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Residential mortgage default: Theory works and so does policy ☆

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ABSTRACT

Using a national loan level data set we examine loan default as explained by local demographic characteristics and state level legislation that regulates foreclosure procedures and predatory lending, using a hierarchical linear model. When controlling for loan and local conditions, we observe significant variation in the default rate across states, with lower default levels in states with higher temporal and financial costs to lenders. State level legislative influences provide a foundation for discussion of national level policy that further regulates predatory lending and financial institution foreclosure activities.

1. Introduction

Residential mortgage default is a complex event triggered by a host of household and socio-economic events. The recent collapse of the subprime market, coupled with the imposing downturn in the housing and broader economic markets has resulted in a rapidly expanding rate of mortgage defaults, many of which end in foreclosure and REO.[1] We know from previous literature that there are trigger events, underwriting issues, economic factors, and interest rate changes that impact the probability and timing of default (Quercia et al., 2005; Renuart, 2004; Vandell, 1995; Foster and Van Order, 1984, 1985). We further recognize that variations in state level legislation regulating predatory lending and foreclosure proceedings exist, and that both legislative directives impose varying costs and benefits that affect the value of a mortgage to the lender and borrower. We have only limited information, however, on the impact of such legislation on the propensity of a default event and the ultimate foreclosure or REO from the lender's perspective (Ambrose and Buttimer, 2000; Capozza and Thomson, 2005, 2006; Cutts and Merrill, 2008).

We do not argue that the optimal foreclosure rate is zero. While lenders, of course, predicate their loans on the probability of repayment, those lenders who would seek only to minimize either the number of bad loans, or the volume of dollars foregone due to foreclosure, would clearly forego potentially substantial profits. Still mass foreclosures can have deleterious neighborhood and national impacts, as has become apparent in the United

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[1] The phrase *real estate owned property* indicates that the property in question has been foreclosed on and taken back by the mortgage lender or trustee. Real estate owned and foreclosures are not synonymous, however an REO is the result of a foreclosure that is not cured or ends in a short sale.

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States since 2007. Policies that would reduce the numbers of foreclosures, and their external impacts, would be warmly greeted by mortgage lenders and borrowers alike.

The literature on foreclosures generally asserts that, except for workout efforts on the part of the lender, the ultimate decision to default rests with the borrower. Although we do not challenge this proposition, we do posit that the legislative costs imposed on financial institutions create an incentive for credit rationing by lenders. Underwriting is the lender's instrument in risk reduction. State policies that impose costs to financial institutions for high-cost (often categorized as predatory) lending and foreclosure processing are designed to motivate restraint on lenders. By instituting higher underwriting standards, financial institutions attempt to reduce potential costs to the overall loan portfolio. This would suggest that restrictive lending policies simply result in lenders imposing greater restraint in granting loans via the underwriting mechanism—a form of credit rationing. Lenders will attempt to mitigate the higher cost of instituting foreclosure in states that impose more stringent legislation by (1) increasing the borrowers' cost of funds (Pence, 2006) and (2) instituting differential underwriting standards with more rigid benchmarks applied to borrowers in high-cost states. We expect to observe this in a lower default rate for those high-cost states as a result of the higher acceptance threshold.

Utilizing a dataset of over 20 million loans aggregated at the zip code level, we attempt to determine the political and locational drivers of default. We rely on state level variations in the foreclosure timeline and estimated cost, as identified in Cutts and Merrill (2008), as proxies for the costs of default to the lender. We also include variables from the predatory lending literature to test their relationship to the default rate (Bostic et al., 2007). The zip code loan data and the state level variables are supplemented with static and dynamic demographic information to control for economic variations and location fixed effects.

Our modeling approach assumes that since financial institutions use the underwriting process to minimize their exposure to future defaults, state laws governing lending and the foreclosure process can affect the pricing and number of loans offered, and hence the numbers and percentages of adverse outcomes. In states where lenders absorb fewer costs associated with default, the lenders have incentives to institute more liberal underwriting practices than in higher-cost states. Because borrowers cannot self-select to avoid disparities caused by location, the borrowers in different states will face different loan requirements. In theory, public policy that seeks to reduce the potential for large scale defaults, yet maintain access to funds as provided by the market, should include provisions recognizing that (a) laws regulating the time before lenders can execute foreclosures influence the rate of foreclosures across the market; and (b) the more options and/or lower costs for borrowers to default, the greater the costs to lenders.

Increased incentives on lenders to tighten underwriting standards would be expected to influence the rate of foreclosures across the market. This conclusion rests on several assumptions. Foreclosures impose costs on lenders, and the costs can be estimated and built into the price of a mortgage. Because of differences in state laws, lenders face different foreclosure costs depending upon the state where the loan originates. Assuming lenders are rational and well-informed of the cost differentials, they will have a higher acceptance bar for borrowers in states with higher foreclosure rates relative to the price that can be legally charged for loans. This practice reduces the lender's exposure in states with higher relative foreclosure costs. In theory, lenders will accept fewer high-risk applicants in high-cost states than in low-cost states. One should therefore expect to see fewer foreclosures in states with higher costs to the lender.

In the next section, we outline the well developed literature on state legislation governing predatory lending and foreclosure proceedings. We rely on the literature to establish the role of underwriting in reducing lender cost and the loan pricing (and by default rationing) process. We follow with the modeling approach to the analysis and the data, along with a discussion of the results. The paper concludes with a summary and discussion of the implications for state policy.

2. State legislation

2.1. Predatory lending laws

One of the first legislative acts directly addressing *predatory mortgage lending* was the Federal Home Ownership and Equity Protection Act of 1994 (HOEPA) (Pub. L. 103-325, 108 Stat. 21,600).[2] HOEPA defined a class of mortgage loans that can be classified as "high-cost" if the APR on the loans exceeded the yield on a then-current Treasury Security, having a comparable maturity, by 8% points.[3] In the late 1990s, many states adopted legislation designed to reduce predatory lending. Some of these state laws are patterned on older laws that pre-dated HOEPA (An and Bostic, 2008) while North Carolina was the first state to adopt a true state "mini-HOEPA" law in 1999.[4] The effect of these statutes is a matter of debate, and prior research provides support for both supporters and critics.

Supporters of these statutes argue that regulation is needed, both to allay consumer fears about dishonest lenders and to ensure that creditors internalize the cost of any negative externalities resulting from predatory

[2] Although subprime lending and predatory lending are not synonymous, the similarities in the target borrower segment and the accompanying results in high fee and interest costs to the purchaser are telling. There is no common legal definition in the United States of predatory lending; however, there are laws against many of the specific practices commonly identified as predatory. In the strictest and legal sense of the word, predatory lending refers to secured loans, such as home or car loans, that are made by the lender with the intention that the borrower will be precluded from paying in a timely fashion, allowing the lender to seize the car or home. The phrase has been expanded to refer to deceptive or aggressive sales tactics that unduly expose ill-informed borrowers, coupled with excess fee structures, and prepayment penalties.

[3] In classifying a loan as predatory the 8% APR threshold includes the interest rate on the loan and all fees.

[4] As of 2009, well over half the states and the District of Columbia have anti-predatory lending statutes that regulate a more limited set of lending practices associated with predatory lending, such as prepayment penalties (Bostic et al., 2007). Many additional states have expanded or created lending restrictions since Bostic et al.

loans (for an overview of predatory lending from marketing to securitization see Renuart, 2004). In a study on credit flows in North Carolina (Inside B&C Lending, 2001), lenders still offered a full menu of loan products with little or no effect on loan prices. Elliehausen and Staten (2004) find that the volume of subprime mortgages originated in North Carolina relative to the control states dropped for North Carolina borrowers with annual household incomes of $50,000 or less, but rose for higher-income borrowers in that state (Bostic et al., 2007). Ernst et al. (2002) estimated that the North Carolina law saved the state's borrowers $100 million by deterring predatory loan practices, while Quercia et al. (2004) confirmed that overall subprime originations dropped in North Carolina following enactment.[5]

Li and Ernst (2006) ranked state laws according to the type of loans covered, points-and-fee triggers, substantive legal protections, and remedies available to borrowers. The authors concluded that state anti-predatory lending laws reduced the prevalence of predatory loan terms, but failed to reduce subprime loan originations (except in Georgia and New Jersey), compared with unregulated states. In addition, compared with the control states, nominal interest rates on mortgages stayed level or dropped in all states with anti-predatory lending laws except Georgia and Virginia.

Critics charge that anti-predatory lending statutes reduce the availability of credit to borrowers who previously were credit constrained, including lower-income households and minorities, by rationing credit and increasing the price of subprime loans. Ho and Pennington-Cross (2006a) find that the presence of a predatory lending law alone has little impact on loan originations, while applications and rejection rates generally decline. The punitive severity of the legislation, however, appears relevant as more aggressive legislation is correlated with a decline in originations by subprime lenders. These changes appear to occur because of changes in marketing and are consistent with subprime lenders' avoidance of loans made to higher risk borrowers that are covered under state predatory mortgage laws. In a follow up study, Ho and Pennington-Cross (2006b) used the same legal index and border area methodology to examine the effect of state anti-predatory lending laws on the cost of credit. They discover that subprime loans originated in states with anti-predatory lending legislation have lower APRs than loans in unregulated states. They also observe that increasing the strength of a law increases the deviation in the APR. A study by Ernst et al. (2002) indicated that total subprime originations fell in North Carolina in 2000, compared with other states, but the drop was relatively small. The study, however, also reported that North Carolina had 15% more subprime home loans per capita than the national average in 2000 and that low-income borrowers in North Carolina received a higher proportion of subprime to prime loans in 2000 than low-income borrowers in any other state (Bostic et al., 2007).

Two additional studies considered whether the reduction in North Carolina subprime loans, post-law, was due to supply-side or demand-side effects. Reports by Burnett et al. (2004), and Harvey and Nigro (2004) find that loan originations fell due to relative reductions in application volumes, but the probability of subprime loan denials held constant. They attributed the reduction in North Carolina originations to reduced demand, not to supply.

Another line of research sought to explain subprime performance as a function of the factors that are used to categorize mortgage lending practices as predatory. For example, Quercia et al. (2005) find that two risk factors, balloon payments and prepayment penalties, increase mortgage foreclosure risk 20–50% on refinance loans. Rose (2008), however, finds that the impacts of the examined loan features on the probability of foreclosure vary significantly across subprime refinances and home purchase mortgages.

Alexander et al. (2002) finds the risk of default to be higher for loans originated by a third party, such as a mortgage broker. The number of mortgage brokers has expanded in recent years, and the Office of Thrift Supervision has noted that mortgage brokers originate up to 80% of risky, subprime loans. A study by Harvey (2003) of HMDA data in Chicago seeks to ascertain the effect of anti-predatory lending ordinances adopted by Chicago. After enactment of the Chicago ordinance, the likelihood of subprime originations generally, and by nonbanks in particular, increased when compared to the rest of Illinois. Among other things, this suggests that subprime lending migrated from banks to nonbanks after passage of the law.[6]

In a national study Elliehausen et al. (2006a,b) report that about half of the states with strong laws had higher-than-expected originations and roughly half of those states had weaker-than expected originations. For the vast majority of laws with high combined scores for coverage and restrictions, high-cost originations fell while non-high-cost subprime originations remained the same or grew. The authors interpret these findings as evidence that lenders shifted from covered high-cost loans to uncovered loans in response to the enactment of state mini-HOEPA statutes.

An and Bostic (2008) take into account enforcement mechanisms of anti-predatory lending laws that have not previously been examined in detail. The results are consistent with the view that anti-predatory lending laws have not hampered the expansion of subprime lending and indeed may have contributed to the functioning of the market. The data show that applications for, and originations of, subprime lending are higher, and denial rates are lower in states that have stronger anti-predatory lending laws. The authors assert this relationship suggests some portion of borrowers that apply for a "high-cost" loan possess higher than anticipated credit quality. This is consistent with the view that predatory lending laws have adversely

[5] The authors also observe that the North Carolina reduction was confined to the refinance market, where loan flipping abuses are more prevalent.

[6] No conclusions can be drawn from the Philadelphia results because the study did not examine data during the brief time-period when the Philadelphia ordinance was in effect.

affected access to credit for marginal borrowers who would be served by the subprime lending market.

Provisions of anti-predatory lending laws also seem to matter, as the observed overall patterns (higher applications and originations, lower denial rates) are stronger with language providing wider coverage, greater restrictions, and stronger enforcement mechanisms. Consider Fig. 1 where the current status of loans in default is compared against that of states with and without HOEPA like legislation. The percent of loans 30 and 60 days late is higher for states with HOEPA laws in place. That relationship is reversed as the loans become delinquent at 90 days and move into foreclosure and REO status, indicating there may be some correlation between legislation and the potential for delinquent loans to cure. The effect of predatory lending practices on default rates, however, appears more complex than a superficial view would suggest and as yet is not fully resolved. The mixed results from this group of studies call into question the merit for federal legislation designed to restrict mortgage products.

2.2. Foreclosure laws

It is clear that lenders face differential loan default costs based on state legislation. As example, some control over default losses is afforded to lenders through the workout process and the use of deficiency judgments where available (Ambrose and Buttimer, 2000). In states that provide deficiency judgment the lender receives the house plus any deficiency judgment, collections, and the borrower receives the benefit of eliminating negative equity less any deficiency judgment. In 21 states, judicial foreclosure requires lenders to go through the court system to foreclose on property. Judicial foreclosure proceedings restrict lenders or trustees in their disposition of the property (Edmiston and Zalneraitis, 2007) resulting in a foreclosure process that takes, on average, five months longer than the nonjudicial alternative (Wood, 1997) and imposes more transaction costs.

Several studies have verified that the judicial requirement can significantly raise lender foreclosure costs, perhaps by as much as 10% of the loan balance (Ghent and Kudlyak, 2009). From the defaulting borrower's perspective, this requirement provides several months of free rent and protection against lender excesses. Likewise, the findings of Kahn and Yavas (1994) indicate increased legal fees and holding costs in states with a judicial foreclosure requirement. The costs, however, are not borne directly by the financial institution, as Meador (1982) and Kahn and Yavas (1994) report higher effective interest rates on mortgages in judicial states (Edmiston and Zalneraitis, 2007). Clauretie (1989) argues there is evidence that the increased transaction costs in judicial states deter financial institutions from exercising foreclosure. Pence (2006) finds that loans are 3–7% smaller in defaulter-friendly states, suggesting that legislation favoring the defaulting borrower imposes material costs on borrowers at the time of loan origination.[7]

Foreclosure costs can also vary according to the type of redemption allowed (statutory or equitable), and whether the state allows deficiency judgments. Statutory redemption refers to the period of time after a foreclosure sale during which the borrower has the right to redeem the property by paying the principal balance, accrued interest, any penalties or fees, and court costs (Clauretie and Herzog, 1990). Deficiency judgments allow the lender to attempt to recover funds that remain unpaid after the foreclosure sale. The availability of deficiency judgments has the opposite effect on default rates as foreclosure relief, such as redemption (Kahn and Yavas, 1994). Cutts and Merrill (2008) observe that the probability of successful reinstatement of defaulted loans can be reduced by 3–9% points by shortening state statutory timelines to match the national median timeline. Pennington-Cross (2003) finds that houses in judicial foreclosure states sell for 4% less than those in statutory foreclosure states, presumably due to greater depreciation during the longer foreclosure process.

Clauretie (1989) and Clauretie and Herzog (1990) look at losses to primary mortgage insurance companies in the 1980s. They conclude that because judicial procedures and a statutory right of redemption lengthen the foreclosure process, (and by default delay the liquidation of the property), losses are greater in states that require the former and grant the latter.

Regardless of the extent of underwriting and information gathering that typically occurs in the qualification of borrowers at origination, lenders still have limited ability to control the borrower's decision to default (Ambrose and Buttimer, 2000). For example, trigger events and house price volatility are virtually impossible to foresee. Further, most mortgage pricing models rely on the interaction of interest rates and property values post origination to determine the probability of borrower default (Kau and Kim, 1994; Kau et al., 1993; Foster and Van Order, 1984).[8]

The objective of the underwriting process is to minimize those costs subject to information constraints regarding the borrower and future events with the profit incentive as guidance in the decision process. It is assumed that applying for a loan is costly, so that individuals will only do so if their chance of being approved is sufficiently high (Longhofer and Peters, 2005). Borrowers decide whether to apply for a loan given their creditworthiness; and assets (the houses) are fixed in location. It is this location variation (across states) that exposes all borrowers within a state to similar levels of discrimination, as borrowers select lenders naively.[9]

Consider the case in which there are pools of applicants residing in two states; one is a low cost state for default and the other is a high cost state, with costs representing lender costs if the borrower defaults. The borrowers are applying for loans with a single financial institution that

[7] The "power of sale clause," according to Edmiston and Zalneraitis (2007) grants the lender (or trustee) the right to sell the property at auction without requiring court authority.

[8] As Ambrose and Buttimer (2000) report, numerous studies that examine time to default indicate that borrower characteristics have a limited impact in predicting borrower default after the second year from origination (von Furstenberg and Green, 1974; Williams et al., 1974).

[9] The prospect of borrowers spilling across boundaries does affect our comparison by state as we anticipate varying underwriting standards determined by the location of the asset which is fixed in space.

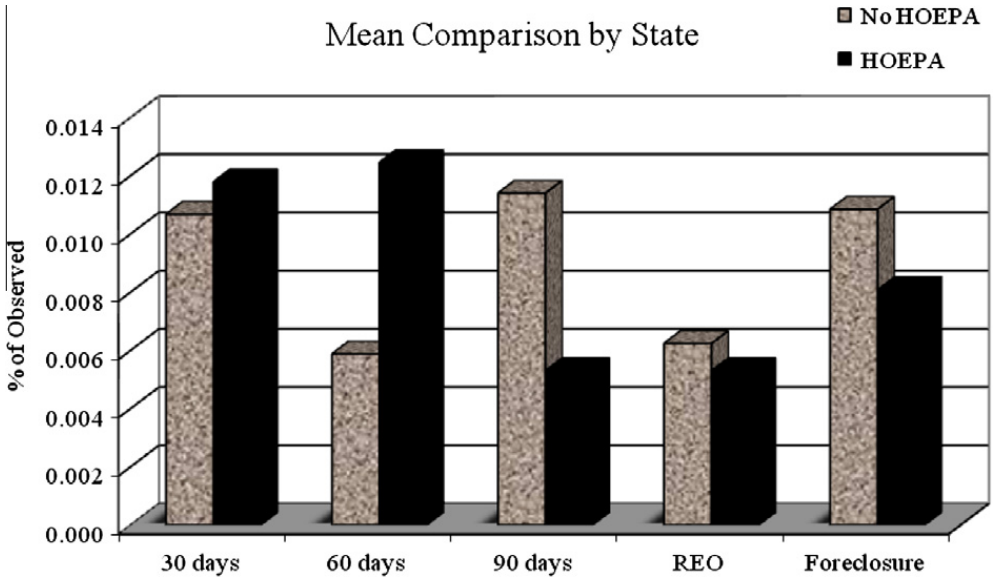

Fig. 1. Distribution of loan status by state. This figure has been created from the LPS analytics mortgage data used in the analysis. The data is divided into those states that do and do not have HOEPA legislation in place at the time of the analysis. The data is further divided into the five levels of loan distress from 30 days late through REO and foreclosure. The *y* axis represents the percent of observed loans in each of the distress categories.

services both states. The state with lower cost of default provide incentive to lenders to institute more liberal underwriting practices than for similar loans in the high cost state. Given the borrower's inability to self-select, borrowers from the two states will face different requirements.

From this set of conditions, we formulate the following hypotheses.

- The legal prescript regulating the time before lenders can execute foreclosures (Cutts and Merrill, 2008) influences the rate of foreclosures across the market.
- The more options and lower costs for borrowers to default, the greater the cost to lenders. The increased incentive on lenders to tighten underwriting standards influences the rate of foreclosures across the market.

This is particularly relevant to the period of observation (August, 2008) given the overall downward trend in the housing market. Financial institutions that proceed from foreclosure to REO incur extensive transaction and holding costs in acquiring and disposing of foreclosed properties given the time that they are on market is increasing and property values are decreasing at the end of the analysis period. In the analysis that follows we incorporate legislative controls for both predatory lending and foreclosure execution in order to gauge the impact they have on the extent of default.

3. Analysis

3.1. Establishing the models

Our analysis uses a database comprised of individual loan performance data aggregated by zip code. Default and foreclosure might be considered as either a "place" or "people" issue. In this paper, we concentrate on the *places* they occur, rather than who defaults or gets foreclosed. Housing markets have multiple geographic aspects, including neighborhood externalities, municipal tax base impacts, and real estate markets. Large parts of urban areas have been adversely affected by large-scale default and foreclosure, and as such location is an important policy issue in regulating foreclosure.[10]

We assume that each zip code observation has a set of unknown factors that contribute to mortgage selection and default, and this set of factors includes characteristics of the mortgages. The observations include both dynamic data (the number of loans in various states of default, the number of loans with prepayment penalties, and the number of loans in foreclosure); and static data (loan to value ratio, original FICO and original purchase price). To compare zip codes we convert count variables into percentages. Mean level data includes the average age of the loans, the average remaining balance, and the interest rates charged. Foreclosure rates are assumed to be given in the independent standard forms as follows:

$$y = X_f b_f + \varepsilon_f, \tag{1}$$

where y is the percent of loans in foreclosure and/or REO observed for each zip code and X is a vector of explanatory variables including loan attributes. Disturbance ε represents those unobservable characteristics of the pool of zip-code level loans that affect the foreclosure rate, and the errors are assumed to follow a normal distribution with zero mean and variance σ^2.

[10] Individual foreclosure/defaults represent an alternative level of analysis, looking at which people are foreclosed as opposed to which places have foreclosures. Although regrettably more common than in the past, even foreclosure rates of 4 or 5% present problems for the use of common logit, probit, or hazard based models. This is fertile ground for future analysis, but beyond the scope of the current analysis.

Additionally, we know that the distribution of loan types is subject to conditions endogenous to the neighborhood such as geographic targeting by mortgage venders, variations that underwriting place on borrower credibility by neighborhood, and borrowers' selection processes in purchasing a mortgage product (Pavlov and Wachter, 2006). The borrowers' selections can be influenced by information asymmetries that limit the choice set, perceived variations in transaction costs, and motivations for borrowing. Furthermore, given that households—either consciously or through socioeconomic mechanisms—sort themselves into neighborhoods comprised of households with similar characteristics, it is reasonable to expect that neighborhood composition plays a formidable role in determining the loan products offered and acquired by borrowers and consequently the inevitable probability of foreclosure (Phillips and VanderHoff, 2004). We control for the characteristics of the neighborhood by including zip code level census data.

Zip code location variables do not address all the unobserved biases embedded in the economic conditions of the local market. For this reason we include both dynamic and static data at the metropolitan level. Finally, the models include state level proxies for foreclosure and predatory lending legislation to respond to our hypothesis that higher lender costs (both fiscal and temporal) result in tighter underwriting, thereby reducing default rates.

3.2. HLR modeling

Our analysis is based on zip-code level observations that occur within MSAs and within particular states. For example, New York City and Buffalo are subject to the same state regulations, but are located almost 400 miles apart, and are subject to different MSA-level housing market conditions. Kansas City, Missouri and Kansas City, Kansas share a common border, but lie in different states. Both MSA and state level variables matter.

While metropolitan or state level indicators can be included in an ad hoc manner, depending on the problem, we borrow the analytical framework from the education, evaluation, and health care literatures. Education researchers have long recognized that students learn within groups that are nested within classrooms, nested within grades, within schools, and within school districts. The achievement, and hence behavioral coefficients, within a particular classroom may be related to the specific teacher, which may be related to attitudes or supervision at the particular school. Bryk and Raudenbush (1992) provide detailed explanation of the method, and Goodman and Thibodeau (1998) apply it to housing markets and submarkets.

We begin our discussion with a baseline set of ordinary least squares regressions to serve as a point of comparison and demarcation. Start with model

$$y_f = a_f + b_f x_f + c_f z_f + \varepsilon_f \tag{2}$$

f, subscripts refer to foreclosure variables; y_f, appropriate foreclosure indicator; x_f, variables subject to HLR; z_f, variables not subject to HLR; ε_f, error term.

An OLS formulation implicitly assumes that the relationships are constant either across metropolitan areas or across states and that the error variances are also constant.

Referring to Eq. (2), assume arbitrarily that constant a_f varies by state and slope b_f varies by MSA (which may or may not be nested within a single state).

Then, write coefficients:

$$a_f = g'_o + g'_S S + \varepsilon'_a \qquad \text{State} \tag{3}$$

$$b_f = h'_o + h'_M M + \varepsilon'_b \qquad \text{Metro} \tag{4}$$

where ε'_a are the error terms in the constant substitutions and ε'_b are the error terms in the slope substitutions.

Substituting (3) and (4) into (2),

$$y_f = g'_o + g'_S S + h'_o x_f + h'_M M x_f + c_f z_f + \varepsilon' \tag{5}$$

where $\varepsilon' = \varepsilon_f + \varepsilon'_a + \varepsilon'_b x_f$.

Referring to Eq. (2), one can assume alternatively that constant a_f varies by MSA (which again may not be nested within a single state) and slope b_f varies by state.

Similar to above:

$$a_f = g''_o + g''_M M + \varepsilon''_a \qquad \text{MSA} \tag{3'}$$

$$b_f = h''_o + h''_S S + \varepsilon''_b \qquad \text{State} \tag{4'}$$

where ε''_a are the error terms in the constant substitutions and ε''_b are the error terms in the slope substitutions.

Substituting (3′) and (4′) into (2),

$$y_f = g''_o + g''_M M + h''_o x_f + h''_s S x_f + c_f z_f + \varepsilon'' \tag{5'}$$

where $\varepsilon'' = \varepsilon_f + \varepsilon''_a + \varepsilon''_b x_f$. Eqs. (5) and (5′) are estimated using maximum likelihood methods (in SAS 9.2).[11]

3.3. Data

The loan data (from LPS Applied Analytics, Inc.) represent the servicing reports on anonymous individual loans aggregated to the five-digit zip code for the third quarter of 2008 for all 50 states and the District of Columbia. The data used in this analysis are compiled from a raw dataset sample containing over 34 million first mortgages representing nine of the top ten servicing agents.[12] The data spans over 17 years and includes comprehensive representation of all credit grades, and product types including subprime, alt-A, prime, GSE, second loans, HELOCs and portfolio loans. The zip-code level socioeconomic variables have been obtained from the United States Census Bureau from the summary tape files for the 2000 Census. Recognizing that the composition of mortgages in a neighborhood is a

[11] In principle, the nesting can combine both metropolitan and state effects, but the memory requirements of current software make this process computationally intractable.

[12] LPS Applied Analytics, LLC, is a data repository for the mortgage banking industry. The firm aggregates loan level data provided directly by servicers into a single anonymous database going back to 1990. Data from LPS is used by the Federal Reserve Board for analysis of mortgage performance. Moreover, the data is considered among the most comprehensive data sets available on performance of loans over time. The individual loan data have been provided by the Federal Reserve Bank of Richmond via an operating and use agreement between LPS Applied Analytics, Inc., the Federal Reserve Bank and Brent C Smith.

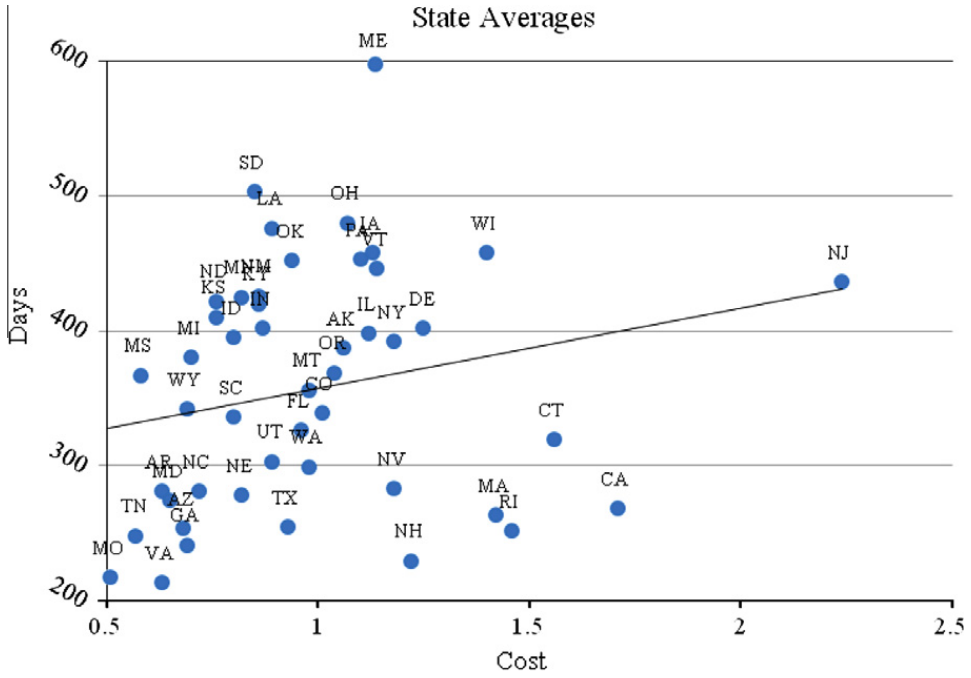

Fig. 2. Comparison of average days to foreclosure and average cost of foreclosure. This figure is created from data in Cutts and Merrill, 2008, and illustrates the distribution of the average number of days from initiation through disposition for foreclosures, and the estimated cost of foreclosure as a percent of the loan value. The upward sloping trend line indicates a positive relationship between the time and cost, but this is likely driven by clustering of the data and/or a few outliers (e.g. New Jersey). There is one cluster that includes Virginia, Georgia, and Tennessee with an average of less than 300 from initiation to foreclosure and the average cost to the lender at less than 1% of the loan value. Another cluster occurs around 420 days (Kansas and Indiana are examples), where the time and cost are closely correlated. Note, Hawaii is not included in this graph due to a lack of available data.

function of the economic and demographic characteristics of borrowers in that neighborhood, these variables allow us to control for variations both within and across zip codes. Additionally, to control for the overriding effects of the metropolitan economy on a single neighborhood, we have included MSA level controls. Incorporating this level of control requires us to restrict our observations to those zip codes located in MSAs.

To test for factors that influence the length and cost of the foreclosure process, we consider variations in state regulations on the foreclosure filings by financial institutions. Each state has unique legislation restricting the foreclosure proceeding, and the variation among states has implications for the rate at which properties progress into foreclosure. The proxies used in this case come from the Freddie Mac analysis of expected optimal statutory timeline for foreclosure presented by Cutts and Merrill (2008). From foreclosure referral through the title work, the foreclosure sale and, where applicable, the redemption period, the authors calculate expected total and actual average days from "due date of the last paid installment" to disposition.[13] Using Freddie Mac's experience with lenders, the average actual time across all states between the due date of the last paid mortgage installment and the foreclosure sale is nearly a year (355 days).

Fig. 2 illustrates the distribution of the average number of days from initiation through disposition for foreclosures, and the estimated cost of foreclosure as a percent of the loan value. Although the trend line indicates a positive relationship between the time and cost, the relationship is not particularly strong. There are two strong clusters of observations. One is a group of states (including Virginia, Georgia, and Tennessee) with the average days less than 300 and the average cost of foreclosure less than 1% of the loan value. Another cluster occurs around 420 days (Kansas and Indiana are examples), where the time and cost are closely correlated. Cutts and Merrill also provide us with the average of the incurred gross costs of foreclosure as represented by Freddie Mac's experience as an investor in conventional, conforming prime mortgages. Gross costs include all expenses incurred by the investor, including "pre-foreclosure" costs, and any losses taken on the unpaid principal balance when the property is sold.

Bostic et al. (2007) provide the information to construct variables that distinguish between states with and without HOEPA legislation. The authors distinguish between what they refer to as pre-predatory laws and mini-HOEPA laws, and their analysis suggests that newer mini-HOEPA laws influenced the subprime market above and beyond the older preexisting laws, particularly for subprime originations. We construct dichotomous variables representing those states that do (coded 1) and do not (coded 0) possess either of these two market regulations.[14] After cleaning

[13] Due date of the last paid installment (DDLPI) is the term used by Freddie Mac for the onset of a delinquency. The DDLPI is calculated as 60 days delinquency for a loan. For example, if a payment is due and paid on June 1st but the borrower fails to make a payment in July and August, the DDLPI will be 60 days counted from the June 1 due date of the last payment (Cutts and Merrill, 2008).

[14] There is overlap for 12 states where both laws are present and 13 states with neither forms of legislation at the time of this analysis. The recent trauma in the residential market has created incentives for many new recent legislative acts designed to similarly restrict lending activities.

Table 1
Summary statistics.

Variable		Mean	Standard deviation
REO	% loans reported in REO	0.009	0.012
Foreclosure	% loans reported in process	0.014	0.015
Loan and borrower			
Interest rate	Mean interest rate by zip	6.416	0.379
Refinance	% loans refinanced	0.120	0.066
LTV-ratio	Mean by zip	70.590	8.551
FICO	Mean by zip	706.451	30.431
Term remaining	Mean by zip	265.120	16.240
Interest only flag		0.067	0.067
Current balance due	Mean by zip	0.067	0.067
Political/economic/temporal controls			
Year controls 00–08			
Population black	Mean by zip	0.101	0.177
Rental rate	Mean by MSA current	565.322	227.071
Median Hse Inc.	Mean by MSA current	49,070.410	18,827.610
Median value	Mean by MSA current	147,111.600	101,962.900
GDP test	Change by MSA		
Population change	Change by MSA		
Median value change	Change by MSA		
Std Dev value change	Change by MSA		
State legislation variables			
Cost of foreclosure to investor	Ranges from 0.44 to 2.24	0.960	0.340
Days ref sale	Ranges from 33 to 312	121.280	76.430
Redemption allowed	Ranges from 0 to 180 days	20.500	49.670
Confirmation required	Ranges from 0 to 101	67.000	18.270
Total days from DDLPI to sale	Ranges from 183 to 462	297.694	81.443
Mini_HOEPA	0 or 1	0.400	0.500
Pre_HOEPA	0 or 1	0.580	0.500

and filtering the loan data, we have a dataset that includes 11,950 zip codes created from a cross sectional dataset of over 23 million individual loan records. Table 1 presents the overall summary statistics by zip code with variable definitions.

As of 2008, the time the data were gathered, the mean interest rate charged by zip code ranged from 5.45 to 8.73 with a median of 6.42, which was only moderately above the national average for conventional loans over the observation period (Federal Reserve Bank of St. Louis, 2008). The data show a range on variables that help determine the strength of borrowers' credit. The zip code aggregated average of borrowers' FICO scores ranged from 565 to 783.[15] The average loan-to-value ratio by zip code ranged from 37 to 184 as a percent of the value. This range is interesting given that it represents the range of averages for the observed zip codes. Additionally, there are zip codes in the sample where the percent of loans classified as interest only approaches 50%. The average rate of foreclosures by zip code is 1.4% although some zip codes have as much as 24% of the loans classified as in foreclosure The data also reveal that the average age of loans in this sample is short—just over two years—suggesting few if any seasoned loans in the data and thus a reasonably homogeneous dataset. Over 83% of the loans in this dataset were originated in 2003 or later.

[15] We use the reported FICO score in our analysis because it is a naïve value; scaling issues limit a reasonable alternative. The mean and minimum FICO scores have fallen for the sample between origination and the last observation.

3.4. Discussion of results

We present our findings in a sequential manner to discuss the general modeling approach (OLS and HLR) in Table 2, and then expand it to look at state level effects in Table 3. With large numbers of explanatory variables, we often look at variables in groups, singling out particular variables where the results are important or informative. Three different default settings for the dependent variable are used:

foreclosure—column a,
REO—column b, and,
both foreclosure and REO—column c, the sum of columns a and b.

We test this combined dependent variable given the cross sectional nature of our data and the fact that both foreclosure and REO represent default in different states in the process.

3.5. Metro level analysis

Both the adjusted R^2 for the OLS model and the χ^2 for the Hierarchical Linear Regression (HLR) model indicates significance in the models' ability to explain variation in the default rate, with an adjusted R^2 of 57–73% and χ^2 significance well in excess of 99%. The results for the models also indicate a general stability in the direction and significance of the coefficient estimates.

Columns (a)–(c) present the OLS results. In addition to the zip-level variables, we introduce four variables at the MSA level to address MSA-specific market conditions that

Table 2
Loan foreclosure estimates—MSA effects only.

Dependent	OLS			HLR		
	a	*b*	*c*	*d*	*e*	*f*
Variable	Foreclose	REO	Both	Foreclose	REO	Both
Intercept	**−0.1213**	**−0.1869**	**−0.3082**	**−0.1583**	**−0.1538**	**−0.3134**
	0.0124	0.0089	0.0149	0.0109	0.0091	0.0157
Mean interest rate	**0.0166**	**0.0212**	**0.0378**	**0.0206**	**0.0171**	**0.0378**
	0.0009	0.0007	0.0011	0.0011	0.0009	0.0015
Pct with prepayment penalty	**0.0631**	**0.0472**	**0.1103**	**0.0710**	**0.0680**	**0.1379**
	0.0034	0.0024	0.0041	0.0044	0.0036	0.0062
Pct no cash refinance	**0.0149**	**−0.0020**	**0.0128**	**0.0055**	**0.0044**	**0.0111**
	0.0016	0.0011	0.0019	0.0015	0.0012	0.0021
Mean LTV-ratio	**0.0003**	**0.0002**	**0.0004**	**0.0002**	**0.0002**	**0.0004**
	2.765E-05	1.976E-05	3.326E-05	0.000021	0.000018	0.000031
Mean FICO	**−8.1E-05**	**−1.5E-05**	**−9.6E-05**	**−0.00006**	**−8.7E-06**	**−0.00007**
	8.29E-06	5.92E-06	9.97E-06	6.26E-06	5.284E-06	9.18E-06
Mean months remaining	**7.59E-05**	**6.54E-05**	**0.00014**	**0.00004**	**0.00005**	**0.00009**
	1.126E-05	8.05E-06	0.00001	0.00001	0.00001	0.00001
Mean interest only flag	**0.0090**	**0.0529**	**0.0619**	**0.0407**	**0.0359**	**0.0773**
	0.0036	0.0026	0.0044	0.0029	0.0024	0.0042
Mean principal balance remaining	**1.16E-05**	**6.52E-06**	**1.81E-05**	**4.73E-06**	**−3E-06**	**1.93E-06**
	3.84E-06	2.74E-06	4.62E-06	2.67E-06	2.261E-06	3.938E-06
Pct originated in 2000	**−0.1059**	**−0.0455**	**−0.1514**	**0.0390**	**0.0271**	**0.0638**
	0.0233	0.0166	0.0280	0.0160	0.0135	0.0235
Pct originated in 2001	**0.0407**	**0.0084**	**0.0491**	**0.0311**	**0.0073**	**0.0375**
	0.0121	0.0086	0.0145	0.0085	0.0072	0.0125
Pct originated in 2002	**0.0617**	**0.0453**	**0.1070**	**0.0608**	**0.0340**	**0.0946**
	0.0082	0.0058	0.0098	0.0058	0.0049	0.0085
Pct originated in 2003	**0.0431**	**0.0831**	**0.1262**	**0.0703**	**0.0534**	**0.1232**
	0.0054	0.0038	0.0065	0.0043	0.0036	0.0062
Pct originated in 2004	**0.0198**	**0.0493**	**0.0691**	**0.0478**	**0.0330**	**0.0805**
	0.0067	0.0048	0.0080	0.0048	0.0041	0.0070
Pct originated in 2005	**0.0568**	**0.0563**	**0.1131**	**0.0656**	**0.0390**	**0.1044**
	0.0057	0.0041	0.0069	0.0041	0.0035	0.0061
Pct originated in 2006	**0.0706**	**0.0213**	**0.0919**	**0.0463**	**0.0172**	**0.0631**
	0.0055	0.0039	0.0066	0.0039	0.0033	0.0057
Pct originated in 2007	**−0.0118**	**−0.0033**	**−0.0151**	**0.0176**	**−0.0035**	**0.0133**
	0.0056	0.0040	0.0068	0.0040	0.0034	0.0059
Pct originated in 2008	**−0.0077**	**0.0392**	**0.0315**	**0.0365**	**0.0355**	**0.0711**
	0.0070	0.0050	0.0084	0.0050	0.0043	0.0074
Zip black percentage	**0.0021**	**0.0070**	**0.0090**	**0.0041**	**0.0054**	**0.0094**
	0.0007	0.0005	0.0008	0.0006	0.0005	0.0008
Zip value rent ratio	**−2.8E-06**	**4.06E-06**	**1.21E-06**	**−7.83E-07**	**1.7E-06**	**7.93E-07**
	1.55E-06	1.11E-06	1.87E-06	−1.01E-06	8.596E-07	1.498E-06
Zip median household income	**2.74E-06**	**−1.4E-05**	**−1.1E-05**	**0.00001**	**6.75E-06**	**0.000019**
	9.04E-06	6.46E-06	1.087E-05	6.30E-06	5.335E-06	9.293E-06
Zip median house value	**3.02E-06**	**−1.1E-05**	**−7.6E-06**	**4.51E-06**	**4.6E-07**	**5.04E-06**
	3.17E-06	2.27E-06	3.82E-06	2.29E-06	1.936E-06	3.376E-06
MSA level variables						
Pct change in MSA GDP	**0.0013**	**−0.0007**	**0.0006**	**0.0003**	**−0.0003**	**0.0001**
	6.266E-05	4.478E-05	0.0001	0.0001	0.0001	0.0002
Pct change in house values	**0.0070**	**0.0101**	**0.0171**	**0.0095**	**0.0073**	**0.0169**
	0.0004	0.0003055	0.0005	0.0009	0.0007	0.0012
Pct population change	**−0.0003**	**0.0001**	**−0.00020**	**0.00001**	**0.00000**	**−0.00002**
	2.298E-05	1.642E-05	0.00003	0.00005	0.00004	0.00006
Average Pct value change	**0.0013**	**−0.0004**	**0.000891**	**0.0005**	**−0.0001**	**0.0005**
	5.176E-05	3.698E-05	6.226E-05	0.0001	0.0001	0.0002
Std Dev Pct value change	**−0.0013**	**0.0002**	**−0.00117**	**−0.0005**	**0.0001**	**−0.0005**
	7.349E-05	5.252E-05	8.841E-05	0.0002	0.0001	0.0002
Interaction						
Pct zip value change*	**−0.0011**	**−0.0017**	**−0.00282**	**−0.0016**	**−0.0012**	**−0.0028**
Current interest rate	6.655E-05	4.755E-05	8.005E-05	0.0001	0.0001	0.0002
N	11950	11950	11950			
R^2	0.5701	0.6297	0.7296			
SER	0.0100	0.0071	0.0120			
Elasticity-interest rates	7.3545	14.9706	10.2816	9.1030	12.1317	10.2888
Elasticity-FICO	−4.1189	−1.2037	−2.9980	−3.0466	−0.7095	−2.1876

Table 2 (*continued*)

Dependent	OLS			HLR		
	a	*b*	*c*	*d*	*e*	*f*
Variable	Foreclose	REO	Both	Foreclose	REO	Both
Year effects						
2000				0.0175	0.0195	0.0176
2001				0.0617	0.0232	0.0458
2002				0.2985	0.2676	0.2861
2003				0.9330	1.1346	1.0070
2004				0.3969	0.4388	0.4111
2005				0.6910	0.6577	0.6768
2006				0.5186	0.3080	0.4352
2007				0.1861	−0.0598	0.0868
2008				0.1982	0.3084	0.2374

Coefficient in **bold** type; standard error in roman type.

have control for time varying effects: GDP test, population change, median value change, standard deviation value change. Although these MSA-level variables are included largely as controls, they provide some interesting impacts in that the signs (positive or negative) differ depending on whether we are measuring loan foreclosures or REO. For example, both household income and house values are positively related to foreclosure but negatively related to REO and the combined REO foreclosure variable. This is our first indication that there are different factors at the state level that influence foreclosure and the transition of foreclosed properties to REO. We calculate the elasticity of the foreclosure percent by zip code with respect to average value change. For foreclosures, the elasticity is +0.79; for REO, it is −0.41. These suggest that systematic increases in home values over previous years are positively related to foreclosures, but negatively related to REO. Other variables have similar opposite signs, and the combined percentage (foreclosures + REO) is generally an average of the two elasticities.

Consider the results of the OLS models for the interest rate and FICO scores as indicators of foreclosure probabilities. For ease of interpretation the results are converted to elasticities, which are large and significant. For column (a), the foreclosure percentage, the elasticity with respect to the interest rate is +7.35, and the elasticity with respect to the FICO score is −4.12. For column (b), the interest rate elasticity is +14.97, and the FICO elasticity is −1.20. Although there is no theoretical foundation for the sizes of the elasticities, the signs are intuitive.[16] High interest rates are related to large numbers of foreclosures; high FICO scores prevent them. Other loan characteristics included in the models also appear to have the anticipated signs and connection to default.

Anomalies in the OLS models, however, suggest that OLS is limited in its ability to explain the variations in the dependent variables. For example, the lack of significance at any level for the variable *median household income* is also interesting. This is an estimate of the real household income in 2008 dollars based on the Regional Consumer Price Index applied to each zip code. The lack of significance in this variable suggests the foreclosures observed in this dataset are not restricted to low-wealth neighborhoods as is frequently asserted. The variable indicating the percent of the population that is composed of African Americans, however, suggests there is racial dependence. The percent of the population identified as black is significant in every case, suggesting race matters in spite of the influence of legal elements. The socio-economic elements of the immediate neighborhood provide relevant explanatory power of the tendency for households to cluster in neighborhoods comprised of households with similar socio-economic characteristics and, thus, similar levels of exposure to economic transition.

Columns (d)–(f) show the impacts of the metropolitan level HLR, in which we allow the intercept and the interest rate impact to vary with the percentage change in house value. In other words, this provides a change in the impact, for each MSA. The individual MSA variables have smaller explicit impacts (because the HLR models are translating the intercept and slope variables). Nonetheless, the interest and FICO elasticities remain large and significant. Finally, because this is a "place" analysis, relating to aggregate impacts by zip code, we examine the "age profile" related to increased rates of foreclosure. As noted in the accompanying Fig. 3, compared with earlier years, the percentage of loans originated in 2003 and 2005 has the expected impact on default rates. For example, a 1% increase in the percentage of loans initiated in 2003, leads to a 1.13% increase in the percent REO and a 0.93% increase in the percent foreclosed. The timing of default is not surprising given previous research demonstrated that default occurs within the first four years of the loan tenure (Kau et al., 1992; Ambrose et al., 1997).

3.6. State effects

Interpreting multiple policy effects in theory or in practice can be challenging. Policy analysts have long realized, for example, that increasing the generosity of food stamps

[16] One might conjecture that these are changes over a small base. However, the variable values have natural meaning, and although the base rates are in fractions of a percent, of the 11,950 observations for the loan foreclosure variable, only 396, or 3.3%, have values of zero. We find that 6097 zip codes (50.9%) have rates greater than 0 but less than 0.1% and another 3094 (25.8%) have rates greater than 0.1%, but less than 0.2%. Using the median rate of 0.0092 as the reference value, rather than the mean of 0.0140, the calculated elasticity is even higher.

Table 3
Loan foreclosure estimates—state and msa effects.

	OLS			HLR		
	a	*b*	*c*	*d*[a]	*e*[b]	*f*[b]
Variable	Foreclose	REO	Both	Foreclose	REO	Both
Intercept	**0.0081**	**−0.2085**	**−0.2004**	**−0.1705**	**0.1094**	**−0.0237**
	0.0108	0.0086	0.0151	0.0499	0.0149	0.0260
Mean interest rate	**0.0009**	**0.0208**	**0.0218**	**0.0206**	**0.0165**	**0.0177**
	0.0008	0.0007	0.0012	0.0010	0.0019	0.0024
Pct with prepayment penalty	**0.0922**	**0.0549**	**0.1471**	**0.0749**	**0.0984**	**0.2003**
	0.0031	0.0024	0.0042	0.0045	0.0035	0.0061
Pct no cash refinance	**0.0005**	**0.0076**	**0.0081**	**0.0092**	**0.0036**	**0.0134**
	0.0014	0.0011	0.0019	0.0016	0.0014	0.0024
Mean LTV-ratio	**0.0001**	**0.0003**	**0.0004**	**0.00020**	**0.00027**	**0.00052**
	2.275E-05	1.798E-05	3.158E-05	0.00002	0.00002	0.00003
Mean FICO	**−9.1E-05**	**−2.2E-05**	**−0.00011**	**−0.00006**	**−3E-06**	**−0.00006**
	6.89E-06	5.45E-06	9.57E-06	6.623E-06	5.639E-06	9.917E-06
Mean months remaining	**6.77E-05**	**7.28E-05**	**0.00014**	**0.00005**	**0.00007**	**0.00012**
	9.17E-06	7.24E-06	1.273E-05	9.255E-06	7.841E-06	0.000014
Mean interest only flag	**0.02455**	**0.03817**	**0.06273**	**0.04054**	**0.02530**	**0.05853**
	0.00296	0.00234	0.00411	0.00305	0.00260	0.00458
Mean principal balance remaining	**8.96E-06**	**6.29E-06**	**1.52E-05**	**9.03E-06**	**1.94E-06**	**0.000011**
	0.0000031	2.45E-06	0.0000043	2.814E-06	2.456E-06	4.292E-06
Pct originated in 2000	**−0.0715**	**−0.0184**	**−0.0899**	**−0.0072**	**−0.0179**	**−0.0620**
	0.0188	0.0149	0.0261	0.0165	0.0142	0.0248
Pct originated in 2001	**0.0342**	**0.0514**	**0.0856**	**0.0300**	**0.0224**	**0.0496**
	0.0098	0.0077	0.0136	0.0090	0.0078	0.0137
Pct originated in 2002	**0.0342**	**0.0616**	**0.0957**	**0.0605**	**0.0520**	**0.1086**
	0.0067	0.0053	0.0093	0.0061	0.0053	0.0092
Pct originated in 2003	**0.0569**	**0.0607**	**0.1175**	**0.0736**	**0.0453**	**0.1101**
	0.0045	0.0035	0.0062	0.0045	0.0038	0.0067
Pct originated in 2004	**0.0349**	**0.0345**	**0.0693**	**0.0459**	**0.0246**	**0.0644**
	0.0054	0.0043	0.0075	0.0051	0.0043	0.0076
Pct originated in 2005	**0.0458**	**0.0644**	**0.1102**	**0.0683**	**0.0407**	**0.1057**
	0.0047	0.0037	0.0065	0.0044	0.0037	0.0066
Pct originated in 2006	**0.0536**	**0.0261**	**0.0797**	**0.0511**	**0.0229**	**0.0760**
	0.0045	0.0035	0.0062	0.0041	0.0035	0.0062
Pct originated in 2007	**−0.0039**	**−0.0033**	**−0.0072**	**0.0153**	**−0.0077**	**0.0013**
	0.0046	0.0036	0.0063	0.0042	0.0036	0.0064
Pct originated in 2008	**0.0182**	**0.0374**	**0.0555**	**0.0357**	**0.0246**	**0.0586**
	0.0057	0.0045	0.0079	0.0053	0.0046	0.0081
Zip black percentage	**0.0049**	**0.0071**	**0.0121**	**0.0046**	**0.0059**	**0.0103**
	0.0006	0.0005	0.0008	0.0006	0.0005	0.0008
Zip value rent ratio	**4.57E-07**	**4.57E-06**	**5.03E-06**	**1.1E-06**	**2.72E-06**	**4.47E-06**
	1.26E-06	9.932E-07	1.74E-06	1.068E-06	9.401E-07	1.64E-06
Zip median household income	**−2.2E-05**	**1.01E-05**	**−1.1E-05**	**0.000012**	**4.33E-06**	**0.000011**
	7.36E-06	5.81E-06	1.021E-05	6.69E-06	5.828E-06	0.00001
Zip median house value	**−1.2E-06**	**−1E-05**	**−1.1E-05**	**−5.6E-06**	**−3.1E-06**	**−9.5E-06**
	2.57E-06	2.03E-06	3.57E-06	2.324E-06	2.03E-06	3.546E-06
MSA level variables						
Pct change in MSA GDP	**0.000326**	**1.21E-06**	**0.000327**	**−0.00421**	**−0.00009**	**0.000125**
	5.398E-05	4.266E-05	7.494E-05	0.00087	0.000075	0.00017
Pct change in house values	**0.00528**	**0.00972**	**0.015**	**0.007458**	**−0.00022**	**−0.00038**
	0.0003559	0.0002813	0.0004941	0.000542	0.000047	0.000106
Pct population change	**−4.9E-05**	**1.16E-05**	**−3.7E-05**	**0.000296**	**−0.00123**	**0.000076**
	1.977E-05	1.563E-05	2.745E-05	0.000347	0.000066	0.000078
Average Pct value change	**0.000221**	**5.02E-05**	**0.000271**	**−0.00364**	**−0.00908**	**0.000213**
	4.541E-05	3.588E-05	6.303E-05	0.000808	0.002585	0.000231
Std Dev Pct value change	**−0.00042**	**−0.00013**	**−0.00055**	**0.000031**	**−0.01991**	**−0.0002**
	6.234E-05	4.926E-05	8.654E-05	0.001288	0.002494	0.000298
State level variables						
Cost of foreclosure to investor	**−0.00043**	**0.00381**	**0.00339**	**0.006453**	**0.000051**	**−0.0911**
	0.000378	0.0002987	0.0005247	0.01695	0.000034	0.008355
Days_ref_sale	**−0.00053**	**6.94E-05**	**−0.00046**	**−0.00118**	**−0.00007**	**0.00003**
	1.615E-05	1.277E-05	2.242E-05	0.00027	0.0001	0.000122
Redemption	**6.79E-05**	**−2.4E-05**	**4.35E-05**	**−0.00066**	**7.07E-07**	**−0.00004**
	4.43E-06	0.0000035	6.15E-06	0.000247	0.000129	0.000102
Confirmation	**0.000186**	**−9.3E-05**	**9.27E-05**	**−0.00101**	**−0.06353**	**−0.00114**
	3.98E-06	3.14E-06	5.52E-06	0.000237	0.004786	0.000093
Total days	**−7.6E-05**	**7.78E-05**	**1.93E-06**	**0.000772**	**0.001353**	**−0.000440**
	0.0000053	4.19E-06	7.36E-06	0.000261	0.000070	0.000115

Table 3 (*continued*)

	OLS			HLR		
	a	*b*	*c*	*d*[a]	*e*[b]	*f*[b]
Variable	Foreclose	REO	Both	Foreclose	REO	Both
Mini_HOEPA (1 = yes; 0 otherwise)	**0.00149**	**0.00126**	**0.00274**	**−0.022660**	**0.000517**	**−0.031390**
	0.0001959	0.0001548	0.0002719	0.008338	0.000058	0.004426
Pre_HOEPA	**−0.00182**	**−0.00011**	**−0.00193**	**−0.002640**	**0.000577**	**−0.035710**
	0.000177	0.0001399	0.0002458	0.008425	0.000053	0.004286
Interaction variables						
Pct zip value change*	**−0.00077**	**−0.00164**	**−0.00242**	**−0.001620**		
Current interest rate	5.513E-05	4.356E-05	7.653E-05	0.000108		
Days_ref_sale*	**0.000102**	**−2.6E-05**	**7.63E-05**		**−0.000020**	**0.000088**
Current interest rate	2.48E-06	1.96E-06	3.44E-06		0.000012	0.000014
Pct zip value change*	**−8.1E-07**	**4.4E-07**	**−3.7E-07**			
Days_ref_sale*	5.72E-08	4.52E-08	7.941E-08			
Current interest rate						
N	11950	11,950	11,950			
R^2	0.7229	0.7081	0.7679			
SER	0.0080	0.00633	0.01112			
Elasticity-interest rates	6.3293	12.2646	8.6101	9.0661	10.2403	8.2531
Elasticity-FICO	−4.6074	−1.7579	−3.5117	−3.0466	−0.2430	−1.8751
Elasticity-redemption	0.0872	−0.0501	0.0895	−0.8474	1.0624	−0.0316
Elasticity-confirmation	0.1309	−0.1051	0.1044	−0.7108	0.6500	−0.4938
Year effects						
2000				−0.0032	−0.0129	−0.0171
2001				0.0595	0.0710	0.0605
2002				0.2971	0.4090	0.3283
2003				0.9775	0.9629	0.8999
2004				0.3811	0.3273	0.3291
2005				0.7199	0.6861	0.6853
2006				0.5722	0.4110	0.5241
2007				0.1621	−0.1310	0.0083
2008				0.1938	0.2137	0.1957

Coefficient in **bold** type; standard error in roman type.
[a] Current interest rate effect varies at the MSA level; constant varies at the state level.
[b] Current interest rate effect varies at the state level; constant varies at the MSA level.

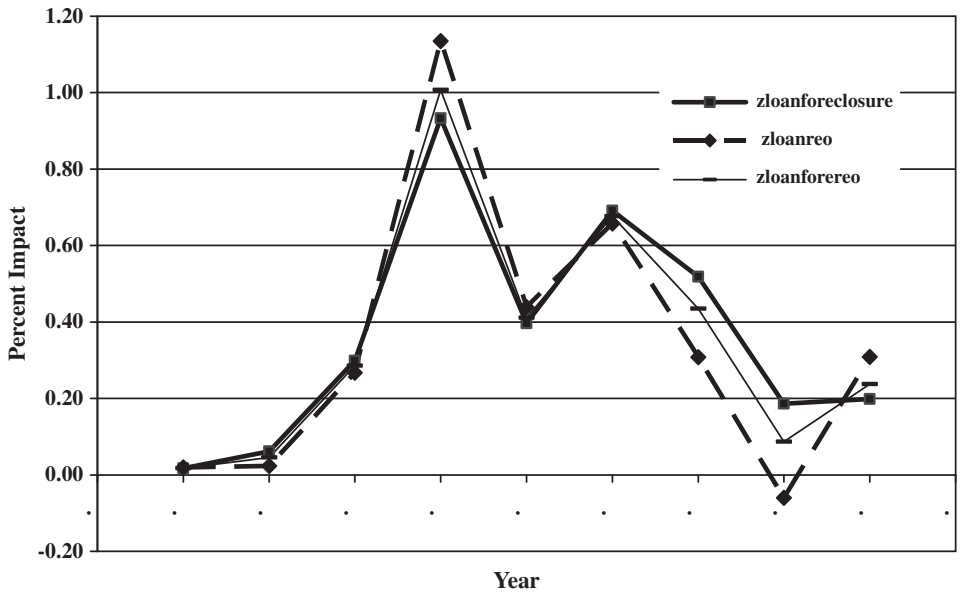

Fig. 3. Year elasticities by type of loan—metro only. This figure presents the elasticity of the dependent variable(s) (loan is in REO and/or foreclosure). The percentage of loans originated in 2003 and 2005 has the expected impact on default rates. For example, a 1% increase in the percentage of loans initiated in 2003, leads to a 1.13% increase in the variable loanreo and a 0.93% increase in the variable loanforeclosure. The timing of default is not surprising given previous research demonstrated that default occurs within the first four years of the loan tenure. The drop in 2004 is likely a result of increased refinancing activity.

might adversely affect the impacts of housing subsidies if the imputed income from the food stamps reduces or eliminates household eligibility for the housing subsidies. In our case, pre_HOEPA and mini_HOEPA are not exclusive—12 states (including California) have both—so that their joint impacts may be ambiguous. If increased costs in the past have led somehow to "better" loans then the variables measuring "days to foreclosure" may have smaller impacts than otherwise because the overall quality of the loans is better.

Table 3 incorporates the vector of seven state level variables at the OLS level (equations a–c) and at the HLR level (equations d–f). In all estimates, elements in the group as a whole are significant, and in most cases, the single variables are significant at the 1% level. In brief, the elasticities with respect to interest rate and FICO are the same signs and similar magnitudes as Table 2. In the OLS estimates, the addition of the seven variables improves the fit as measured by R^2 and $\bar{R}^2$ at nearly 73%, as well smaller standard errors of estimate and appropriately significant analysis of covariance *F*-tests (for OLS) and χ^2 tests (for HLR).

Although the coefficient values vary from those reported in the Table 2 models the direction and significance of relationship is generally consistent. The HLR estimates support the use of the enriched procedures. Consider the variables *redemption* and *confirmation* provided at the state level. Using OLS, their impacts (although statistically significant) are small. However, looking at the HLR analysis for foreclosures (column d), the redemption and confirmation elasticities are −0.85 and −0.71, respectively, whereas the comparable elasticities for REO are +1.06 and +0.65, respectively. In the combined estimate (column f), the combined elasticities are rough averages of (c) and (d), suggesting a substantive aggregation bias. In other words, with respect to state laws and practices, it is essential to disaggregate foreclosure and REO because there are different incentives in the borrower's decision to default, and the lender/servicer proceeding from foreclosure to REO.

Looking at those state variables of interest, five variables represent lender/investor foreclosure costs. The variables "cost of foreclosure to investor" (transaction and holding costs during the foreclosure period) "days_ref_sale" (total days from foreclosure to referral of sale) and "total_days" (total days from DDLPI to finalized sale including post-sale redemption period) are values presented in Cutts and Merrill (2008) and derived from Freddie Mac internal data. The variables "redemption" and "confirmation" have been obtained from published estimates from Realtytrac.com and All-foreclosures.com, respectively. In states with a redemption period, the borrower has the right to occupy the property and may reclaim title and possession by paying the outstanding debt until the redemption period expires or until the borrower voluntarily vacates the property. Clauretie (1989) suggests a redemption period lengthens the foreclosure process, thereby increasing possible losses. In states with a confirmation period, the court is charged with reviewing the sale of foreclosed property to ensure that a "fair" price has been paid and that the sale represents an arms length transaction. A confirmation period further extends the foreclosure process by protecting the borrower. Typically, the new owner of the property cannot market the home for sale until the confirmation has elapsed. As constructed, all five variables increase the cost of foreclosure to the lender. Our hypothesis is that higher costs encourage discrimination in lending through the underwriting process, thereby reducing the number of higher risk loans. Thus, we expect

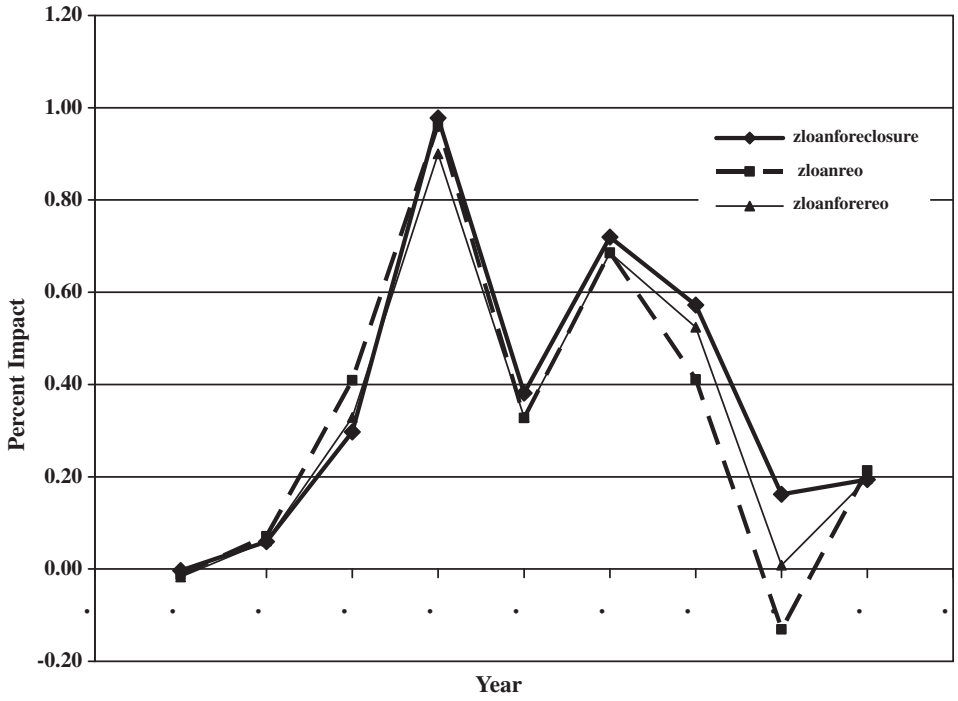

Fig. 4. Year elasticities by type of loan—state and metro. The trends in this figure are similar to those in Fig. 3. This suggests reasonable consistency across the two political hierarchies (metropolitan area and state).

to see fewer foreclosures as costs increase. Although not entirely consistent across the model runs, there is clearly a strong association between lower foreclosures and higher costs. Many of the coefficient estimates are negative, or are insignificant.

Two variables represent legislation defined as obstructing predatory lending practices, identified as "mini_HOEPA" and "pre_HOEPA." Both come from Bostic et al. (2007). Predatory lending laws seek to reduce unscrupulous underwriting. One outcome of relaxed underwriting standards is equity stripping, as periodic resets force borrowers into perpetual refinancing sequences incurring transaction costs and lender fees. The prepayment penalty frequently associated with many predatory loans further burdens borrowers by locking borrowers into a higher interest rate for a fixed period. As we have previously noted, legislation that is more stringent, or constructed in a similar fashion to the HOEPA legislation, has been shown to have a greater impact in reducing predatory lending practices than legislation devised prior to HOEPA (pre_HOEPA).

The coefficient estimates for the variable "mini_HOEPA" offer conflicting conclusions. The coefficients for the HLR models are consistent with expectations, reducing the level of foreclosures. The OLS coefficients, however, are all significantly positively related to foreclosures. The variable "pre_HOEPA" offers a more convincing conclusion with all the significant coefficients negatively related to the percent of foreclosures.

As with the simpler OLS analysis, once again loan vintage matters. Fig. 4 compares the outcomes for loans originating with the year 2000, and again the major impacts involve the percentage of loans originated in 2003 and 2005. For example, a 1% increase in the percentage of loans initiated in 2003, leads to a 0.96% increase in REO and a 0.97% increase in foreclosure. Consistent with the previous models, the two origination years most related to these rates are 2003 and 2005. This is likely an artifact of loan seasoning, as most "bad" loans originated prior to 2003 have dropped out, and, at the time the data were collected, loans originated after 2005 were entering the period of likely foreclosure.

4. Conclusion

It is increasingly clear that over the observation period many factors (e.g. stagnant home prices, rising interest rates, lax underwriting, predatory lending, fraud, lack of borrower due diligence, and underlying economic factors in some regions) combined to create an environment in which some homeowners found themselves in negative equity positions, while other homeowners were trapped in loans they could not afford to keep current or refinance. Many of these borrowers acquired their homes with unconventional mortgage loans. While we reiterate that a zero default rate is not necessarily desirable, the unprecedented high rates (at least since the 1930s) seen in our data almost certainly would have been reduced by closer attention to

- the types of loans made available (interest rates and interest terms),
- borrower characteristics (particularly FICO scores),
- the profit incentive of the mortgage lenders as it affects access to credit, and
- appropriate state legislation that regulates mortgage products.

Opponents of increased regulation of the subprime market may argue that amplified restrictions will result in higher costs and reduced access to credit for many borrowers. However, Immergluck and Smith (2005) argue that the social costs of foreclosure outweigh lower borrowing costs. Foreclosures may have spillover effects in terms of value loss, tax base erosion, instability in retirement wealth for middle income households, and ultimately the economic stability of local communities. The results from our analysis suggest that, holding a large number of important zipcode and MSA level variables constant, state level legislation is linked to the rate of default and provides a foundation for discussion of a national level policy that might regulate predatory lending and financial institution foreclosure activities. This is one of many proposed directives for addressing the current (2010) mortgage challenges and future borrower lender interaction during potential default. The elasticity of foreclosures is influenced by those factors illustrated in prior literature to be important in explaining the probability of default as well as the timing of loan origination and the legislative variables of interest.

Our results suggest that higher lender costs for foreclosure and stringent controls on predatory lending are connected to lower foreclosure rates. As we noted earlier, high interest rates are related to large numbers of foreclosures; high FICO scores prevent them. A lack of servicing incentives further exacerbates the probability of foreclosure of troubled loans, and such incentives can be built into the origination process (Cordell et al., 2008).

Caution is warranted in interpreting these results. Cutts and Merrill (2008) warn that longer foreclosure timelines alter the cost/benefit relationship for the borrower's decision to default by creating opportunities for borrowers to occupy the house free of rent during the foreclosure process. Alternatively, states with short timelines to foreclosure reduce the incentive for lenders to conduct workouts in an attempt to cure loans and reduce costs. Nonetheless, our zip code level analysis shows that during a period of unprecedented financial turmoil in the housing markets, sets of widely varying state level housing laws had plausible and expected impacts. Theory works ... and so does policy.

References

Alexander, W.P., Grimshaw, S.D., McQueen, G.R., Slade, B.A., 2002. Some loans are more equal than others: third-party originations and defaults in the subprime mortgage industry. Real Estate Economics 30 (4), 667–697.

Ambrose, B.W., Buttimer, R.J., 2000. Embedded options in the mortgage contract. Journal of Real Estate Finance and Economics 21 (2), 95–111.

Ambrose, B.W., Buttimer Jr., R.J., Capone, Charles, 1997. Pricing mortgage default and foreclosure delay. Journal of Money Credit and Banking 29 (3), 314–325.

An, X., Bostic, R.W., 2008. GSE activity, FHA feedback, and implications for the efficacy of the affordable housing goals. Journal of Real Estate Finance and Economics 36 (2), 207–231.
Bostic, R.W., Engel, K.C., McCoy, P.A., Pennington-Cross, A., Wachter, S.M., 2007. State and local anti-predatory lending laws: the effect of legal enforcement mechanisms. Journal of Economics and Business 60 (1–2), 47–66.
Bryk, A.S., Raudenbush, S.W., 1992. Hierarchical Linear Models: Applications and Data Analysis Methods. Sage, Newbury Park.
Burnett, K., Finkel, M., Kaul, B., 2004. Mortgage Lending in North Carolina After the Anti-predatory Lending Law. Cambridge, MA, Abt Associates, Inc.
Capozza, D.R., Thomson, T.A., 2006. Subprime transitions: lingering or malingering in default? Journal of Real Estate Finance and Economics 33 (3), 241–258.
Capozza, D.R., Thomson, T.A., 2005. Optimal stopping and losses on subprime mortgages. Journal of Real Estate Finance and Economics 30 (2), 115–131.
Clauretie, T.M., 1989. State foreclosure laws, risk shifting, and the PMI industry. Journal of Risk and Insurance 56 (3), 544–554.
Clauretie, T.M., Herzog, T., 1990. The effect of state foreclosure laws on loan losses: evidence from the mortgage insurance industry. Journal of Money, Credit and Banking 22 (2), 221–233.
Cordell, L., Dynan, K., Lehnert, A., Liang, N., Mauskopf, E., 2008. The Incentives of Mortgage Servicers: Myths and Realities, Federal Reserve Board Finance and Economics Discussion Series: 2008, 46.
Cutts, A.C., Merrill, W.A., 2008. Interventions in mortgage default: policies and practices to prevent home loss and lower costs. In: Retsinas, Nicolas P., Belsky, Eric S. (Eds.), Borrowing to Live: Consumer and Mortgage Credit Revisited. Brookings Institution Press, Washington, DC, pp. 203–254.
Edmiston, K.D., Zalneraitis, R., 2007. Rising Foreclosures in the United States: The Perfect Storm. Economic Review-Federal Reserve Bank of Kansas City.
Elliehausen, G., Staten, M.E., 2004. Regulation of subprime mortgage products: an analysis of North Carolina's predatory lending law. Journal of Real Estate Finance and Economics 29 (4), 411–433.
Elliehausen, G., Staten, M.E., Steinbuks, J., 2006a. The Effects of State Predatory Lending Laws on the Availability of Subprime Mortgage Credit. Monograph #38 of the Georgetown University Credit Research Center, March.
Elliehausen, G., Staten, M.E., Steinbuks, J., 2006b. The Effect of Prepayment Penalties on the Pricing of Subprime Mortgage. Working Paper of the George Washington University Credit Research Center, September.
Ernst, K., Farris, J., Stein, E., 2002. North Carolina's Subprime Home Loan Market After Predatory Lending Reform. Durham, NC, Center for Responsible Lending, August.
Federal Home Ownership and Equity Protection Act of 1994 (HOEPA). (Pub. L. 103-325, 108 Stat. 21600).
Federal Reserve Bank of St. Louis, 2008. Mortgage Interest Rates.
Foster, C., Van Order, R., 1984. An option-based model of mortgage default. Housing Finance Review 3 (4), 351–372.
Foster, C., Van Order, R., 1985. FHA terminations: a prelude to rational mortgage pricing. Real Estate Economics 13 (3), 273–291.
Ghent, A.C., Kudlyak, M., 2009. Recourse and Residential Mortgage Default: Theory and Evidence from US States, July 10. Federal Reserve Bank of Richmond Working Paper No. 09-10.
Goodman, A.C., Thibodeau, T.G., 1998. Housing market segmentation. Journal of Housing Economics 7 (2), 121–143.
Harvey, K.D., 2003. How do predatory lending laws influence mortgage lending in urban areas? A tale of two cities. Journal of Real Estate Research 25 (4), 479–508.
Harvey, K.D., Nigro, P.J., 2004. Do predatory lending laws influence mortgage lending? An analysis of the North Carolina predatory lending law. Journal of Real Estate Finance and Economics 29 (4), 435–456.
Ho, G., Pennington-Cross, A., 2006a. The impact of local predatory lending laws on the flow of subprime credit. Journal of Urban Economics 60 (2), 210–228.
Ho, G., Pennington-Cross, A., 2006b. The Termination of Subprime Hybrid and Fixed Rate Mortgages. FRB of St. Louis Working Paper No. 2006-042A.
Immergluck, D., Smith, G., 2005. Measuring the effect of subprime lending on neighborhood foreclosures: evidence from Chicago. Urban Affairs Review 40 (3), 240–362.
Inside B&C Lending, 2001. Lenders Will Try to Pin Down Effects of NC Mortgage Law. March 5.
Kahn, C.M., Yavas, A., 1994. The economic role of foreclosures. Journal of Real Estate Finance 8 (1), 35–51.
Kau, J.B., Keenan, D.C., Kim, T., 1993. Transaction costs, suboptimal termination, and default probabilities. Real Estate Economics 21 (3), 247–264.
Kau, J.B., Keenan, D.C., Muller III, W.J., Epperson, J.F., 1992. A generalized valuation model for fixed-rate residential mortgages. Journal of Money, Credit & Banking 24 (3), 279–299.
Kau, J.B., Kim, T., 1994. Waiting to default: the value of delay. Real Estate Economics 22 (3), 539–551.
Li, W., Ernst, K., 2006. The Best Value in the Subprime Market. February 23, Durham, NC, Center for Responsible Lending.
Longhofer, S.D., Peters, S.R., 2005. Self-selection and discrimination in credit markets. Real Estate Economics 33 (2), 237–268.
Meador, M., 1982. The effect of mortgage laws on home mortgage rates. Journal of Economics and Business 34 (2), 143–148.
Pavlov, A.D., Wachter, S.M., 2006. Underpriced Lending and Real Estate Markets. University of Pennsylvania Wharton School Working Paper, December.
Pence, K.M., 2006. Foreclosing on opportunity: state laws and mortgage credit. Review of Economics and Statistics 88 (1), 177–182.
Pennington-Cross, A., 2003. Credit history and the performance of prime and nonprime mortgages. Journal of Real Estate Finance and Economics 27 (3), 279–301.
Phillips, R.A., VanderHoff, J.H., 2004. The conditional probability of foreclosure: an empirical analysis of conventional mortgage loan defaults. Real Estate Economics 32 (4), 571–587.
Quercia, R.G., Stegman, M.A., Davis, W.R., 2004. Assessing the impact of North Carolina's predatory lending law. Housing Policy Debate 15 (3), 573–601.
Quercia, R.G., Stegman, M.A., Davis, W.R., 2005. The Impact of Predatory Loan Terms on Subprime Foreclosures: The Special Case of Prepayment Penalties and Balloon Payments. Center for Community Capitalism at the University of North Carolina at Chapel Hill. January 25, 2005.
Renuart, E., 2004. An overview of the predatory mortgage lending process. Housing Policy Debate 15 (3), 467–502.
Rose, M.J., 2008. Predatory lending practices and suprime foreclosures: distinguishing impacts by loan category. Journal of Economics and Business 60 (1–2), 13–32.
Vandell, K.D., 1995. How ruthless is mortgage default? a review and synthesis of the evidence. Journal of Housing Research 6 (2), 245–264.
Von Furstenberg, G., Green, R.J., 1974. Home mortgages delinquency: a cohort analysis. Journal of Finance 29, 1545–1548.
Williams, A.O., Beranek, W., Kenkel, J., 1974. Default risk in urban mortgages: a Pittsburgh prototype analysis. Real Estate Economics 2, 101–112.
Wood, C., 1997. The Impact of Mortgage Foreclosure Laws on Secondary Market Loan Loses, Cornell University Dissertation.