.0226]	-0.194*** [0.0160]
<i>VarHPI</i>	0.00254 [0.00302]	0.0172*** [0.00108]	0.00584 [0.00431]	0.0226*** [0.00212]	-0.00441** [0.00217]	0.0397*** [0.00169]	0.0144*** [0.00264]	0.0504*** [0.00179]
<i>VarFixed</i>	-0.603* [0.350]	0.166 [0.109]	-0.628* [0.352]	0.155* [0.0925]				
<i>VarLIBOR</i>					-0.101** [0.0505]	-0.251*** [0.0404]	-0.233*** [0.0618]	-0.458*** [0.0426]
<i>Judicial</i>	-0.637 [0.530]	-0.206 [0.190]	-0.114 [0.457]	0.0988 [0.163]	-0.583** [0.291]	-0.512*** [0.197]	-0.530* [0.286]	-0.178 [0.200]
<i>Constant1</i>	-9.082*** [0.616]	-4.817*** [0.166]	-7.632*** [0.659]	-4.072*** [0.454]	-5.538*** [0.494]	-5.542*** [0.253]	-7.046*** [0.708]	-5.746*** [0.275]
<i>Constant2</i>	-1.281*** [0.470]	-1.305*** [0.206]	-0.314 [0.714]	-0.461 [0.511]	0.935*** [0.306]	0.277 [0.252]	0.438 [0.335]	0.876*** [0.238]
<i>Prob. Coeff.</i>		3.568*** [0.126]		3.951*** [0.278]		2.114*** [0.0414]		2.122*** [0.0318]
<i>Probability1</i>		97.3%		98.1%		89.2%		89.3%
<i>Observations</i>		972,557		1,434,519		720,265		685,866
<i>Loans</i>		35,900		52,170		39,069		39,313
<i>Log-likelihood</i>		-102,880		-148,354		-146,690		-145,806

This table presents results of multinomial logit regressions with unobserved heterogeneity based on monthly data for loans originated during 2002–2006. Variables are defined as in table 2. Each coefficient estimate represents the impact on the probability of a first foreclosure start or a prepayment, relative to the probability of a loan remaining active, of a one-unit change in the corresponding variable. The dearth of balloon ARMs prior to 2005 required that they be excluded from ARM specifications. Vintage year and MSA indicators are included in all specifications. Robust standard errors clustered by loan are in brackets. Significant at *10%, **5%, and ***1%.

riskiest borrowers, the finding of Demyanyk and Van Hemert (2011) that subprime loan quality deteriorated in the years leading up to the mortgage crisis, and the fact that my sample includes more loans from later years than the samples of the previous literature do. In other words, for the less creditworthy borrowers who entered the subprime market in large numbers leading up to the crisis, the reduction in loan interest rates associated with prepayment penalties appears to have reduced the probability of foreclosure more than the penalty for prepayment itself increased the probability of foreclosure. *PrepayPen* is associated with lower

probabilities of prepayment across all specifications, and *PrepayPenEnd* indicates a spike in prepayments immediately following the expiration of penalty periods. Balloon loans are associated with a 24% and 9% reduction in the probability of prepayment for purchase and refinance FRMs respectively, and are associated with a 29% greater probability of foreclosure for refinance FRMs.¹⁵ Given that the balloon payments on sample loans are generally not due

¹⁵ Recall that the dearth of balloon ARMs prior to 2005 required that they be excluded from ARM specifications.

until some years after the sample period ends, the reason for the foreclosure result is not clear. *LowNoDoc* is associated with a 51% to 77% increase in the probability of foreclosure across all categories and with a slight increase in the probability of prepayment for purchase loans but not for refinance loans.

The results for the control variables are generally in line with expectations, so only exceptions are discussed here. *RelLoanSize* is positively related to the probability of foreclosure, the opposite of expectations. Rather than capturing borrower income or wealth, the variable may be proxying for borrowers with loans that are large relative to their incomes, with less affordable payments driving increased probabilities of foreclosure and prepayment.¹⁶ *VarHPI* is positively related to prepayments, which is consistent with most of the variation in house price indices during the sample period being driven by rapidly rising house prices. *VarFixed* is weakly positively related to prepayments, but only for refinance FRMs.

Constant1 and *Constant2* are the intercept terms associated with the two groups based on unobserved heterogeneity. *Constant1* is consistently less than *Constant2*, implying that the first group is the “safer” group, on average having lower probabilities of both foreclosure and prepayment. *Prob. Coeff.* is a coefficient based on the estimate of the relative sizes of the two groups, and *Probability1* provides the corresponding percentage of borrowers estimated to be in the first group.¹⁷ Results indicate that for all loan categories, the first group is far larger than the second, “riskier” group.

B. Nonparametric Tests for Differences across MSAs

T-test results (not shown for brevity) indicate significant (usually at the 0.1% level) differences in means for each variable across the overwhelming majority of the 45 possible MSA pairs, an indication of variation across subprime mortgage markets. Further evidence of cross-market variation is presented in table 5. Each number represents the chi-square statistic from a nonparametric Wilcoxon test for the equality of survival curves for loans originated in two different MSAs.¹⁸ The results show widespread and highly significant differences. This is ample evidence to warrant multivariate analysis of cross-MSA differences.

C. MSA-by-MSA Analysis

Table 6A (FRMs) and table 6B (ARMs) present results for each MSA separately. The specifications are the same as

¹⁶ LaCour-Little and Yang (2010) proxy for the likelihood that a borrower exaggerated his or her income with the ratio of the income on the loan application to the median income in the borrower’s MSA. They find that this measure is positively related to default risk and that the relationship is stronger for stated-income loans relative to fully documented loans. Income exaggeration can qualify a borrower for a larger loan than a borrower would otherwise be able to acquire, and so could be consistent with a high value for *RelLoanSize*.

¹⁷ *Probability1* is calculated as $e^{(Prob. Coeff.)} / (e^{(Prob. Coeff.)} + 1)$, so *Prob. Coeff.* = 0 implies *Probability1* = 50%.

¹⁸ See Breslow (1970) and Gehan (1965).

in table 4 except *Judicial* and the MSA indicators are necessarily dropped. Estimates for control variables are consistent with those in table 4 and are omitted here for brevity.¹⁹ Consistent with table 4, *PrepayPen* is negatively related to the probability of prepayment in all forty specifications, *LowNoDoc* is positively related to the probability of foreclosure in all but three cases, and other relationships between loan features and outcomes are more sporadic. *PrepayPen* is not significantly related to the probability of foreclosure in half of the FRM specifications, although it is almost always negatively related to the probability of foreclosure in ARMs. In the prepayment equation results, the coefficient estimates for *LowNoDoc* are almost evenly split among positively significant, negatively significant, and not significant. *Balloon* is mostly not significant, but does show some generally positive associations with foreclosures and negative associations with prepayments.

Differences across MSAs in coefficient estimates for *PrepayPen*, *Balloon*, and *LowNoDoc* are summarized in tables 7A and 7B. The listed pairs of MSAs are those for which the coefficient estimates of a given loan feature have opposite signs and are different at the 10% significance level, based on a test statistic $(b_1 - b_2) / (se_1^2 + se_2^2)^{1/2}$ where b_i and se_i are the loan feature’s coefficient estimate and standard error from the regression for MSA_{*i*}. These are cases in which an identical restriction of the loan feature across both MSAs is likely to cause opposite responses in the probability of foreclosure or prepayment, suggesting unintended adverse consequences in at least one of the markets through the elimination of contractual options that some borrowers and lenders may find beneficial. With ten sample MSAs, there are 45 possible MSA pairs and a maximum of 25 pairs with statistically significant opposite-sign differences.

Table 7A, summarizing foreclosure equation estimates, shows that with the exception of those involving Miami purchase FRMs (the only negative coefficient for *LowNoDoc* in the foreclosure equation for any MSA or category, and not itself significant), there are no significant opposite-sign differences associated with *LowNoDoc*. There are a substantial number of significant opposite-sign differences involving *Balloon* and *PrepayPen*, although for *PrepayPen*, the listed differences are all for FRMs with the exception of those involving Pittsburgh purchase ARMs. Table 7B, summarizing prepayment equation estimates, shows nearly the reverse: no significant opposite-sign differences associated with *PrepayPen* or *Balloon* and very large numbers of significant opposite-sign differences for *LowNoDoc*.

D. MSA Loan Feature Interactions

Table 8 provides results from specifications that explicitly model the interactive effect of a given loan feature in a

¹⁹ Complete results of all specifications in these and subsequent tables are available in a supplement at http://www.umbc.edu/economics/wpapers/wp_10_119.pdf.

TABLE 5.—WILCOXON TESTS FOR EQUALITY OF SURVIVAL CURVES ACROSS MSAs

Purchase	Mia	Atl	Pho	Chi	LA	SA	Minn	Balt	NYC
FRMs									
Atl	352.14***								
Pho	0.58	358.34***							
Chi	18.59***	564.45***	10.93***						
LA	124.43***	868.59***	103.19***	54.94***					
SA	718.82***	160.31***	726.26***	884.33***	1,038.65***				
Minn	100.50***	19.20***	103.64***	182.90***	315.19***	211.80***			
Balt	33.06***	89.38***	38.91***	82.76***	187.63***	368.89***	14.68***		
NYC	40.15***	143.89***	44.43***	128.18***	339.46***	442.73***	23.52***	0.29	
Pitt	513.78***	73.13***	518.23***	657.82***	804.04***	13.00***	118.44***	236.73***	289.39***
Refinance FRMs									
Atl	117.66***								
Pho	14.79***	48.99***							
Chi	0.60	139.13***	21.89***						
LA	79.30***	357.55***	164.95***	72.44***					
SA	163.02***	22.59***	100.88***	173.05***	295.27***				
Minn	5.28**	120.14***	30.40***	2.66	15.11***	156.86***			
Balt	1.69	87.06***	5.43**	3.95**	92.10***	140.69***	10.31***		
NYC	0.02	109.15***	14.19***	1.27	93.64***	148.25***	7.53***	1.40	
Pitt	171.82***	19.39***	101.71***	185.57***	330.99***	0.35	163.69***	144.93***	156.05***
Purchase ARMs									
Atl	165.90***								
Pho	0.13	176.61***							
Chi	1.62	195.42***	0.74						
LA	968.00***	2,375.29***	1,224.95***	1,905.08***					
SA	407.25***	165.57***	409.41***	398.41***	1,243.12***				
Minn	12.52***	235.51***	18.39***	28.03***	555.85***	442.30***			
Balt	10.23***	40.23***	10.05***	6.58**	619.63***	247.14***	33.31***		
NYC	1.71	167.84***	1.62	6.19**	662.12***	411.41***	4.43**	16.25***	
Pitt	244.79***	63.33***	244.50***	239.50***	1,038.97***	17.83***	282.96***	126.35***	247.55***
Refinance ARMs									
Atl	17.12***								
Pho	0.06	26.03***							
Chi	47.49***	166.71***	75.46***						
LA	577.88***	1,044.31***	998.67***	749.87***					
SA	45.71***	22.34***	51.19***	91.03***	261.41***				
Minn	201.43***	399.97***	307.32***	139.40***	60.60***	155.23***			
Balt	2.01	33.84***	1.68	38.31***	663.58***	57.50***	209.34***		
NYC	108.52***	239.96***	154.00***	30.35***	200.55***	126.62***	24.34***	102.81***	
Pitt	80.32***	36.76***	96.71***	191.07***	590.90***	0.43	322.10***	105.65***	253.88***

Numbers are χ^2 statistics from Wilcoxon tests for the equality of nonparametric survival curves across each pair of MSAs for each loan category. Levels of significant at *10%, **5%, and ***1%.

given MSA. Each specification includes the variables from the table 4 specifications, as well as interaction terms for the MSA indicators and each of *PrepayPen*, *PrepayPenEnd*, *Balloon*, and *LowNoDoc*. Coefficient estimates for the control variables are similar to those in table 4 and are omitted from table 8 for brevity.

PrepayPen is associated with a 29% increase in the probability of foreclosure for refinance FRMs, with no significant association for purchase FRMs. This suggests that for FRMs, once the MSA-specific impacts are controlled for, the general impact of prepayment penalties on foreclosures is more positive than table 4 indicates. In contrast, for ARMs, *PrepayPen* is associated with a 63% to 77% reduction in the probability of foreclosure, a more dramatic reduction than shown in table 4. *PrepayPen* remains negatively associated with the probability of prepayment across all loan categories. *Balloon* and *LowNoDoc* are associated with a 91% to 124% and a 24% to 99% increase in the probability of foreclosure, respectively. Neither *Balloon* nor *LowNoDoc* is significantly associated with the probability of prepayment.

The number of MSA-loan feature interaction terms that are statistically significant varies by loan category and loan feature, with no obvious pattern across MSAs. More relevant to the question of geographic variation in the loan features' impacts is whether the MSA-loan feature interaction terms are significantly different from each other rather than from 0. Similar to table 7, table 9 lists the pairs of MSAs for which the combined impact of the loan feature variable and the MSA-loan feature interaction term have opposite signs and are significantly different at the 10% level based on Wald tests.²⁰ The results are not identical between table 7 and table 9, but there are clear similarities. There are no significant opposite-sign differences for *LowNoDoc* in relation to foreclosures or for *PrepayPen* in relation to prepayments. There is roughly the same number of cross-MSA differences in relation to foreclosures associated with *Balloon*

²⁰ Note that as an example, the sum of the coefficient estimates of *PrepayPen* and *Miami*×*PrepayPen* could have a different sign from the sum of the coefficient estimates of *PrepayPen* and *Atlanta*×*PrepayPen* even if the coefficient estimates of *Miami*×*PrepayPen* and *Atlanta*×*PrepayPen* have the same sign.

TABLE 6.—CHANGES IN THE PROBABILITY OF A FORECLOSURE START AND A PREPAYMENT BY MSA FOR ARMs AND FRMs

A. FRMs										
Purchase FRMs										
	Mia	Atl	Pho	Chi	LA	SA	Minn	Balt	NYC	Pitt
Foreclosure equation results										
<i>PrepayPen</i>	-0.0795	-0.239	-0.351**	-0.549***	-0.184*	-0.167	-0.00854	-0.219	0.00651	0.134
	[0.119]	[0.157]	[0.142]	[0.156]	[0.100]	[0.162]	[0.165]	[0.241]	[0.115]	[0.121]
<i>Balloon</i>	0.147	0.666*	0.640***	-0.543***	0.510***	-0.146	-0.346	-0.115	0.0369	0.160
	[0.189]	[0.381]	[0.232]	[0.147]	[0.144]	[0.413]	[0.257]	[0.300]	[0.163]	[0.251]
<i>LowNoDoc</i>	-0.0600	0.661***	0.405***	0.434***	0.544***	0.405***	0.730***	0.660***	0.519***	0.520***
	[0.0940]	[0.128]	[0.122]	[0.0912]	[0.0943]	[0.127]	[0.132]	[0.172]	[0.104]	[0.126]
Prepayment equation results										
<i>PrepayPen</i>	-0.802***	-0.587***	-1.191***	-1.488***	-0.781***	-1.044***	-0.508***	-0.689***	-1.234***	-0.609***
	[0.0870]	[0.0617]	[0.112]	[0.0971]	[0.0384]	[0.131]	[0.0738]	[0.126]	[0.0783]	[0.0788]
<i>Balloon</i>	-0.465**	-0.196	-0.132	-0.174***	-0.404***	-0.313	-0.290***	-0.521**	-0.235*	-0.268
	[0.195]	[0.122]	[0.205]	[0.0592]	[0.141]	[0.391]	[0.102]	[0.219]	[0.131]	[0.197]
<i>LowNoDoc</i>	0.132**	0.0785*	-0.178***	0.323***	-0.0670**	0.0155	0.130**	0.0593	0.104**	0.0267
	[0.0559]	[0.0436]	[0.0542]	[0.0420]	[0.0326]	[0.0992]	[0.0634]	[0.0835]	[0.0484]	[0.0764]
Observations	182,621	258,782	149,652	222,515	340,597	152,932	124,155	96,854	278,983	132,936
Loans	3,966	5,772	4,178	6,453	9,103	2,796	3,422	2,781	7,104	2,258
Log likelihood	-22,373	-24,077	-18,329	-31,201	-39,650	-9,445	-11,143	-11,007	-27,685	-9,397
Refinance FRMs										
Foreclosure equation results										
<i>PrepayPen</i>	-0.116	-0.243**	-0.383***	-0.551***	0.216***	-0.147	0.119	-0.252***	-0.272**	-0.322***
	[0.0896]	[0.119]	[0.0846]	[0.126]	[0.0675]	[0.166]	[0.0936]	[0.0910]	[0.136]	[0.103]
<i>Balloon</i>	0.199*	0.267**	0.327***	0.0625	0.545***	-1.658*	0.0484	0.0579	-0.101	-0.0273
	[0.114]	[0.136]	[0.119]	[0.107]	[0.0910]	[1.005]	[0.142]	[0.142]	[0.138]	[0.208]
<i>LowNoDoc</i>	0.264***	0.500***	0.526***	0.690***	0.342***	0.250***	0.850***	0.316***	0.501***	0.406***
	[0.0630]	[0.0893]	[0.0697]	[0.0660]	[0.0528]	[0.0787]	[0.0957]	[0.0928]	[0.0849]	[0.0907]
Prepayment equation results										
<i>PrepayPen</i>	-0.208***	-0.460***	-0.638***	-0.686***	-0.295***	-0.855***	-0.149***	-0.360***	-0.820***	-0.483***
	[0.0482]	[0.0462]	[0.0479]	[0.0469]	[0.0198]	[0.169]	[0.0334]	[0.0588]	[0.0365]	[0.0963]
<i>Balloon</i>	-0.0242	-0.0999	-0.0850	-0.0658	-0.154***	-1.565**	-0.259***	-0.0930	-0.138**	-0.256
	[0.0938]	[0.105]	[0.103]	[0.0414]	[0.0411]	[0.650]	[0.0585]	[0.0873]	[0.0596]	[0.206]
<i>LowNoDoc</i>	-0.0509	-0.0203	-0.195***	0.127***	-0.0104	-0.274***	0.0229	-0.104**	0.0461**	-0.136*
	[0.0340]	[0.0395]	[0.0403]	[0.0240]	[0.0144]	[0.0840]	[0.0318]	[0.0520]	[0.0202]	[0.0788]
Observations	633,006	606,844	561,425	785,113	2,220,258	289,787	446,679	411,085	875,072	360,089
Loans	18,474	14,693	15,006	22,514	56,123	7,769	10,648	13,266	22,142	9,067
Log-L	-68,233	-53,647	-59,101	-92,453	-233,471	-21,016	-44,810	-52,320	-87,477	-25,312
B. ARMs										
Purchase ARMs										
	Mia	Atl	Pho	Chi	LA	SA	Minn	Balt	NYC	Pitt
Foreclosure equation results										
<i>PrepayPen</i>	-7.940***	-0.646***	-1.795***	-0.603***	-1.916***	-0.283*	-0.121	-0.485***	-0.474***	0.0384
	[1.448]	[0.0543]	[0.175]	[0.0392]	[0.114]	[0.153]	[0.118]	[0.0838]	[0.0887]	[0.207]
<i>LowNoDoc</i>	0.0886	0.744***	0.459***	0.247***	0.290***	0.0661	0.764***	0.265***	0.564***	0.832***
	[0.0676]	[0.0506]	[0.0531]	[0.0294]	[0.0462]	[0.0626]	[0.0754]	[0.0725]	[0.0727]	[0.158]
Prepayment equation results										
<i>PrepayPen</i>	-8.862***	-0.699***	-2.903***	-1.441***	-2.906***	-0.884***	-0.576***	-0.774***	-1.422***	-0.817***
	[1.441]	[0.0502]	[0.166]	[0.0340]	[0.107]	[0.102]	[0.0933]	[0.0450]	[0.0790]	[0.0710]
<i>LowNoDoc</i>	0.127**	0.327***	-0.095***	0.111***	0.115***	-0.184***	0.264***	-0.00253	0.258***	-0.0471
	[0.0559]	[0.0442]	[0.0343]	[0.0228]	[0.0279]	[0.0546]	[0.0530]	[0.0420]	[0.0618]	[0.0424]
Observations	328,264	568,670	414,785	809,047	536,185	182,393	264,283	132,820	196,289	182,104
Loans	16,957	26,868	20,518	43,427	33,314	6,535	12,920	7,581	11,265	7,099
Log-L	-65,999	-106,736	-77,120	-173,771	-129,121	-21,633	-53,660	-28,907	-45,404	-24,909
Refinance ARMs										
Foreclosure equation results										
<i>PrepayPen</i>	-0.939***	-0.243***	-1.492***	-0.467***	-0.802***	-0.643***	-0.220***	-0.891***	-0.528***	-0.498***
	[0.155]	[0.0492]	[0.114]	[0.0289]	[0.0614]	[0.213]	[0.0632]	[0.0655]	[0.0667]	[0.101]
<i>LowNoDoc</i>	0.295***	0.481**	0.467***	0.481**	0.482***	0.365***	0.703***	0.364***	0.544***	0.387***
	[0.0618]	[0.0482]	[0.0397]	[0.0226]	[0.0291]	[0.106]	[0.0421]	[0.0607]	[0.0459]	[0.0679]
Prepayment equation results										
<i>PrepayPen</i>	-1.119***	-0.574***	-1.929***	-1.022***	-1.085***	-1.416***	-0.439***	-1.017***	-1.087***	-0.828***
	[0.122]	[0.0416]	[0.102]	[0.0163]	[0.0383]	[0.227]	[0.0486]	[0.0391]	[0.0442]	[0.0809]
<i>LowNoDoc</i>	-0.0200	-0.0946**	-0.129***	0.00959	0.129***	-0.152	0.124***	-0.232***	0.164***	-0.173***
	[0.0406]	[0.0379]	[0.0266]	[0.0136]	[0.0140]	[0.104]	[0.0311]	[0.0414]	[0.0329]	[0.0477]

TABLE 6.—(CONTINUED)

Observations	423,760	826,397	805,177	1,525,674	1,232,882	126,285	688,167	407,995	481,111	321,756
Loans	22,871	36,727	43,206	86,004	86,038	5,019	37,141	27,590	29,961	11,923
Log-L	-85,557	-143,482	-158,076	-327,801	-312,014	-17,719	-148,175	-99,836	-113,457	-43,189

This table presents results of multinomial logit regressions with unobserved heterogeneity based on monthly data for fixed-rate loans originated during 2002–2006. Specifications include the same control variables as in table 4, with the exception of *Judicial* and MSA indicators. Variables are defined as in table 2. Each coefficient estimate represents the impact on the probability of a first foreclosure start or a prepayment, relative to the probability of a loan remaining active, of a one-unit change in the corresponding variable. Robust standard errors clustered by loan are in brackets. Significant at *10%, **5%, and ***1%. For 6A: Due to nonconvergence, the constant heterogeneity weight approach described in section III was used in the purchase FRM regressions for Minneapolis and Pittsburgh, and in the refinance FRM regression for Baltimore. For 6B: Due to nonconvergence, the constant heterogeneity weight approach described in section 3 was used in the purchase ARM regressions for Chicago, San Antonio, and Baltimore, and in the refinance ARM regressions for Chicago, Los Angeles, San Antonio, Baltimore, New York City, and Pittsburgh.

and *PrepayPen*, although in table 9A, they are more concentrated among purchase FRMs and there are no cross-MSA differences for *PrepayPen* among ARMs. Table 9B has somewhat fewer cross-MSA differences for *LowNoDoc* and more for *Balloon* than table 7B.

E. State Antipredatory Lending Law Provisions

State APLs that restrict the use of prepayment penalties, balloon loans, or reduced documentation in varying degrees are a potential source of the cross-MSA differences identified above. To determine the extent to which this may be so, I conducted an examination of each sample state's lending legislation and regulations with respect to ten provisions often addressed in state APLs. For each one, I construct an indicator variable equaling 1 if, in a given month, the state in question had an APL provision in effect that was more restrictive on lending terms than the comparable provision in HOEPA. Given that HOEPA applies to mortgage lending nationwide, only an APL provision stricter than HOEPA should have a state-specific effect. Most of the sample states enacted or amended their APLs during the sample period, assisting with identification.

The APL variables are defined in table 10. *TriggerAPR* and *TriggerPF* measure whether the high-cost thresholds of a state's APL are lower than HOEPA's thresholds, and so affect the range of loans to which the other provisions in the APLs apply. *FinancingPF* identifies limits on the points and fees that may be financed on high-cost loans. Because they affect the incentives of lenders to originate high-cost loans, those three APL variables could plausibly affect the impacts of any of the three loan features. *PrepayDur*, *PrepayAmt*, and *PrepayNoPre* address specific restrictions on the use of prepayment penalties, and *BalloonTerm* and *Verification* address the use of balloon loans and reduced documentation, respectively. *FlippingDur* and *OwnRefiPF* concern restrictions on refinancing high-cost loans. Because prepayment penalties discourage borrowers from refinancing and impeding balloon payments encourage borrowers to refinance, restrictions on refinancing could affect the impacts of *PrepayPen* and *Balloon*. HOEPA and some state APLs cover refinance loans but not home purchase loans, while other state APLs cover loans with either purpose. A state's APL variables can take different values for purchase versus refinance specifications, reflecting this difference in state APL coverage.

A benefit of simplistic measures like these relative to the indices created by Pennington-Cross and Ho (2006) and Bostic et al. (2008) is that these measures remove the need to make assumptions about the comparative strength of alternative provisions. (For example, should a prohibition against balloon payments due within fifteen years of origination be measured as 50% more restrictive than a prohibition within ten years? 100%?) The related cost is that potentially useful variation in state APLs is lost. (The fifteen-year prohibition is very likely more restrictive to some degree.) Because the primary aim here is not to evaluate specific APL provisions but instead to control for them in examining geographic variation in the effects of *PrepayPen*, *Balloon*, and *LowNoDoc*, I construct simple APL measures rather than develop a full set of assumptions for indexing the provisions. There are strong correlations among the state APL variables, so they are introduced into the specifications one at a time.

Table 11 presents results of specifications as in table 8 with the addition of state APL variables by themselves and interacted with each of the relevant loan feature variables. (Because of its length, table 11 is in the table appendix at the end of this paper.) Results for the control variables are similar to those in table 4 and are omitted here for brevity. Even so, there remains a great deal of information in table 11 that is discussed only briefly here. In a slim majority of cases, the APL provisions are not significantly related to the probability of foreclosure, although they are negatively related in a substantial minority of specifications. There is more variation in the relationships between the APL variables and the probability of prepayment, but for most APL variables, the relationships are more often positive than negative. These results are broadly consistent with the state APL provisions reducing both foreclosures and impediments to prepayment.

The interaction terms of APL provisions and *PrepayPen* are always positively related to the probability of prepayment for *PrepayDur*, *PrepayAmt*, *TriggerPF*, and *FlippingDur*, suggesting that when these provisions are stronger, prepayment penalties are less binding constraints on prepayment. Findings for APL interactions with *PrepayPen* are not as consistent with respect to the probability of foreclosure, with generally positive results for FRMs, occasionally positive results for purchase ARMs, and negative results for refinance ARMs. Under stricter APLs, the freedom of borrowers and lenders to adopt prepayment penalties in exchange for lower loan interest rates may be

TABLE 7.—DIFFERENCES IN LOAN FEATURE COEFFICIENT ESTIMATES ACROSS INDIVIDUAL MSA REGRESSIONS: FORECLOSURE AND PREPAYMENT EQUATIONS

A. Based on Foreclosure Equation Results from Table 6				
	Purchase FRMs	Refinance FRMs	Purchase ARMs	Refinance ARMs
<i>PrepayPen</i>	NYC and Chi*** NYC and Pho * Pitt and Atl* Pitt and Chi*** Pitt and LA** Pitt and Pho***	LA and Atl*** LA and Balt*** LA and Chi*** LA and Mia*** LA and NYC*** LA and Pho*** LA and Pitt*** LA and SA** Minn and Atl** Minn and Balt*** Minn and Chi*** Minn and Mia* Minn and NYC** Minn and Pho*** Minn and Pitt***	Pitt and Atl*** Pitt and Balt** Pitt and Chi*** Pitt and LA*** Pitt and Mia*** Pitt and NYC** Pitt and Pho***	No significant oppositesign differences
<i>Balloon</i>	Balt and LA* Balt and Pho** Chi and Atl*** Chi and LA*** Chi and Mia*** Chi and NYC*** Chi and Pho*** Chi and Pitt*** Minn and Atl** Minn and LA*** Minn and Pho*** SA and Pho*	NYC and Atl* NYC and LA*** NYC and Mia* NYC and Pho** Pitt and LA** SA and Atl* SA and Balt* SA and Chi* SA and LA** SA and Mia* SA and Minn* SA and Pho**		
<i>LowNoDoc</i>	Mia and Atl*** Mia and Balt*** Mia and Chi*** Mia and LA*** Mia and Minn*** Mia and NYC*** Mia and Pho*** Mia and Pitt*** Mia and SA***	No significant opposite-sign differences	No significant opposite-sign differences	No significant opposite-sign differences
B. Based on Prepayment Equation Results from Table 6				
	Purchase FRMs	Refinance FRMs	Purchase ARMs	Refinance ARMs
<i>PrepayPen</i>	No significant opposite-sign differences	No significant opposite-sign differences	No significant opposite-sign differences	No significant opposite-sign differences
<i>Balloon</i>	No significant opposite-sign differences	No significant opposite-sign differences		
<i>LowNoDoc</i>	LA and Atl*** LA and Chi*** LA and Mia*** LA and Minn*** LA and NYC*** Pho and Atl*** Pho and Balt** Pho and Chi*** Pho and Mia*** Pho and Minn*** Pho and NYC*** Pho and Pitt** Pho and SA*	Chi and Atl*** Chi and Balt*** Chi and LA*** Chi and Mia*** Chi and Pho*** Chi and Pitt*** Minn and Balt** Minn and Pho*** Minn and Pitt* Minn and SA*** NYC and Balt*** NYC and LA** NYC and Mia** NYC and Pho*** NYC and Pitt** NYC and SA***	Balt and Atl*** Balt and Chi** Balt and LA** Balt and Mia* Balt and Minn*** Balt and NYC*** Pho and Atl*** Pho and Chi*** Pho and LA*** Pho and Mia*** Pho and Minn*** Pho and NYC*** Pitt and Atl*** Pitt and Chi*** Pitt and LA*** Pitt and Mia** Pitt and Minn*** Pitt and NYC*** SA and Atl*** SA and Chi*** SA and LA*** SA and Mia*** SA and Minn*** SA and NYC***	Chi and Atl*** Chi and Balt*** Chi and Pho*** Chi and Pitt*** LA and Atl*** LA and Balt*** LA and Mia*** LA and Pho*** LA and Pitt*** LA and SA*** Minn and Atl*** Minn and Balt*** Minn and Mia*** Minn and Pho*** Minn and Pitt*** Minn and SA** NYC and Atl*** NYC and Balt*** NYC and Mia*** NYC and Pho*** NYC and Pitt*** NYC and SA***

The listed pairs of MSAs exhibit coefficient estimates for *PrepayPen*, *Balloon*, or *LowNoDoc* that have opposite signs and are different at the 10% level of significance or greater. Coefficient estimates of unlisted MSA pairs either have the same sign or do not exhibit a statistically significant difference. These coefficient estimate differences are based on the foreclosure (prepayment) equation results from table 6. The dearth of balloon ARMs prior to 2005 required that they be excluded from ARM specifications. Significant at *10%, **5%, and ***1%.

TABLE 8.—CHANGES IN THE PROBABILITY OF A FORECLOSURE START AND A PREPAYMENT: MSA-LOAN FEATURE INTERACTIONS

		Foreclosure			Prepayment		
		Purchase FRMs					
<i>PrepayPen</i>	0.132				-0.473***		
	[0.140]				[0.0392]		
<i>Balloon</i>	0.805***				-0.232		
	[0.238]				[0.153]		
<i>LowNoDoc</i>	0.690***	MSA interactions with:			-0.0343	MSA interactions with:	
	[0.144]	<i>PrepayPen</i>	<i>Balloon</i>	<i>LowNoDoc</i>	[0.0383]	<i>PrepayPen</i>	<i>Balloon</i>
<i>Mia</i>	1.421***	-0.476**	0.204	-0.608***	-0.371*	-0.102	-0.333
	[0.547]	[0.199]	[0.421]	[0.195]	[0.206]	[0.0699]	[0.273]
<i>Atl</i>	0.0595	-0.252	-0.826**	-0.0135	-0.425***	-0.281***	0.299
	[0.187]	[0.201]	[0.406]	[0.183]	[0.0632]	[0.0890]	[0.217]
<i>Pho</i>	0.225	-0.754***	0.194	-0.250	0.156**	-0.383***	0.0938
	[0.232]	[0.223]	[0.405]	[0.232]	[0.0641]	[0.0720]	[0.248]
<i>Balt</i>	1.169**	-0.540**	-1.292***	-0.257	0.129	-0.907***	-0.0337
	[0.538]	[0.237]	[0.307]	[0.188]	[0.203]	[0.104]	[0.170]
<i>SA</i>	-0.974***	-0.612**	-1.183	-0.523**	-0.851***	-0.731***	-0.275
	[0.247]	[0.240]	[0.844]	[0.237]	[0.0916]	[0.106]	[0.461]
<i>Minn</i>	0.109	-0.0460	-1.056**	-0.166	-0.169**	0.112	0.0339
	[0.223]	[0.237]	[0.413]	[0.230]	[0.0779]	[0.0963]	[0.196]
<i>Balt</i>	0.302	0.268	-1.105**	-0.161	0.203	0.113	-0.303
	[0.559]	[0.398]	[0.464]	[0.281]	[0.204]	[0.115]	[0.201]
<i>NYC</i>	0.719	0.148	-0.578	-0.0954	-0.272	-0.511***	0.302
	[0.550]	[0.214]	[0.361]	[0.212]	[0.204]	[0.0971]	[0.214]
<i>Pitt</i>	-0.432	-0.543**	-0.665	0.0887	-0.381*	-0.486***	-0.456
	[0.560]	[0.245]	[0.489]	[0.260]	[0.210]	[0.106]	[0.315]
		Refinance FRMs					
<i>PrepayPen</i>	0.255**				-0.133***		
	[0.129]				[0.0296]		
<i>Balloon</i>	0.647***				-0.107		
	[0.196]				[0.0877]		
<i>LowNoDoc</i>	0.218*	MSA interactions with:			-0.0405	MSA interactions with:	
	[0.111]	<i>PrepayPen</i>	<i>Balloon</i>	<i>LowNoDoc</i>	[0.0276]	<i>PrepayPen</i>	<i>Balloon</i>
<i>Mia</i>	0.492	-0.776***	0.441	0.377**	-0.564***	-0.166**	0.0863
	[0.527]	[0.225]	[0.462]	[0.188]	[0.179]	[0.0661]	[0.184]
<i>Atl</i>	-0.0149	-0.463**	-0.493	0.318	-0.310***	-0.348***	-0.00292
	[0.194]	[0.227]	[0.401]	[0.196]	[0.0696]	[0.0786]	[0.188]
<i>Pho</i>	0.420**	-0.531**	-0.660*	0.394*	0.135**	-0.323***	-0.118
	[0.214]	[0.229]	[0.373]	[0.205]	[0.0603]	[0.0691]	[0.167]
<i>Balt</i>	0.433	-0.641***	-0.843***	0.704***	-0.0517	-0.477***	0.0857
	[0.493]	[0.230]	[0.303]	[0.193]	[0.167]	[0.0722]	[0.121]
<i>SA</i>	-0.832***	-0.309	-1.040	0.0130	-0.939***	-0.386**	-0.261
	[0.294]	[0.388]	[1.278]	[0.272]	[0.137]	[0.189]	[0.770]
<i>Minn</i>	0.716***	-0.408*	-0.212	0.633***	0.138**	-0.0210	0.0259
	[0.208]	[0.217]	[0.342]	[0.205]	[0.0657]	[0.0689]	[0.137]
<i>Balt</i>	0.469	-0.484*	-0.863**	0.187	0.155	-0.187***	0.0297
	[0.499]	[0.250]	[0.385]	[0.224]	[0.168]	[0.0670]	[0.144]
<i>NYC</i>	0.667	-0.674***	-0.760**	0.406**	-0.123	-0.603***	-0.0165
	[0.495]	[0.256]	[0.350]	[0.173]	[0.168]	[0.0811]	[0.150]
<i>Pitt</i>	-0.0222	-0.579**	-0.380	0.304	-0.783***	-0.380***	-0.188
	[0.533]	[0.254]	[0.501]	[0.241]	[0.194]	[0.101]	[0.249]
		Purchase ARMs					
<i>PrepayPen</i>	-1.486***				-1.917***		
	[0.150]				[0.137]		
<i>LowNoDoc</i>	0.328***	MSA interactions with:			0.0304	MSA interactions with:	
	[0.0857]	<i>PrepayPen</i>		<i>LowNoDoc</i>	[0.0526]	<i>PrepayPen</i>	<i>LowNoDoc</i>
<i>Mia</i>	0.192	0.220		-0.0768	-0.425	-0.0589	0.0142
	[0.358]	[0.194]		[0.127]	[0.263]	[0.164]	[0.0932]
<i>Atl</i>	-1.622***	1.018***		0.486***	-1.113***	1.088***	0.198**
	[0.170]	[0.162]		[0.114]	[0.152]	[0.151]	[0.0875]
<i>Pho</i>	-0.729***	-0.0823		0.114	-0.145	-0.105	-0.215***
	[0.200]	[0.195]		[0.122]	[0.175]	[0.173]	[0.0831]
<i>Balt</i>	-0.833**	0.982***		-0.0462	-0.452*	0.432***	0.197***
	[0.337]	[0.159]		[0.105]	[0.245]	[0.141]	[0.0737]
<i>SA</i>	-2.529***	0.877***		-0.0524	-1.615***	0.460**	-0.0501
	[0.226]	[0.216]		[0.177]	[0.204]	[0.197]	[0.143]
<i>Minn</i>	-1.542***	1.158***		0.245*	-0.599***	1.027***	0.0675
	[0.205]	[0.195]		[0.132]	[0.177]	[0.173]	[0.0953]
<i>Balt</i>	-1.160***	1.019***		-0.182	-0.426	0.946***	-0.0955
	[0.356]	[0.233]		[0.198]	[0.259]	[0.183]	[0.137]

TABLE 8.—(CONTINUED)

		Foreclosure			Prepayment		
		Purchase ARMs					
<i>NYC</i>	−1.067***	1.295***	0.407**	−0.650**	0.426**	0.288**	
	[0.356]	[0.219]	[0.166]	[0.259]	[0.200]	[0.117]	
<i>Pitt</i>	−1.980***	0.953***	0.0753	−0.697**	0.568***	0.217	
	[0.369]	[0.214]	[0.181]	[0.279]	[0.193]	[0.146]	
		Refinance ARMs					
<i>PrepayPen</i>	−1.005***			−1.100***			
	[0.186]			[0.141]			
<i>LowNoDoc</i>	0.443***	<i>MSA interactions with:</i>		−0.0518	<i>MSA interactions with:</i>		
	[0.0948]	<i>PrepayPen</i>	<i>LowNoDoc</i>	[0.0527]	<i>PrepayPen</i>	<i>LowNoDoc</i>	
<i>Mia</i>	−0.362	0.374	−0.202	−1.243***	0.173	−0.0933	
	[0.409]	[0.277]	[0.165]	[0.308]	[0.221]	[0.105]	
<i>Atl</i>	−1.077***	0.814***	0.155	−0.590***	0.350**	−0.0820	
	[0.212]	[0.214]	[0.142]	[0.158]	[0.162]	[0.0946]	
<i>Pho</i>	−0.307	−0.198	0.190	0.121	−0.537***	−0.0532	
	[0.243]	[0.241]	[0.141]	[0.188]	[0.187]	[0.0866]	
<i>Balt</i>	−0.359	0.411**	0.227*	−0.269	−0.117	0.205***	
	[0.353]	[0.196]	[0.123]	[0.256]	[0.144]	[0.0769]	
<i>SA</i>	−1.690***	0.946**	0.122	−1.400***	0.426	0.151	
	[0.270]	[0.409]	[0.281]	[0.195]	[0.316]	[0.186]	
<i>Minn</i>	−0.483**	0.871***	0.291**	−0.0992	0.485***	0.143	
	[0.229]	[0.224]	[0.144]	[0.174]	[0.174]	[0.0935]	
<i>Balt</i>	−0.358	0.281	−0.0565	−0.0515	0.210	−0.0685	
	[0.362]	[0.254]	[0.209]	[0.260]	[0.165]	[0.124]	
<i>NYC</i>	−0.321	0.573**	0.233	−0.466*	0.125	0.137	
	[0.363]	[0.262]	[0.161]	[0.261]	[0.180]	[0.101]	
<i>Pitt</i>	−1.193***	0.797***	0.0920	−0.973***	0.120	0.221	
	[0.390]	[0.252]	[0.212]	[0.289]	[0.197]	[0.163]	

This table presents results of multinomial logit regressions with unobserved heterogeneity based on monthly data for loans originated during 2002–2006. Specifications include the same control variables as in table 4, plus interactions of *PrepayPen*, *PrepayPenEnd*, *Balloon*, and *LowNoDoc* with MSA indicators. Variables are defined as in table 2. Each coefficient estimate represents the impact on the probability of a first foreclosure start or a prepayment, relative to the probability of a loan remaining active, of a one-unit change in the corresponding variable. The dearth of balloon ARMs prior to 2005 required that they be excluded from ARM specifications. Robust standard errors clustered by loan are in brackets. Significant at *10%, **5%, and ***1%.

For purchase FRMs: observations, 972, 557; loans, 35,900; log likelihood, −102, 686. For refinance FRMs: observations, 1,434, 519; loans, 52,170; log likelihood, −148, 187. For purchase ARMs: observations, 720, 265; loans, 39, 069; log likelihood, −146, 492. For refinance ARMs: observations 685, 866; loans, 39,313; log likelihood, −145, 700.

restricted, reducing affordability and making foreclosures more likely. At the same time, stricter APLs may make refinancing more available to distressed borrowers who took out loans with prepayment penalties, thereby making foreclosures less likely. Because initial loan interest rates are on average highest for FRMs, lower for purchase ARMs, and lowest for refinance ARMs, the former effect of stricter APLs is plausibly most dominant for FRMs and the latter effect most dominant for refinance ARMs.²¹ APL interactions with *Balloon* and with *LowNoDoc* are significant much less often than the interactions with *PrepayPen*.²²

There are endogeneity concerns associated with the APL provision results in table 11. Using the sum of a state's values for the ten APL provision variables as an extremely crude measure of the overall restrictiveness of the state APL and using average annual state subprime foreclosure

rates over 1998 to 2001 from Haver Analytics to measure presample foreclosure rates, I find a strong negative correlation between presample foreclosure rates and APL restrictiveness at the start of the sample period and a strong positive correlation between presample foreclosure rates and the adoption of strict APL provisions during the sample period. In addition, *Judicial* is correlated with most of the APL provision variables, especially for purchase loans, suggesting a relationship between state foreclosure law and antipredatory lending law that could bias the results.²³ A more thorough investigation of the effects of APL provisions on loan outcomes would need to address these concerns, but such analysis is beyond the scope of this paper.

Table 12 uses the APL provision results to address the primary focus here: the geographic variation in the loan features' effects on the probabilities and foreclosure and prepayment. For each specification in table 11, the number of significant opposite-sign cross-MSA differences (defined as in table 9) is shown in table 12. The less variation there is in the number of cross-MSA differences across the APL provision specifications (that is, the less the numbers in a given column change), the less likely it is that differences in state APL provisions explain the geographic variation in the effects of the loan features on loan outcomes identified in table 9.

²¹ The sample average initial loan interest rates are 7.01% for purchase FRMs, 6.95% for refinance FRMs, 6.86% for purchase ARMs, and 6.50% for refinance ARMs.

²² In the *TriggerAPR* specifications for purchase FRMs in table 11A, the coefficient estimate for $APL \times Balloon$ is extremely high (15.25), and the estimate for *Minneapolis* \times *Balloon* (unreported, but available in the supplement at http://www.umbc.edu/economics/wpapers/wp_10_119.pdf) is extremely low (−16.14). Minnesota is one of only two sample states for which *TriggerAPR* equals 1 for purchase loans at any point during the sample period. It equals 1 for Minnesota during the entire sample period and for Georgia for only six months. All other APL provisions examined here show greater variation across states over the sample period.

²³ Dropping *Judicial* from the specifications does not substantively affect the results.

TABLE 9.—DIFFERENCES IN COEFFICIENT ESTIMATES OF MSA-LOAN FEATURE INTERACTION TERMS IN POOLED MSA REGRESSIONS: FORECLOSURE AND PREPAYMENT EQUATIONS

A. Based on Foreclosure Equation Results from Table 8				
	Purchase FRMs	Refinance FRMs	Purchase ARMs	Refinance ARMs
<i>MSA</i> × <i>PrepayPen</i>	Balt and Chi* Balt and Mia* Balt and Pho** Balt and Pitt* Balt and SA** LA and Chi** LA and Mia** LA and Pho*** LA and Pitt** LA and SA** Minn and Chi* Minn and Mia* Minn and Pho*** Minn and Pitt* Minn and SA** NYC and Atl* NYC and Chi*** NYC and Mia*** NYC and Pho*** NYC and Pitt*** NYC and SA***	LA and Atl** LA and Balt* LA and Chi*** LA and Mia*** LA and Minn* LA and NYC*** LA and Pho** LA and Pitt**	No significant opposite-sign differences	No significant opposite-sign differences
<i>MSA</i> × <i>Balloon</i>	LA and Atl** LA and Balt** LA and Chi*** LA and Minn** Mia and Atl** Mia and Balt** Mia and Chi*** Mia and Minn*** NYC and Chi** Pho and Atl** Pho and Balt** Pho and Chi*** Pho and Minn***	LA and Balt** LA and Chi*** LA and NYC** LA and Pho* Mia and Balt** Mia and Chi*** Mia and NYC** Mia and Pho** Minn and Chi*		
<i>MSA</i> × <i>LowNoDoc</i>	No significant opposite-sign differences	No significant opposite-sign differences	No significant opposite-sign differences	No significant opposite-sign differences
B. Based on Prepayment Equation Results from Table 8				
	Purchase FRMs	Refinance FRMs	Purchase ARMs	Refinance ARMs
<i>MSA</i> × <i>PrepayPen</i>	No significant opposite-sign differences	No significant opposite-sign differences	No significant opposite-sign differences	No significant opposite-sign differences
<i>MSA</i> × <i>Balloon</i>	Atl and Balt*** Atl and Chi* Atl and Mia** Atl and Pitt** NYC and Balt*** NYC and Chi** NYC and Mia** NYC and Pitt**	No significant opposite-sign differences		
<i>MSA</i> × <i>LowNoDoc</i>	LA and Atl* LA and Chi*** LA and Mia** LA and Minn** LA and NYC*** LA and Pitt* Pho and Atl*** Pho and Balt* Pho and Chi*** Pho and Mia*** Pho and Minn*** Pho and NYC*** Pho and Pitt*** SA and Chi*** SA and NYC**	Atl and Balt*** Atl and LA** Atl and Pho* Atl and SA* Balt and Chi*** Balt and Mia** Balt and Minn* Chi and LA*** Chi and Pho*** Chi and Pitt** Chi and SA***	Balt and Atl** Balt and Chi** Balt and NYC** Balt and Pitt* Pho and Atl*** Pho and Chi*** Pho and LA*** Pho and Mia** Pho and Minn*** Pho and NYC*** SA and Atl* SA and Chi*	Chi and Atl*** Chi and Balt** Chi and LA*** Chi and Mia*** Chi and Pho*** Minn and Atl** Minn and Mia** Minn and Pho* NYC and Atl* NYC and Mia* NYC and Pho* Pitt and Atl* Pitt and Mia*

The listed pairs of MSAs exhibit coefficient estimates for interaction variables of MSA indicators and *PrepayPen*, *Balloon*, or *LowNoDoc* such that the combined estimated impacts of the loan feature variable and the MSA-loan feature interaction variable have opposite signs and the MSA-loan feature interaction variables are different at the 10% level of significance or greater. Coefficient estimates of unlisted MSA pairs either have combined estimated impacts of the same sign or interaction variables that do not exhibit a statistically significant difference. These coefficient estimate differences are based on the foreclosure (prepayment) equation results from table 8. The dearth of balloon ARMs prior to 2005 required that they be excluded from ARM specifications. Significant at *10%, **5%, and ***1%.

TABLE 10.—STATE ANTIPREDATORY LENDING LAW VARIABLE DEFINITIONS

Variable	Definition
<i>TriggerAPR</i>	Equals 1 if the APR threshold above which a state's APL law applies for first-lien loans is lower than the yield on a comparable Treasury security at the time of loan origination plus 8%, 0 otherwise
<i>TriggerPF</i>	Equals 1 if the points and fees threshold above which a state's APL law applies for first-lien loans is lower than the greater of 8% of the loan origination amount or an annually adjusted dollar amount established by the Truth in Lending Act (\$480 in 2002, \$528 in 2006), 0 otherwise
<i>FinancingPF</i>	Equals 1 if a state's APL law restricts the amount of points and fees that may be financed on a covered loan, 0 otherwise
<i>PrepayDur</i>	Equals 1 if a state's APL law's prohibition against prepayment penalties on covered loans takes effect sooner than five years after loan origination, 0 otherwise
<i>PrepayAmt</i>	Equals 1 if a state's APL law restricts the maximum amount that can be charged as a prepayment penalty on a covered loan, 0 otherwise
<i>PrepayNoPre</i>	Equals 1 if a state's APL law requires that any lender originating a covered loan with a prepayment penalty must also offer the borrower the choice of a loan with no prepayment penalty
<i>BalloonTerm</i>	Equals 1 if a state's APL law's prohibition against balloon payments on covered loans is in effect for longer than five years after origination, 0 otherwise
<i>Verification</i>	Equals 1 if a state's APL law specifies a minimum standard for the verification of a borrower's ability to pay for a covered loan, 0 otherwise
<i>FlippingDur</i>	Equals 1 if a state's APL law restricts lenders from refinancing covered loans beyond the first twelve months of the original loan, 0 otherwise
<i>OwnRefiPF</i>	Equals 1 if a state's APL law prohibits a lender from financing points and fees on a refinancing of a covered loan originated by the same lender, 0 otherwise

For each variable, a value of 1 indicates a provision in a state APL law that is more restrictive on lenders than the relevant provision of the federal Home Ownership and Equity Protection Act (HOEPA), and a value of 0 indicates a provision in a state APL law that is equally or less restrictive than the relevant provision in HOEPA. A covered loan is one that meets the state's criteria for a high-cost loan and so is subject to the restrictions in the state's APL law. State APL information is from my own analysis of the relevant states' lending legislation and regulations.

Starting with table 12A, pertaining to results regarding the probability of foreclosure, there is a consistent pattern of changes in the number of cross-MSA differences in the $MSA \times PrepayPen$ interaction terms when an APL provision is also interacted with *PrepayPen*. This usually results in less geographic variation for FRMs but more for ARMs. If the two effects driving the $APL \times PrepayPen$ results described above are accurate, then the reduction of geographic variation for FRMs suggests that the use of prepayment penalties to increase affordability can be circumscribed by stricter APLs, and so including $APL \times PrepayPen$ interaction terms controls for one source of the identified cross-MSA variation in prepayment penalties' effects on foreclosures. At the same time, including $APL \times PrepayPen$ terms for ARMs may primarily control for a geographically consistent reduction in foreclosures due to an increased availability of refinancing, allowing a greater identification of underlying cross-MSA variation in the effects of prepayment penalties on foreclosures. Cross-MSA variation in the effects of balloon loans is largely stable, and there are no changes at all in the number of cross-MSA differences in the $MSA \times LowNoDoc$ interaction terms. Thus, there is little evidence that state APL provisions explain the geographic variation (or lack thereof) in the effects of balloon loans or reduced documentation identified in table 9. State APL provisions do explain a portion of the geographic variation associated with *PrepayPen* and foreclosures, but substantial variation remains even after controlling for APL provisions.

In table 12B, pertaining to results regarding the probability of prepayment, almost all of the substantial changes in the numbers of cross-MSA differences occur for purchase FRMs. Only in the purchase FRM specification with $PrepayNoPre \times PrepayPen$ is the coefficient estimate for *PrepayPen* greater than 0 (but not significant). The number of cross-MSA differences associated with $MSA \times Balloon$

often falls, frequently to 0, when APL provisions are interacted with *Balloon*, suggesting that differences in state APLs may explain a substantial portion of the geographic variation in the effects of balloon purchase FRMs on the probability of prepayment. For refinance FRMs, purchase ARMs, and refinance ARMs, the introduction of APL provisions into the specifications has little appreciable effect on the geographic variation in the impacts of prepayment penalties, balloon loans, or reduced documentation.

F. Robustness Checks

Several alternative specifications were tested to check the robustness of the geographic variation results. The definition of foreclosure used above, a loan first entering a foreclosure process or REO status, does not take into account that some loans entering the foreclosure process are resolved prior to completion of a foreclosure. I used two alternative definitions: a first foreclosure start or entrance into REO status that ultimately results in a completed foreclosure (so that a loan entering a foreclosure process or REO status that does not result in a foreclosure is considered an active loan) and the completion of a foreclosure. Under these definitions, the number of cross-MSA differences associated with *PrepayPen* and foreclosures was smaller for FRMs and larger for ARMs, but otherwise the pattern of results was the same.

Because *PrepayPenEnd* is clearly related to *PrepayPen*, the inclusion of *PrepayPenEnd* could plausibly affect the *PrepayPen* results. In specifications in which *PrepayPenEnd* was omitted, the coefficient estimates for *PrepayPen* were affected, particularly in the prepayment equation results, but the findings concerning geographic variation were not substantially different. Due to the potential for state foreclosure laws to influence both foreclosure rates

and the effects of state APLs, alternative treatments of state foreclosure laws were used. In addition to *Judicial*, I used an indicator variable equaling 1 if a state's laws allow lenders to obtain a deficiency judgment against borrowers when the proceeds from a foreclosure sale do not cover the mortgage debt owed (see Ghent & Kudlyak, 2011). Inclusion or exclusion of these variables affects the coefficient estimates of the MSA indicators, but the results regarding the impacts of the loan features and geographic variation are not substantively different in specifications with both, one, or neither of these variables.²⁴ As noted in footnotes 6 and 7, using alternative definitions of *RefiPremium* and *PaymentAdj* also did not substantively alter the results.

V. Conclusion

Federal-level regulation of a particular loan feature rests on three premises: (a) there are negative externalities associated with foreclosures, (b) the negative effects of the loan feature outweigh the positive effects, and (c) the overall effects on net are consistently negative in mortgage markets across the country. The third premise is necessary to justify regulatory decision making at the federal level rather than at lower levels, where the net effects of the loan feature in specific mortgage markets can be considered. This is the first paper to empirically test the third premise, doing so by examining the extent of geographic variation in the effects of prepayment penalties, balloon loans, and reduced documentation on the probabilities of foreclosure and prepayment in a sample of over 810,000 subprime purchase and refinance mortgages originated from 2002 to 2006 in ten MSAs. Findings indicate substantial geographic variation in the effects of prepayment penalties and balloon loans on the probability of foreclosure and the effects of reduced documentation on the probability of prepayment. These findings are robust to multiple specifications, including controls for a variety of state APL provisions. Although more definitive conclusions regarding the effects of specific APL provisions on foreclosures and prepayments require more extensive analysis than the scope of this paper permits, in general the APL provisions included here are associated with lesser probabilities of foreclosure and greater probabilities of prepayment. More pertinent to the focus of this paper, APL provisions appear to be related to some of the geographic variation in the effects of the examined loan features, but significant geographic variation remains even after controlling for APL provisions.

Geographic variation in the effects of the loan features on the probabilities of foreclosure and prepayment raises the likelihood that their overall effects may be negative in some markets but positive in others, calling the third premise into question. To the extent this is true, federal-level regulations intended to curb abuses associated with those

loan features would need to be designed with great subtlety and flexibility to avoid causing unwelcome distortions in some markets. Decisions of whether or how to regulate particular loan features therefore may be more optimally made at lower governmental levels.

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²⁴ Inclusion of the deficiency judgment variable introduces collinearity because in each sample MSA that includes portions of two states, both states take the same value for that variable. The same is not true for *Judicial*.

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APPENDIX

TABLE 11.—CHANGES IN THE PROBABILITY OF A FORECLOSURE START AND A PREPAYMENT, APL PROVISIONS, FRMs AND ARMs

A. Purchase FRMs								
APL = <i>TriggerAPR</i>								
	Foreclosure				Prepayment			
APL	0.774*	0.563	0.773*	1.051**	0.109	0.060	0.109	-0.0853
	[0.414]	[0.429]	[0.415]	[0.512]	[0.170]	[0.173]	[0.170]	[0.224]
APL× <i>PrepayPen</i>		1.609				0.452		
		[0.988]				[0.352]		
APL× <i>Balloon</i>			15.25***				1.542**	
			[0.767]				[0.689]	
APL× <i>LowNoDoc</i>				-0.505				0.293
				[0.671]				[0.250]
<i>PrepayPen</i>	0.133	0.132	0.133	0.133	-0.473***	-0.473***	-0.473***	-0.473***
	[0.141]	[0.140]	[0.141]	[0.141]	[0.0391]	[0.0392]	[0.0391]	[0.0392]
<i>Balloon</i>	0.803***	0.802***	0.803***	0.802***	-0.233	-0.233	-0.233	-0.233
	[0.239]	[0.237]	[0.240]	[0.239]	[0.153]	[0.153]	[0.153]	[0.153]
<i>LowNoDoc</i>	0.690***	0.689***	0.691***	0.689***	-0.0344	-0.0345	-0.0343	-0.0344
	[0.145]	[0.144]	[0.145]	[0.145]	[0.0383]	[0.0383]	[0.0383]	[0.0383]
Log likelihood	-102,684	-102,679	-102,679	-102,682				
APL = <i>TriggerPF</i>								
	Foreclosure				Prepayment			
APL	-0.307**	-0.456***	-0.353***	-0.272	-0.0592	-0.168***	-0.0688	-0.216***
	[0.134]	[0.145]	[0.134]	[0.223]	[0.0441]	[0.0475]	[0.0446]	[0.0740]
APL× <i>PrepayPen</i>		0.711***				0.782***		
		[0.264]				[0.125]		
APL× <i>Balloon</i>			1.365**				0.346	
			[0.606]				[0.218]	
APL× <i>LowNoDoc</i>				-0.0504				0.215**
				[0.247]				[0.0837]
<i>PrepayPen</i>	0.140	-0.573*	0.140	0.141	-0.472***	-1.255***	-0.472***	-0.472***
	[0.142]	[0.300]	[0.141]	[0.142]	[0.0391]	[0.132]	[0.0392]	[0.0391]
<i>Balloon</i>	0.791***	0.788***	-0.572	0.791***	-0.236	-0.237	-0.581**	-0.236
	[0.242]	[0.239]	[0.653]	[0.242]	[0.153]	[0.154]	[0.266]	[0.153]
<i>LowNoDoc</i>	0.690***	0.685***	0.689***	0.741***	-0.0349	-0.0352	-0.0348	-0.250***
	[0.145]	[0.145]	[0.145]	[0.287]	[0.0382]	[0.0384]	[0.0383]	[0.0921]
Log likelihood	-102,683	-102,660	-102,679	-102,679				
APL = <i>FinancingPF</i>								
	Foreclosure				Prepayment			
APL	-0.393***	-0.641***	-0.532***	-0.281	-0.188***	-0.273***	-0.204***	-0.508***
	[0.148]	[0.161]	[0.148]	[0.286]	[0.0465]	[0.0513]	[0.0479]	[0.0852]
APL× <i>PrepayPen</i>		1.270***				0.448***		
		[0.323]				[0.128]		
APL× <i>Balloon</i>			2.218***				0.314*	
			[0.546]				[0.182]	
APL× <i>LowNoDoc</i>				-0.134				0.421***
				[0.312]				[0.0950]
<i>PrepayPen</i>	0.140	-1.130***	0.139	0.141	-0.471***	-0.921***	-0.472***	-0.471***
	[0.141]	[0.352]	[0.141]	[0.142]	[0.0392]	[0.134]	[0.0393]	[0.0392]
<i>Balloon</i>	0.791***	0.788***	-1.424**	0.791***	-0.240	-0.241	-0.553**	-0.238
	[0.241]	[0.240]	[0.599]	[0.242]	[0.153]	[0.154]	[0.238]	[0.153]
<i>LowNoDoc</i>	0.691***	0.689***	0.690***	0.826**	-0.0351	-0.0354	-0.0351	-0.456***
	[0.145]	[0.145]	[0.145]	[0.345]	[0.0383]	[0.0385]	[0.0384]	[0.102]
Log likelihood	-102,676	-102,660	-102,667	-102,665				
APL = <i>PrepayDur</i>								
	Foreclosure				Prepayment			
APL	-0.386***	-0.534***	-0.180***	-0.293***	0.0506	-0.0797	0.153**	-0.0571
	[0.114]	[0.123]	[0.0418]	[0.0452]	[0.181]	[0.214]	[0.0747]	[0.0830]
APL× <i>PrepayPen</i>		0.828***		0.848***		0.421		0.899***
		[0.254]		[0.124]		[0.348]		[0.164]
<i>PrepayPen</i>	0.139	-0.694**	-0.470***	-1.321***	0.131	-0.291	-0.474***	-1.374***
	[0.141]	[0.292]	[0.0391]	[0.131]	[0.140]	[0.377]	[0.0393]	[0.169]
<i>Balloon</i>	0.793***	0.793***	-0.239	-0.238	0.805***	0.805***	-0.229	-0.230
	[0.241]	[0.238]	[0.153]	[0.154]	[0.237]	[0.236]	[0.153]	[0.153]
<i>LowNoDoc</i>	0.690***	0.685***	-0.0357	-0.0357	0.689***	0.687***	-0.0333	-0.0338
	[0.145]	[0.145]	[0.0382]	[0.0384]	[0.144]	[0.144]	[0.0384]	[0.0384]
Log likelihood	-102,673	-102,645			-102,684	-102,668		
APL = <i>PrepayAmt</i>								
	Foreclosure				Prepayment			
APL	-0.386***	-0.534***	-0.180***	-0.293***	0.0506	-0.0797	0.153**	-0.0571
	[0.114]	[0.123]	[0.0418]	[0.0452]	[0.181]	[0.214]	[0.0747]	[0.0830]
APL× <i>PrepayPen</i>		0.828***		0.848***		0.421		0.899***
		[0.254]		[0.124]		[0.348]		[0.164]
<i>PrepayPen</i>	0.139	-0.694**	-0.470***	-1.321***	0.131	-0.291	-0.474***	-1.374***
	[0.141]	[0.292]	[0.0391]	[0.131]	[0.140]	[0.377]	[0.0393]	[0.169]
<i>Balloon</i>	0.793***	0.793***	-0.239	-0.238	0.805***	0.805***	-0.229	-0.230
	[0.241]	[0.238]	[0.153]	[0.154]	[0.237]	[0.236]	[0.153]	[0.153]
<i>LowNoDoc</i>	0.690***	0.685***	-0.0357	-0.0357	0.689***	0.687***	-0.0333	-0.0338
	[0.145]	[0.145]	[0.0382]	[0.0384]	[0.144]	[0.144]	[0.0384]	[0.0384]
Log likelihood	-102,673	-102,645			-102,684	-102,668		

TABLE 11.—(CONTINUED)

APL = <i>PrepayNoPre</i>								
	Foreclosure				Prepayment			
APL	0.0685	0.693**	0.220**	0.479***				
	[0.264]	[0.337]	[0.0893]	[0.112]				
APL × <i>PrepayPen</i>		-1.779***		-0.766***				
		[0.552]		[0.192]				
<i>PrepayPen</i>	0.132	1.908***	-0.473***	0.293				
	[0.140]	[0.570]	[0.0392]	[0.195]				
<i>Balloon</i>	0.805***	0.805***	-0.233	-0.233				
	[0.238]	[0.237]	[0.153]	[0.153]				
<i>LowNoDoc</i>	0.690***	0.690***	-0.0347	-0.0349				
	[0.144]	[0.144]	[0.0383]	[0.0384]				
Log likelihood	-102,683	-102,672						
APL = <i>BalloonTerm</i>					APL = <i>Verification</i>			
	Foreclosure				Prepayment			
APL	-0.307**	-0.338**	-0.0593	-0.0634	1.865	2.069	-0.161	-0.645
	[0.134]	[0.134]	[0.0441]	[0.0446]	[1.183]	[1.320]	[0.413]	[0.645]
APL × <i>Balloon</i>		0.937		0.156				
		[0.593]		[0.225]				
APL × <i>LowNoDoc</i>						-0.407		0.790
						[1.166]		[0.731]
<i>PrepayPen</i>	0.140	0.140	-0.472***	-0.472***	0.131	0.131	-0.473***	-0.473***
	[0.142]	[0.141]	[0.0391]	[0.0392]	[0.141]	[0.141]	[0.0392]	[0.0392]
<i>Balloon</i>	0.791***	-0.145	-0.236	-0.392	0.807***	0.807***	-0.233	-0.232
	[0.242]	[0.641]	[0.153]	[0.271]	[0.239]	[0.239]	[0.153]	[0.153]
<i>LowNoDoc</i>	0.690***	0.689***	-0.0349	-0.0349	0.692***	0.692***	-0.0342	-0.0342
	[0.145]	[0.145]	[0.0382]	[0.0383]	[0.145]	[0.145]	[0.0383]	[0.0383]
Log likelihood	-102,683	-102,681			-102,684	-102,683		
APL = <i>FlippingDur</i>								
	Foreclosure				Prepayment			
APL	-0.377***	-0.507***	-0.414***	-0.142***	-0.254***	-0.148***		
	[0.116]	[0.125]	[0.118]	[0.0424]	[0.0457]	[0.0428]		
APL × <i>PrepayPen</i>		0.763***			0.886***			
		[0.263]			[0.127]			
APL × <i>Balloon</i>			0.931*			0.239		
			[0.517]			[0.230]		
<i>PrepayPen</i>	0.138	-0.629**	0.137	-0.471***	-1.360***	-0.472***		
	[0.141]	[0.300]	[0.141]	[0.0391]	[0.134]	[0.0392]		
<i>Balloon</i>	0.794***	0.794***	-0.135	-0.237	-0.236	-0.476*		
	[0.241]	[0.237]	[0.571]	[0.153]	[0.154]	[0.276]		
<i>LowNoDoc</i>	0.690***	0.685***	0.690***	-0.0353	-0.0352	-0.0353		
	[0.145]	[0.144]	[0.145]	[0.0382]	[0.0384]	[0.0383]		
Log likelihood	-102,677	-102,649	-102,675					
APL = <i>OwnRefiPF</i>								
	Foreclosure				Prepayment			
APL	-0.495***	-0.640***	-0.569***	-0.153***	-0.212***	-0.161***		
	[0.162]	[0.173]	[0.162]	[0.0514]	[0.0551]	[0.0522]		
APL × <i>PrepayPen</i>		0.909**			0.393**			
		[0.430]			[0.190]			
APL × <i>Balloon</i>			1.684**			0.257		
			[0.728]			[0.294]		
<i>PrepayPen</i>	0.142	0.141	0.140	-0.472***	-0.473***	-0.473***		
	[0.142]	[0.141]	[0.141]	[0.0392]	[0.0393]	[0.0393]		
<i>Balloon</i>	0.791***	0.788***	0.793***	-0.237	-0.239	-0.237		
	[0.241]	[0.241]	[0.240]	[0.153]	[0.154]	[0.154]		
<i>LowNoDoc</i>	0.691***	0.690***	0.689***	-0.0348	-0.035	-0.0349		
	[0.145]	[0.145]	[0.145]	[0.0383]	[0.0384]	[0.0384]		
Log likelihood	-102,678	-102,671	-102,675					
B. Refinance FRMs								
APL = <i>TriggerAPR</i>								
	Foreclosure				Prepayment			
APL	-0.158	-0.258*	-0.200	-0.219	0.130***	0.119***	0.110**	0.154***
	[0.136]	[0.145]	[0.140]	[0.162]	[0.0443]	[0.0459]	[0.0449]	[0.0542]
APL × <i>PrepayPen</i>		0.560*				0.087		
		[0.325]				[0.102]		

TABLE 11.—(CONTINUED)

<i>APL</i> × <i>Balloon</i>			0.515				0.271**		
			[0.458]				[0.136]		
<i>APL</i> × <i>LowNoDoc</i>				0.169				−0.0647	
				[0.254]				[0.0778]	
<i>PrepayPen</i>	0.255**	0.252*	0.254**	0.254**	−0.133***	−0.133***	−0.133***	−0.133***	
	[0.129]	[0.129]	[0.129]	[0.129]	[0.0298]	[0.0298]	[0.0298]	[0.0298]	
<i>Balloon</i>	0.640***	0.640***	0.643***	0.640***	−0.0995	−0.0995	−0.0977	−0.0996	
	[0.197]	[0.197]	[0.197]	[0.197]	[0.0881]	[0.0881]	[0.0881]	[0.0881]	
<i>LowNoDoc</i>	0.216*	0.216*	0.216*	0.216*	−0.0399	−0.0400	−0.0399	−0.0400	
	[0.111]	[0.111]	[0.111]	[0.111]	[0.0276]	[0.0276]	[0.0276]	[0.0276]	
Log likelihood	−148,179	−148,177	−148,177	−148,178					
APL = <i>TriggerPF</i>									
Foreclosure				Prepayment					
<i>APL</i>	−0.183*	−0.349***	−0.214*	−0.124	0.0968***	0.0267	0.0841**	0.113***	
	[0.111]	[0.120]	[0.113]	[0.133]	[0.0345]	[0.0354]	[0.0341]	[0.0428]	
<i>APL</i> × <i>PrepayPen</i>		0.660***				0.365***			
		[0.234]				[0.0804]			
<i>APL</i> × <i>Balloon</i>			0.535				0.248**		
			[0.379]				[0.123]		
<i>APL</i> × <i>LowNoDoc</i>				−0.147				−0.0410	
				[0.188]				[0.0561]	
<i>PrepayPen</i>	0.257**	−0.408	0.257**	0.257**	−0.133***	−0.500***	−0.133***	−0.133***	
	[0.129]	[0.270]	[0.130]	[0.129]	[0.0298]	[0.0897]	[0.0299]	[0.0298]	
<i>Balloon</i>	0.633***	0.631***	0.104	0.633***	−0.0983	−0.0991	−0.344**	−0.0984	
	[0.197]	[0.196]	[0.423]	[0.197]	[0.0880]	[0.0881]	[0.153]	[0.0881]	
<i>LowNoDoc</i>	0.214*	0.214*	0.214*	0.361*	−0.0399	−0.0400	−0.0397	0.00113	
	[0.112]	[0.111]	[0.112]	[0.216]	[0.0276]	[0.0276]	[0.0276]	[0.0601]	
Log likelihood	−148,179	−148,163	−148,176	−148,179					
APL = <i>FinancingPF</i>									
Foreclosure				Prepayment					
<i>APL</i>	−0.181	−0.303**	−0.224*	−0.179	0.0294	0.00913	0.0186	0.00374	
	[0.114]	[0.126]	[0.117]	[0.136]	[0.0327]	[0.0362]	[0.0328]	[0.0395]	
<i>APL</i> × <i>PrepayPen</i>		0.369				0.0689			
		[0.227]				[0.0682]			
<i>APL</i> × <i>Balloon</i>			0.660*				0.209*		
			[0.373]				[0.126]		
<i>APL</i> × <i>LowNoDoc</i>				−0.00592				0.0636	
				[0.194]				[0.0563]	
<i>PrepayPen</i>	0.258**	−0.113	0.257**	0.258**	−0.133***	−0.203***	−0.134***	−0.133***	
	[0.129]	[0.262]	[0.129]	[0.129]	[0.0297]	[0.0758]	[0.0297]	[0.0297]	
<i>Balloon</i>	0.634***	0.632***	−0.0196	0.634***	−0.105	−0.106	−0.312**	−0.105	
	[0.196]	[0.196]	[0.417]	[0.196]	[0.0878]	[0.0879]	[0.155]	[0.0878]	
<i>LowNoDoc</i>	0.215*	0.214*	0.215*	0.221	−0.0404	−0.0404	−0.0403	−0.104*	
	[0.111]	[0.111]	[0.111]	[0.223]	[0.0276]	[0.0276]	[0.0276]	[0.0625]	
Log likelihood	−148,185	−148,180	−148,182	−148,184					
APL = <i>PrepayDur</i>				APL = <i>PrepayAmt</i>					
Foreclosure				Prepayment				Foreclosure	Prepayment
<i>APL</i>	−0.242**	−0.374***	0.0135	−0.0593*	−0.272**	−0.427***	0.0940**	0.0375	
	[0.0953]	[0.105]	[0.0300]	[0.0335]	[0.123]	[0.136]	[0.0400]	[0.0438]	
<i>APL</i> × <i>PrepayPen</i>		0.585***		0.336***		0.633**		0.282***	
		[0.209]		[0.0728]		[0.255]		[0.0903]	
<i>PrepayPen</i>	0.256**	−0.336	−0.133***	−0.470***	0.253**	−0.385	−0.133***	−0.416***	
	[0.129]	[0.249]	[0.0296]	[0.0826]	[0.129]	[0.288]	[0.0298]	[0.0985]	
<i>Balloon</i>	0.632***	0.633***	−0.106	−0.105	0.631***	0.629***	−0.100	−0.101	
	[0.196]	[0.194]	[0.0878]	[0.0877]	[0.196]	[0.195]	[0.0880]	[0.0880]	
<i>LowNoDoc</i>	0.215*	0.217**	−0.0405	−0.0404	0.214*	0.213*	−0.0399	−0.0401	
	[0.111]	[0.110]	[0.0276]	[0.0276]	[0.111]	[0.111]	[0.0276]	[0.0277]	
Log likelihood	−148,183	−148,167			−148,180	−148,171			
APL = <i>PrepayNoPre</i>									
Foreclosure				Prepayment					
<i>APL</i>	0.270	0.300	0.204***	0.242***					
	[0.164]	[0.256]	[0.0496]	[0.0810]					
<i>APL</i> × <i>PrepayPen</i>		−0.0447		−0.0599					
		[0.308]		[0.0932]					
<i>PrepayPen</i>	0.255**	0.300	−0.133***	−0.0731					
	[0.129]	[0.335]	[0.0297]	[0.0971]					
<i>Balloon</i>	0.651***	0.651***	−0.105	−0.105					
	[0.197]	[0.197]	[0.0879]	[0.0879]					

TABLE 11.—(CONTINUED)

	APL = <i>BalloonTerm</i>				APL = <i>Verification</i>			
	Foreclosure		Prepayment		Foreclosure		Prepayment	
<i>LowNoDoc</i>	0.218*	0.218*	-0.0402	-0.0401				
	[0.111]	[0.111]	[0.0276]	[0.0276]				
Log likelihood	-148,175	-148,175						
	APL = <i>FlippingDur</i>				APL = <i>OwnRefiPF</i>			
	Foreclosure		Prepayment		Foreclosure		Prepayment	
APL	-0.0367	-0.0925	0.0745*	0.0705*	-0.174	-0.157	0.119***	0.145**
	[0.138]	[0.139]	[0.0388]	[0.0383]	[0.139]	[0.169]	[0.0458]	[0.0564]
APL× <i>Balloon</i>		1.262**		0.113				
		[0.605]		[0.197]				
APL× <i>LowNoDoc</i>						-0.0484		-0.0752
						[0.264]		[0.0827]
<i>PrepayPen</i>	0.256**	0.257**	-0.133***	-0.133***	0.255**	0.255**	-0.133***	-0.133***
	[0.129]	[0.129]	[0.0296]	[0.0297]	[0.129]	[0.129]	[0.0298]	[0.0298]
<i>Balloon</i>	0.646***	-0.610	-0.104	-0.217	0.639***	0.639***	-0.0998	-0.0999
	[0.196]	[0.633]	[0.0877]	[0.219]	[0.197]	[0.197]	[0.0881]	[0.0881]
<i>LowNoDoc</i>	0.217*	0.217*	-0.0403	-0.0402	0.215*	0.215*	-0.0399	-0.0399
	[0.111]	[0.111]	[0.0275]	[0.0275]	[0.111]	[0.112]	[0.0276]	[0.0276]
Log likelihood	-148,184	-148,182			-148,181	-148,180		
	Foreclosure		Prepayment		Foreclosure		Prepayment	
APL	-0.0831	-0.267*	-0.118	0.0164	-0.175***	0.0182		
	[0.123]	[0.141]	[0.124]	[0.0369]	[0.0437]	[0.0368]		
APL× <i>PrepayPen</i>		0.551**			0.639***			
		[0.252]			[0.0890]			
APL× <i>Balloon</i>			0.967			-0.0537		
			[0.630]			[0.210]		
<i>PrepayPen</i>	0.256**	-0.299	0.256**	-0.133***	-0.772***	-0.133***		
	[0.129]	[0.286]	[0.129]	[0.0296]	[0.0982]	[0.0296]		
<i>Balloon</i>	0.646***	0.647***	-0.319	-0.107	-0.104	-0.0537		
	[0.196]	[0.194]	[0.657]	[0.0877]	[0.0878]	[0.230]		
<i>LowNoDoc</i>	0.217*	0.218**	0.217*	-0.0405	-0.0396	-0.0405		
	[0.111]	[0.111]	[0.111]	[0.0276]	[0.0276]	[0.0275]		
Log likelihood	-148,186	-148,149	-148,185					
	Foreclosure		Prepayment		Foreclosure		Prepayment	
APL	0.107	-0.0887	0.0628	0.0522	-0.0152	0.0454		
	[0.170]	[0.192]	[0.173]	[0.0466]	[0.0510]	[0.0463]		
APL× <i>PrepayPen</i>		0.483			0.234**			
		[0.369]			[0.117]			
APL× <i>Balloon</i>			0.753			0.174		
			[0.624]			[0.227]		
<i>PrepayPen</i>	0.254**	0.256**	0.255**	-0.133***	-0.133***	-0.133***		
	[0.129]	[0.129]	[0.129]	[0.0296]	[0.0297]	[0.0297]		
<i>Balloon</i>	0.650***	0.649***	0.652***	-0.106	-0.107	-0.106		
	[0.196]	[0.196]	[0.196]	[0.0877]	[0.0878]	[0.0877]		
<i>LowNoDoc</i>	0.218**	0.217*	0.218*	-0.0405	-0.0405	-0.0405		
	[0.111]	[0.111]	[0.111]	[0.0276]	[0.0276]	[0.0276]		
Log likelihood	-148,186	-148,179	-148,185					
	C. <i>Purchase ARMs</i>							
	APL = <i>TriggerAPR</i>							
	Foreclosure		Prepayment		Foreclosure		Prepayment	
APL	0.0572	-0.0637	-0.0291	-0.317	-0.299	-0.425*		
	[0.298]	[0.318]	[0.316]	[0.217]	[0.233]	[0.219]		
APL× <i>PrepayPen</i>		0.540			-0.180			
		[0.464]			[0.349]			
APL× <i>LowNoDoc</i>			0.379			0.472		
			[0.467]			[0.342]		
<i>PrepayPen</i>	-1.483***	-1.481***	-1.481***	-1.916***	-1.914***	-1.915***		
	[0.150]	[0.150]	[0.150]	[0.137]	[0.137]	[0.137]		
<i>LowNoDoc</i>	0.327***	0.327***	0.327***	0.0308	0.0308	0.0305		
	[0.0857]	[0.0857]	[0.0857]	[0.0526]	[0.0526]	[0.0526]		
Log likelihood	-146,491	-146,489	-146,490					

TABLE 11.—(CONTINUED)

APL = <i>TriggerPF</i>								
	Foreclosure				Prepayment			
APL	-0.308**	-0.396**	-0.414***	0.172*	-0.281**	0.229**		
	[0.123]	[0.180]	[0.145]	[0.0889]	[0.143]	[0.106]		
APL× <i>PrepayPen</i>		0.0297			0.979***			
		[0.232]			[0.202]			
APL× <i>LowNoDoc</i>			0.288			-0.138		
			[0.230]			[0.161]		
<i>PrepayPen</i>	-1.471***	-1.516***	-1.472***	-1.919***	-2.926***	-1.918***		
	[0.150]	[0.286]	[0.150]	[0.138]	[0.259]	[0.138]		
<i>LowNoDoc</i>	0.319***	0.319***	0.0305	0.0322	0.0325	0.170		
	[0.0858]	[0.0858]	[0.246]	[0.0527]	[0.0528]	[0.169]		
Log likelihood	-146,483	-146,464	-146,481					
APL = <i>FinancingPF</i>								
	Foreclosure				Prepayment			
APL	-0.0479	-0.392*	-0.204	0.139	0.0181	0.130		
	[0.142]	[0.211]	[0.177]	[0.0915]	[0.147]	[0.114]		
APL× <i>PrepayPen</i>		0.686**			0.164			
		[0.268]			[0.186]			
APL× <i>LowNoDoc</i>			0.324			0.0218		
			[0.247]			[0.163]		
<i>PrepayPen</i>	-1.481***	-2.171***	-1.480***	-1.917***	-2.081***	-1.916***		
	[0.150]	[0.314]	[0.150]	[0.137]	[0.240]	[0.138]		
<i>LowNoDoc</i>	0.327***	0.328***	0.00303	0.0324	0.0326	0.0105		
	[0.0858]	[0.0859]	[0.261]	[0.0526]	[0.0526]	[0.171]		
Log likelihood	-146,491	-146,485	-146,490					
APL = <i>PrepayDur</i>				APL = <i>PrepayAmt</i>				
	Foreclosure		Prepayment		Foreclosure		Prepayment	
APL	-0.138	-0.181	-0.0789	-0.442***	-0.398***	-0.816***	0.240**	-1.001***
	[0.103]	[0.130]	[0.0764]	[0.103]	[0.147]	[0.268]	[0.110]	[0.250]
APL× <i>PrepayPen</i>		-0.0957		1.129***		0.292		1.888***
		[0.204]		[0.174]		[0.315]		[0.302]
<i>PrepayPen</i>	-1.484***	-1.394***	-1.914***	-3.076***	-1.475***	-1.793***	-1.920***	-3.856***
	[0.150]	[0.261]	[0.137]	[0.234]	[0.150]	[0.370]	[0.138]	[0.361]
<i>LowNoDoc</i>	0.325***	0.323***	0.0295	0.0321	0.320***	0.320***	0.0313	0.0322
	[0.0858]	[0.0857]	[0.0526]	[0.0528]	[0.0857]	[0.0858]	[0.0526]	[0.0529]
Log likelihood	-146,491	-146,459			-146,481	-146,446		
APL = <i>PrepayNoPre</i>				APL = <i>Verification</i>				
	Foreclosure		Prepayment		Foreclosure		Prepayment	
APL	-0.0262	0.495	-0.193*	0.178	-0.962*	-0.575	-0.306	-0.143
	[0.179]	[0.412]	[0.112]	[0.300]	[0.551]	[0.585]	[0.423]	[0.512]
APL× <i>PrepayPen</i>		-0.750		-0.450				
		[0.457]		[0.337]				
APL× <i>LowNoDoc</i>						-1.017		-0.399
						[0.882]		[0.703]
<i>PrepayPen</i>	-1.485***	-0.739	-1.918***	-1.469***	-1.485***	-1.484***	-1.916***	-1.915***
	[0.150]	[0.474]	[0.137]	[0.354]	[0.150]	[0.150]	[0.137]	[0.137]
<i>LowNoDoc</i>	0.328***	0.329***	0.0319	0.0323	0.328***	0.328***	0.0305	0.0304
	[0.0857]	[0.0858]	[0.0526]	[0.0526]	[0.0857]	[0.0857]	[0.0526]	[0.0526]
Log likelihood	-146,491	-146,488			-146,491	-146,490		
APL = <i>FlippingDur</i>				APL = <i>OwnRefiPF</i>				
	Foreclosure		Prepayment		Foreclosure		Prepayment	
APL	-0.0993	-0.131	-0.0618	-0.447***	-0.0158	-0.232	0.0732	0.102
	[0.105]	[0.134]	[0.0781]	[0.107]	[0.212]	[0.246]	[0.140]	[0.165]
APL× <i>PrepayPen</i>		-0.148		1.217***		0.775*		-0.329
		[0.212]		[0.184]		[0.458]		[0.344]
<i>PrepayPen</i>	-1.485***	-1.339***	-1.915***	-3.162***	-1.485***	-1.484***	-1.916***	-1.915***
	[0.150]	[0.267]	[0.137]	[0.241]	[0.150]	[0.150]	[0.137]	[0.138]
<i>LowNoDoc</i>	0.326***	0.323***	0.0297	0.0324	0.328***	0.328***	0.0309	0.0309
	[0.0858]	[0.0857]	[0.0526]	[0.0528]	[0.0857]	[0.0858]	[0.0526]	[0.0526]
Log likelihood	-146,492	-146,456			-146,492	-146,489		

TABLE 11.—(CONTINUED)

D.Refinance ARMs								
APL = TriggerAPR								
	Foreclosure				Prepayment			
APL	-0.204**	-0.125	-0.273***	0.0923	0.0498	0.0780		
	[0.0923]	[0.113]	[0.106]	[0.0604]	[0.0794]	[0.0683]		
APL×PrepayPen		-0.294*			0.104			
		[0.172]			[0.110]			
APL×LowNoDoc			0.218			0.0528		
			[0.164]			[0.108]		
PrepayPen	-0.995***	-0.996***	-0.996***	-1.097***	-1.099***	-1.097***		
	[0.186]	[0.186]	[0.186]	[0.141]	[0.141]	[0.141]		
LowNoDoc	0.438***	0.437***	0.438***	-0.0499	-0.0497	-0.0499		
	[0.0949]	[0.0949]	[0.0949]	[0.0527]	[0.0527]	[0.0527]		
Log likelihood	-145,694	-145,690	-145,693					
	APL = TriggerPF							
	Foreclosure				Prepayment			
APL	-0.102	0.0174	-0.211**	0.269***	0.142**	0.248***		
	[0.0830]	[0.102]	[0.0926]	[0.0533]	[0.0690]	[0.0591]		
APL×PrepayPen		-0.412***			0.329***			
		[0.144]			[0.0924]			
APL×LowNoDoc			0.347**			0.0761		
			[0.140]			[0.0889]		
PrepayPen	-0.961***	-0.550**	-0.963***	-1.080***	-1.419***	-1.081***		
	[0.183]	[0.236]	[0.183]	[0.138]	[0.171]	[0.139]		
LowNoDoc	0.440***	0.437***	0.0925	-0.0418	-0.0410	-0.118		
	[0.0946]	[0.0947]	[0.169]	[0.0524]	[0.0525]	[0.103]		
Log likelihood	-145,681	-145,662	-145,677					
	APL = FinancingPF							
	Foreclosure				Prepayment			
APL	-0.0324	0.0511	-0.110	0.134**	0.110	0.0873		
	[0.0840]	[0.106]	[0.0948]	[0.0535]	[0.0708]	[0.0596]		
APL×PrepayPen		-0.233*			0.0551			
		[0.137]			[0.0910]			
APL×LowNoDoc			0.249*			0.161*		
			[0.138]			[0.0896]		
PrepayPen	-0.981***	-0.747***	-0.981***	-1.091***	-1.148***	-1.091***		
	[0.185]	[0.233]	[0.185]	[0.140]	[0.169]	[0.140]		
LowNoDoc	0.443***	0.441***	0.194	-0.0467	-0.0469	-0.208**		
	[0.0948]	[0.0948]	[0.168]	[0.0526]	[0.0526]	[0.104]		
Log likelihood	-145,696	-145,693	-145,694					
	APL = PrepayDur				APL = PrepayAmt			
	Foreclosure		Prepayment		Foreclosure		Prepayment	
APL	-0.205***	-0.190**	0.0210	-0.186***	-0.201**	-0.0923	0.211***	0.0364
	[0.0721]	[0.0906]	[0.0477]	[0.0658]	[0.0862]	[0.110]	[0.0566]	[0.0789]
APL×PrepayPen		-0.230*		0.523***		-0.403***		0.406***
		[0.137]		[0.0931]		[0.155]		[0.103]
PrepayPen	-0.999***	-0.779***	-1.101***	-1.646***	-0.980***	-0.580**	-1.091***	-1.511***
	[0.187]	[0.238]	[0.141]	[0.177]	[0.185]	[0.247]	[0.140]	[0.180]
LowNoDoc	0.434***	0.430***	-0.0518	-0.0477	0.436***	0.433***	-0.0460	-0.0450
	[0.0950]	[0.0952]	[0.0528]	[0.0530]	[0.0948]	[0.0949]	[0.0526]	[0.0527]
Log likelihood	-145,694	-145,666			-145,683	-145,663		
	APL = PrepayNoPre				APL = Verification			
	Foreclosure		Prepayment		Foreclosure		Prepayment	
APL	-0.177	-0.293	0.0278	0.441***	-0.207**	-0.292***	0.117*	0.104
	[0.113]	[0.219]	[0.0675]	[0.165]	[0.0934]	[0.106]	[0.0613]	[0.0690]
APL×PrepayPen		0.238		-0.518***				
		[0.257]		[0.191]				
APL×LowNoDoc						0.272		0.0498
						[0.169]		[0.111]
PrepayPen	-1.008***	-1.239***	-1.101***	-0.581**	-0.991***	-0.992***	-1.095***	-1.096***
	[0.186]	[0.317]	[0.141]	[0.237]	[0.186]	[0.186]	[0.141]	[0.141]
LowNoDoc	0.443***	0.443***	-0.0518	-0.0516	0.438***	0.438***	-0.0492	-0.0493
	[0.0948]	[0.0948]	[0.0527]	[0.0527]	[0.0949]	[0.0949]	[0.0527]	[0.0527]
Log likelihood	-145,698	-145,691			-145,692	-145,691		

TABLE 11.—(CONTINUED)

	APL = <i>FlippingDur</i>				APL = <i>OwnRefiPF</i>			
	Foreclosure		Prepayment		Foreclosure		Prepayment	
APL	-0.101 [0.0997]	-0.206 [0.126]	-0.0289 [0.0652]	-0.473*** [0.0916]	0.139 [0.157]	0.0751 [0.189]	0.293*** [0.0966]	0.271** [0.116]
APL × <i>PrepayPen</i>		0.0401 [0.198]		1.152*** [0.145]		0.231 [0.353]		-0.0390 [0.214]
<i>PrepayPen</i>	-1.004*** [0.186]	-1.054*** [0.280]	-1.101*** [0.141]	-2.279*** [0.213]	-0.990*** [0.184]	-0.982*** [0.184]	-1.089*** [0.139]	-1.082*** [0.138]
<i>LowNoDoc</i>	0.441*** [0.0949]	0.440*** [0.0949]	-0.0523 [0.0527]	-0.0486 [0.0530]	0.445*** [0.0947]	0.446*** [0.0946]	-0.0489 [0.0525]	-0.0487 [0.0524]
Log likelihood	-145,700	-145,658			-145,696	-145,694		

This table presents results of multinomial logit regressions without unobserved heterogeneity based on monthly data for loans originated during 2002–2006. Specifications include the same control variables as in table 8, plus APL provision variables and their interactions with *PrepayPen*, *PrepayPenEnd*, *Balloon*, and *LowNoDoc*. Variables are defined as in tables 2 and 10. Each coefficient estimate represents the impact on the probability of a first foreclosure start or a prepayment, relative to the probability of a loan remaining active, of a one-unit change in the corresponding variable. Robust standard errors clustered by loan are in brackets. The dearth of balloon ARMs prior to 2005 required that they be excluded from ARM specifications. Significant at *10%, **5%, and ***1%.

TABLE 12.—NUMBERS OF DIFFERENCES IN COEFFICIENT ESTIMATES OF MSA-LOAN FEATURE INTERACTION TERMS IN POOLED MSA REGRESSIONS WITH APL PROVISIONS – FORECLOSURE EQUATIONS

	A. Based on Foreclosure Equation results from Table 11					
	Purchase FRMs			Refinance FRMs		
	MSA × <i>PrepayPen</i>	MSA × <i>Balloon</i>	MSA × <i>LowNoDoc</i>	MSA × <i>PrepayPen</i>	MSA × <i>Balloon</i>	MSA × <i>LowNoDoc</i>
No APL variable (table 9a)	21	13	0	8	9	0
<i>TriggerAPR</i>	21	13	0	8	9	0
<i>TriggerAPR</i> and <i>TriggerAPR</i> × <i>PrepayPen</i>	18	13	0	8	8	0
<i>TriggerAPR</i> and <i>TriggerAPR</i> × <i>Balloon</i>	21	15	0	8	8	0
<i>TriggerAPR</i> and <i>TriggerAPR</i> × <i>LowNoDoc</i>	21	13	0	8	9	0
<i>TriggerPF</i>	21	10	0	8	9	0
<i>TriggerPF</i> and <i>TriggerPF</i> × <i>PrepayPen</i>	8	13	0	0	8	0
<i>TriggerPF</i> and <i>TriggerPF</i> × <i>Balloon</i>	21	14	0	8	9	0
<i>TriggerPF</i> and <i>TriggerPF</i> × <i>LowNoDoc</i>	21	10	0	8	9	0
<i>FinancingPF</i>	21	13	0	8	9	0
<i>FinancingPF</i> and <i>FinancingPF</i> × <i>PrepayPen</i>	12	8	0	0	9	0
<i>FinancingPF</i> and <i>FinancingPF</i> × <i>Balloon</i>	5	13	0	8	6	0
<i>FinancingPF</i> and <i>FinancingPF</i> × <i>LowNoDoc</i>	21	13	0	8	9	0
<i>PrepayDur</i>	21	10	0	8	9	0
<i>PrepayDur</i> and <i>PrepayDur</i> × <i>PrepayPen</i>	8	13	0	0	9	0
<i>PrepayAmt</i>	21	13	0	8	9	0
<i>PrepayAmt</i> and <i>PrepayAmt</i> × <i>PrepayPen</i>	12	13	0	0	8	0
<i>PrepayNoPre</i>	21	13	0	8	9	0
<i>PrepayNoPre</i> and <i>PrepayNoPre</i> × <i>PrepayPen</i>	24	13	0	5	9	0
<i>BalloonTerm</i>	21	10	0	8	9	0
<i>BalloonTerm</i> and <i>BalloonTerm</i> × <i>Balloon</i>	21	10	0	8	3	0
<i>Verification</i>	21	13	0	8	9	0
<i>Verification</i> and <i>Verification</i> × <i>LowNoDoc</i>	21	13	0	8	9	0
<i>FlippingDur</i>	21	10	0	8	9	0
<i>FlippingDur</i> and <i>FlippingDur</i> × <i>PrepayPen</i>	14	13	0	0	9	0
<i>FlippingDur</i> and <i>FlippingDur</i> × <i>Balloon</i>	21	12	0	8	4	0
<i>OwnRefiPF</i>	21	13	0	8	9	0
<i>OwnRefiPF</i> and <i>OwnRefiPF</i> × <i>PrepayPen</i>	15	13	0	8	9	0
<i>OwnRefiPF</i> and <i>OwnRefiPF</i> × <i>Balloon</i>	21	15	0	8	11	0
	Purchase ARMs			Refinance ARMs		
	MSA × <i>PrepayPen</i>	MSA × <i>LowNoDoc</i>		MSA × <i>PrepayPen</i>	MSA × <i>LowNoDoc</i>	
No APL variable (table 9a)	0	0	0	0		
<i>TriggerAPR</i>	0	0	0	0		
<i>TriggerAPR</i> and <i>TriggerAPR</i> × <i>PrepayPen</i>	0	0	6	0		
<i>TriggerAPR</i> and <i>TriggerAPR</i> × <i>LowNoDoc</i>	0	0	0	0		
<i>TriggerPF</i>	0	0	0	0		
<i>TriggerPF</i> and <i>TriggerPF</i> × <i>PrepayPen</i>	0	0	12	0		
<i>TriggerPF</i> and <i>TriggerPF</i> × <i>LowNoDoc</i>	0	0	0	0		

TABLE 12.—(CONTINUED)

<i>FinancingPF</i>	0	0	0	0		
<i>FinancingPF and FinancingPF×PrepayPen</i>	0	0	5	0		
<i>FinancingPF and FinancingPF×LowNoDoc</i>	0	0	0	0		
<i>PrepayDur</i>	0	0	0	0		
<i>PrepayDur and PrepayDur×PrepayPen</i>	0	0	9	0		
<i>PrepayAmt</i>	0	0	0	0		
<i>PrepayAmt and PrepayAmt×PrepayPen</i>	0	0	19	0		
<i>PrepayNoPre</i>	0	0	0	0		
<i>PrepayNoPre and PrepayNoPre×PrepayPen</i>	3	0	0	0		
<i>Verification</i>	0	0	0	0		
<i>Verification and Verification×LowNoDoc</i>	0	0	0	0		
<i>FlippingDur</i>	0	0	0	0		
<i>FlippingDur and FlippingDur×PrepayPen</i>	0	0	0	0		
<i>OwnRefiPF</i>	0	0	0	0		
<i>OwnRefiPF and OwnRefiPF×PrepayPen</i>	0	0	0	0		
B. Based on Prepayment Equation Results from Table 11						
	Purchase FRMs			Refinance FRMs		
	<i>MSA× PrepayPen</i>	<i>MSA× Balloon</i>	<i>MSA× LowNoDoc</i>	<i>MSA× PrepayPen</i>	<i>MSA× Balloon</i>	<i>MSA× LowNoDoc</i>
No APL variable (table 9b)	0	8	15	0	0	11
<i>TriggerAPR</i>	0	8	15	0	0	12
<i>TriggerAPR and TriggerAPR×PrepayPen</i>	0	8	15	0	0	12
<i>TriggerAPR and TriggerAPR×Balloon</i>	0	10	15	0	0	12
<i>TriggerAPR and TriggerAPR×LowNoDoc</i>	0	8	13	0	0	9
<i>TriggerPF</i>	0	8	15	0	0	12
<i>TriggerPF and TriggerPF×PrepayPen</i>	0	10	15	0	0	12
<i>TriggerPF and TriggerPF×Balloon</i>	0	0	15	0	0	12
<i>TriggerPF and TriggerPF×LowNoDoc</i>	0	8	16	0	0	9
<i>FinancingPF</i>	0	8	15	0	0	12
<i>FinancingPF and FinancingPF×PrepayPen</i>	0	4	15	0	0	12
<i>FinancingPF and FinancingPF×Balloon</i>	0	7	15	0	0	12
<i>FinancingPF and FinancingPF×LowNoDoc</i>	0	8	17	0	0	13
<i>PrepayDur</i>	0	8	15	0	0	11
<i>PrepayDur and PrepayDur×PrepayPen</i>	0	9	14	0	0	12
<i>PrepayAmt</i>	0	8	15	0	0	12
<i>PrepayAmt and PrepayAmt×PrepayPen</i>	0	8	14	0	0	12
<i>PrepayNoPre</i>	0	8	15	0	0	12
<i>PrepayNoPre and PrepayNoPre×PrepayPen</i>	9	8	15	0	0	11
<i>BalloonTerm</i>	0	8	15	0	0	12
<i>BalloonTerm and BalloonTerm×Balloon</i>	0	0	15	0	0	12
<i>Verification</i>	0	8	15	0	0	12
<i>Verification and Verification×LowNoDoc</i>	0	8	15	0	0	8
<i>FlippingDur</i>	0	8	15	0	0	12
<i>FlippingDur and FlippingDur×PrepayPen</i>	0	9	14	0	0	11
<i>FlippingDur and FlippingDur×Balloon</i>	0	0	15	0	0	12
<i>OwnRefiPF</i>	0	8	15	0	0	12
<i>OwnRefiPF and OwnRefiPF×PrepayPen</i>	0	8	15	0	0	12
<i>OwnRefiPF and OwnRefiPF×Balloon</i>	0	4	15	0	0	12
	Purchase ARMs		Refinance ARMs			
	<i>MSA× PrepayPen</i>	<i>MSA× LowNoDoc</i>	<i>MSA× PrepayPen</i>	<i>MSA× LowNoDoc</i>		
No APL variable (table 9b)	0	14	0	13		
<i>TriggerAPR</i>	0	13	0	13		
<i>TriggerAPR and TriggerAPR×PrepayPen</i>	0	13	0	13		
<i>TriggerAPR and TriggerAPR×LowNoDoc</i>	0	16	0	9		
<i>TriggerPF</i>	0	13	0	12		
<i>TriggerPF and TriggerPF×PrepayPen</i>	0	13	0	12		
<i>TriggerPF and TriggerPF×LowNoDoc</i>	0	14	0	10		
<i>FinancingPF</i>	0	14	0	13		
<i>FinancingPF and FinancingPF×PrepayPen</i>	0	13	0	13		
<i>FinancingPF and FinancingPF×LowNoDoc</i>	0	11	0	4		

TABLE 12.—(CONTINUED)

<i>PrepayDur</i>	0	14	0	13
<i>PrepayDur and PrepayDur</i> × <i>PrepayPen</i>	0	13	0	12
<i>PrepayAmt</i>	0	13	0	13
<i>PrepayAmt and PrepayAmt</i> × <i>PrepayPen</i>	0	14	0	13
<i>PrepayNoPre</i>	0	14	0	13
<i>PrepayNoPre and PrepayNoPre</i> × <i>PrepayPen</i>	0	14	0	13
<i>Verification</i>	0	14	0	13
<i>Verification and Verification</i> × <i>LowNoDoc</i>	0	14	0	9
<i>FlippingDur</i>	0	14	0	13
<i>FlippingDur and FlippingDur</i> × <i>PrepayPen</i>	0	13	0	12
<i>OwnRefiPF</i>	0	14	0	12
<i>OwnRefiPF and OwnRefiPF</i> × <i>PrepayPen</i>	0	14	0	12

This table lists, for each regression from table 11, the numbers of MSA pairs that exhibit coefficient estimates for interaction variables of MSA indicators and *PrepayPen*, *Balloon*, or *LowNoDoc* such that (a) the combined estimated impacts of the loan feature variable and the MSA-loan feature interaction variable have opposite signs and (b) the MSA-loan feature interaction variables are different at the 10% level of significance or greater. These coefficient estimate differences are based on the foreclosure (prepayment) equation results from table 11. The dearth of balloon ARMs prior to 2005 required that they be excluded from ARM specifications. Significant at *10%, **5%, and ***1%.