J Real Estate Finan Econ (2012) 45:569–587
DOI 10.1007/s11146-010-9281-0

Risk versus Demographics in Subprime Mortgage Lending: Evidence from Three Connecticut Cities

Sara T. DeLoughy

Published online: 25 September 2010

Abstract This paper analyzes patterns in subprime residential mortgage lending using 2006 Home Mortgage Act Disclosure data for the cities of Bridgeport, New Haven and Waterbury, Connecticut. The analysis applies models presented in earlier research and has the objective of assessing the relative importance of demographic versus risk factors in subprime mortgage lending decisions. Regression equations are estimated for census tracts and individual borrowers and include demographic variables and property risk measures. The results find race and ethnicity to be significant determinants of subprime lending in the borrower equations that include the full set of risk measures. Neighborhood educational levels are found to have an inverse and often significant association with subprime mortgage loans. Property risk measures present mixed results regarding their significance in subprime lending, suggesting that risk may have played less of a role in loan originations in 2006 than it did in earlier studies.

Keywords Subprime mortgages · Mortgage lending and race · Mortgage lending and neighborhoods

Introduction

This paper analyzes patterns in subprime residential mortgage lending for the cities of Bridgeport, New Haven and Waterbury, Connecticut. These three cities have the highest number of active subprime loans in the state, collectively accounting for slightly less than 20% of all outstanding subprime mortgage loans in 2007[1] The suggestion by Calem et al. (2004a) that future researchers extend their work to other cities in other geographic regions served as the inspiration for this research. The models follow their specifications, to the extent permitted by the data, and their

[1]Pitkin, et.al. *Sub-Prime Mortgage Task Force Final Report*. Based on Loan Performance Data. The percent of all loans that are subprime in CT is 12.7, which is below the national average of 14%. Almost 30% of CT subprime mortgages were due to reset between 2007 and 2009.

S. T. DeLoughy (✉)
Western Connecticut State University, 181 White Street, Danbury, CT 06810, USA
e-mail: deloughys@wcsu.edu

objective of gaining some insights into the relative importance of demographic and risk factors in the origination of subprime mortgage loans. Subprime loans are more costly to borrowers than prime mortgage loans; therefore, subprime loan originations ought to be associated with higher risk factors that would justify the higher costs and provide lenders with appropriate rates of return. If race and ethnicity are found to be determinants of subprime lending, even after controlling for the lender's exposure to risk, the data are then consistent with the notion that certain populations may be targeted for these loans irrespective of the associated risks.

The analysis is based on 2006 Home Mortgage Disclosure Act (HMDA) data, supplemented by risk measures derived from the 2000 Census, and a private data source. For each city, subprime lending patterns are examined separately for home purchase and refinance loans at both the census tract level and the individual borrower level. The dependent variable in the tract-level regression equations is the percentage of loans that are subprime, while the dependent variable in [1]the borrower-level logit models is a binary variable indicating whether or not the loan was subprime. The independent variables include demographic characteristics and risk measures for both census tracts and individual borrowers. As noted by previous researchers, the lack of a measure of individual applicant credit worthiness is a major limitation of the use of HMDA data in these types of studies. Unfortunately, this limitation remains in this study despite efforts to obtain alternative data to compensate for it. The measures of risk that are constructed from available data serve only as proxies for the real risks faced by subprime mortgage lenders. Therefore, any conclusions drawn regarding the roles of demographic and risk factors in subprime lending decisions in this paper must be regarded with caution.

The findings of this research suggest that risk played less of a role in subprime lending decisions in these three cities in 2006 than it did in other cities that were the subject of earlier research. The risk measures are often insignificant and without the predicted effect in both the borrower-level and census tract-level equations. When risk measures are significant, they exhibit little consistency across models. Race and ethnicity variables produce mixed results in the tract-level equations, but are generally significant and positively related to subprime lending in the borrower-level models, even with the inclusion of the full set of independent variables. The inconsistency of the results for neighborhood risk and demographic measures across towns were combined with some consistency within towns, suggesting that the roles of risk, race and ethnicity may differ by market. Like earlier studies, this study finds a significant role for the level of education in census tracts, with higher levels of education being associated with lower levels of subprime lending.

The next section of this paper presents a brief review of previous studies on the roles of demographic and risk factors in subprime lending. The following section describes the data and the models used for this analysis. The last sections present the results and conclusions.

Previous Studies

Numerous studies examining patterns in subprime lending have found these loans to be prevalent among minority borrowers, particularly African Americans. The issue

in these analyses is the extent to which the models control for risk while examining the association between subprime lending and minority populations. The Department of Housing and Urban Development (2000) published a number of reports, based on 1998 HMDA Data, on subprime lending trends in five major U.S. cities. These reports document not only the strong growth in subprime mortgage lending between 1993 and 1998, but also the disproportionate impact of these loans on minority and low-income neighborhoods. Canner et al. (1999), in their study of HMDA data from 1993 to 1998 also find evidence of subprime loan concentrations in black neighborhoods, and of the growth in subprime lending occurring through loans to low-income and minority households. Immergluck and Wiles (1999) and Immergluck (2000) document similar results in studies of lending patterns for Chicago. ACORN published comparable findings in its 2004 report on predatory lending. None of these studies, however, included controls for risk factors.

Scheessele (2002) in his analysis of national and metropolitan area HMDA data between 1995 and 2000 presents extensive descriptive statistics exposing the disproportionate impact of subprime loans on minority and low-income borrowers. He then constructs a regression model of subprime refinance lending that shows the African–American composition of a neighborhood to be a significant factor in determining the subprime share of refinance loans in that neighborhood. Scheessele's study controls for a number of neighborhood risk factors, including median home age, percent of owner-occupied homes and share of households receiving public assistance.

Calem et al. (2004a) build census tract-level and loan-level models of subprime refinance and purchase lending for the cities of Philadelphia and Chicago. The models are distinguished by their controls for a range of individual borrower and neighborhood characteristics, particularly the inclusion of tract-level risk measures based on residents' credit scores. The results are fairly consistent for both cities and show higher risk levels to be positively associated with subprime lending. However, the presence of African–Americans, either as homeowners in the tract-level models, or as borrowers in the borrower-level models, is found to be directly related to subprime lending, even after controlling for risk, income and level of education. Both higher incomes and educational levels are found to be generally inversely related to subprime lending. This research is extended in Calem et al. (2004b) wherein the authors present a more detailed analysis of subprime mortgage lending for seven major U.S. cities. The analysis is conducted at the borrower level for 2 years of data, 1997 and 2002, and tests for any effect arising from the interaction between individual borrower and neighborhood characteristics. In the models without interaction terms, the results are consistent across the seven cities within years, with income and education being inversely related to subprime lending, and increased risk directly related to subprime loans. The presence of African–Americans, at both the tract and borrower levels, is consistently significant and positively related to the likelihood of a subprime loan, even when the full set of explanatory variables is included. In the models containing interaction terms, the results for the non-interaction terms are not altered. The National Community Reinvestment Coalition (2003) conducts a similar study at the census tract level and finds a positive relationship between subprime refinance lending and the percentage of minorities in the neighborhoods; the relationship is found to a lesser extent for home purchase loans. Apgar et al. (2004) construct a similar but larger model for all

U.S. Metropolitan Statistical Areas (MSAs), but with a more limited set of neighborhood characteristics. While the effect of the minority factor is reduced, it remains significantly related to subprime lending. Analyses of HMDA data by the Federal Reserve finds racial disparities in 2004 and 2005 data after controlling for income, type of loan and geographical area, but not for risk factors.

Pennington-Cross et. al (2000) use a somewhat different approach to the investigation of subprime lending patterns by constructing a model of mortgage selection among prime, subprime and FHA home purchase mortgages. Their model contains measures of borrower characteristics and economic characteristics of the local (MSA) real estate market, a variable identifying traditionally "underserved" census tracts, and variables capturing the relative cost of the loan to the borrower. A major innovation of their study is the use of FICO score data for individual borrowers which they matched to HMDA loan data. The authors conclude that after incorporating their controls for risk, borrowers belonging to minority race and ethnic groups are more likely to use subprime mortgage financing.

The findings in the literature lead to the conclusion that in the risk versus demographic factors issue in the subprime lending decision, when risk measures are incorporated into the analysis, demographic factors remain significant, though their impact may be reduced.

The Data and the Statistical Models

The brief economic profiles of Bridgeport, Waterbury and New Haven, Connecticut presented in Table 1 reveal higher concentrations of African–American and Hispanic populations than those found in the nation and Connecticut, and economic indicators that are below the national and state averages. City median family incomes appear to be fairly comparable, but decidedly below the state and national averages.

Data for the models come from three sources. Information on loan and borrower characteristics for each city comes from 2006 Home Mortgage Disclosure Act (HMDA) data. HMDA data contains information on characteristics of individual borrowers and mortgage loans that are collected annually by the Federal Financial Institutions Examination Council (FFIEC) in accordance with the 1975 Home Mortgage Disclosure Act. 2000 Census data is used in combination with the HMDA data to construct demographic and property risk measures for each census tract, and

Table 1 Selected economic and demographic characteristics of Bridgeport, New Haven and Waterbury Connecticut: 2000 census data

	Bridgeport	New Haven	Waterbury	U.S.	CT
Percent black population	30.8	37.3	16.3	12.3	9.1
Percent Hispanic population	31.9	21.4	21.9	12.5	9.4
Percent Hispanic population	3.3	3.9	1.5	3.6	2.4
Median tract family income	$37,588	$37,126	$41,954	$50,046	$65,521
Percent families below poverty	16.2	20.5	20.5	9.2	5.6

the 2005 list of subprime lenders provided by the U.S. Department of Housing and Urban Development (HUD) is used to code each loan as subprime or not subprime.[2] The shortcomings of the use of HUD's list of subprime lenders have been well documented by previous researchers; however it remains the most accessible source of identification of subprime loans.[3] 2006 foreclosure data by census tract was obtained from a private data source.

The tract level demographic variables include the percent of owner-occupied homes represented by Black (PCTOWNBLK), Hispanic (PCTOWNHISP) and Asian (PCTOWNASIAN) households respectively; the percent of the tract population over 25 years of age holding at least a bachelor's degree (PCTCOLL); and the tract median family income (MEDTRACTINC). These variables are constructed using 2000 Census data. Five tract-level risk variables are constructed for the analysis. The capitalization rate (CAPRT) serves as a proxy for risk in real estate investment. It is computed from Census data as the ratio of the annual median gross rent to the median value of owner occupied homes. A lower value for this ratio would be consistent with higher expected real estate values, which may reduce mortgage credit risk, leading to the expectation that this variable would be positively associated with subprime lending. The turnover rate (PCTTURNOVER), is computed from HMDA and Census data as the ratio of home purchase loans originated in the tract to the number of owner-occupied homes.[4] Higher values for this ratio suggest a more active real estate market and the availability of better price information, which would be expected to reduce property risk. Therefore, this variable would be expected to have an inverse association with the subprime lending. The tract foreclosure rate (FORECLSRT is calculated as the ratio of the number of foreclosures to the number of owner-occupied units. This measure combines foreclosure data purchased from a private source with HMDA data. Higher foreclosure rates reflect increased property risk, so that this variable would be expected to have a direct relationship with subprime lending. Additional risk measures are the percent of occupied housing that is owner-occupied (PCTOWNOCC) and the median house age (MEDHSAGE); both are constructed from Census data. A higher percentage of owner-occupied housing should reduce property risk since owners have a stake in maintaining the quality of their property investment; therefore this variable would be expected to be inversely related to subprime loans. A higher median house age might be expected to pose a higher risk to mortgage lenders and therefore to be directly related to subprime loans. The first three risk measures are used in Calem et al. (2004a), and the last two in Calem et al. (2004a, b). Both of these studies also include data on the distribution

[2] Using 2000 Census data with 2006 HMDA data raises the possibility of introducing measurement error into the variables if the relative values of the variables among census tracts are affected. A brief comparison was made using American Community Survey data from 2000 to 2006, and did not suggest significant changes in the average values of relevant measures the city level. Differences in the values among Census tracts was not able to be determined.

[3] HMDA data now contain a field for high cost loans which some argue is a better indicator of subprime loans; however HUD notes several reasons why loan price should not replace its list for identifying subprime lenders. See www.huduser.org/datasets/manu.html

[4] The values for the turnover rate seem high in comparison to those in Calem et al. (2004a, b), and remain high even after estimating this variable using 2006 American Community Survey data that reflects the increase in the number of owner-occupied units between 2000 and 2006.

of credit ratings of individuals within census tracts as an additional risk measure to compensate for lack of this information in the HMDA data.[5]

Also calculated at the tract level are the denial rates for purchase and refinance non-subprime conventional loans (DENPURCH, DENREFI). These variables are calculated from HMDA data as the ratio of the number of applications denied to the total number of applications for each loan type. The denial rates would be expected to be directly related to subprime lending since they are an indication of the availability of conventional loans; they may also serve as proxies for the risk posed to lenders by borrowers, perhaps partially compensating for the lack of neighborhood credit rating distributions. At the borrower level, HMDA data is used to construct binary variables for borrowers' racial (BLACK) and ethnic (HISP) and (ASIAN) characteristics. HMDA is also the source of borrower income (APPINC). Due to the limitations of the data, Loan-to-Value and Debt-to-Income ratios, important measures of risk at the borrower level, are not included in the loan-level models. However, the Loan-to-Income ratio (LOANINC) is included in the borrower models as a proxy for the debt-to-income ratio. This variable should be directly related to the probability of a subprime loan, since higher values reflect more risk.

Variable definitions are found in Table 2, and variable means and standard deviations in Table 3. Differences in average purchase and refinance loan amounts suggest differences in housing costs among the three cities, with New Haven being the highest and Waterbury the lowest. A higher percentage of refinance loans is subprime when compared to purchase loans in all three cities; the average loan amounts were also consistently higher for refinance loans than they were for purchase loans.[6] The risk variables present a mixed picture of the three markets, with none emerging as either the most or the least risky by these measures. The non-subprime denial rate for conventional loans is higher for refinance loans than it is for home purchase loans in all three cities, and is a little higher for both loan types in Bridgeport than in the other two cities.

Table 4 presents the percent of loans that are subprime by demographic group and income category for both purchase and refinance loans. These descriptive statistics show significantly higher percentages of subprime lending going to African–Americans and Hispanics; the percentages for Asians are lower with the exception of refinance loans in New Haven. White borrowers have decidedly lower percentages for both types of loans. The data for income categories presents a mixed picture. The inverse relationship that has been found in earlier studies between income and subprime lending is generally present for refinance loans, with the exception of the two lowest income categories. The pattern seems to be the reverse for purchase loans, where subprime percentages tend to increase with income category, with the exception of the highest income categories. The home purchase loan data could be reflecting a pattern that has been found in previous empirical work where in

[5] Calem et al. (2004a, b) used data on credit scores obtained from CRAWiz; CRAWiz no longer makes this data available. Experian, the original source of the data, makes it available by zip code, not census tract, so this measure of borrower credit risk was not included in the models. This omission is a significant weakness in the models.

[6] A higher average loan amount for refinance loans stands in contrast to the results for Philadelphia and Chicago in Calem et al. (2004a, b) However, it is consistent with data for Connecticut presented in the 2007 *Sub-Prime Mortgage Task Force Final Report* to Gov. M. Jodi Rell.

Table 2 Tract- and loan-level variable definitions

Variable	Definition
a) Tract -Level	
PCTSUB	Subprime Loans as a Percent of Loans Originated in Tract
PCTOWNBLACK	Percent of Tract Homeowners who are Black
PCTOWNASIAN	Percent of Tract Homeowners who are Asian
PCTOWNHISP	Percent of Tract Homeowners who are Hispanic
PCTCOLL	Percent of Tract Population 25+ Years With Bachelors Degree or Higher
FRCLSRT	No. Tract Foreclosures/No. of Tract Owner-Occupied Units
PCTTURNOVER	No. Tract Home Purchase Loans/No. Tract Own-Occupied Units
CAPRATE	Annualized Tract Median Rent/Median Tract House Value
MEDHSAGE	Tract Median House Age
PCTOWNOCC	Tract Owner Occupied Homes/Tract Occupied Homes
MEDTRACTIN	Tract Median Family Income
NONSUBDENIAL	No. Loans Denied/No. of Conventional Loan Applications
b) Loan-Level	
SUBPRIME	Dummy Variable for Subprime Loan
BLACK	Dummy Variable for Black Borrower
HISPANIC	Dummy Variable for Hispanic Borrower
ASIAN	Dummy Variable for Asian Borrower
APPINC	Borrower Income
LOANINC	Loan Amount/Borrower Income

predominately black neighborhoods, higher incomes are directly associated with subprime lending (Scheessele 2002; NCRC 2003).

Following Calem et al. (2004a), twelve multivariate regression models are constructed for each city, three for purchase loans and three for refinance loans at the tract level, and three for purchase loans and three for refinance loans at the individual borrower level. Of the three models estimated at the tract and borrower levels, the first contains only demographic characteristics; the second adds the risk measures described in the previous section, and the third includes the non-subprime denial rate. The general specification of the tract-level models is given as

$$\mathrm{PCTSUB_i} = \alpha_o + \alpha_1 \mathrm{D_i} + \alpha_2 \mathrm{R_i} + \alpha_3 \mathrm{P_i} + \varepsilon_i$$

Where PCTSUB is the percent of either purchase or refinance loans originated that is subprime, D is the vector of demographic variables, R is the vector of risk variables, P is the measure of the availability of prime conventional mortgages, and ε is a random error term. The models are estimated using Ordinary Least Squares (OLS). In equations where heteroscedasticity is present, due to the small sample bias of the traditional heteroscedasticity-consistent covariance matrix, coefficient *p*-values are estimated using an empirical distribution of the *t*-ratio in the original OLS regression. Utilizing the procedures in Ross et al. (2008) in their study of mortgage lending, in conjunction with those in Fox (2008), *t*-ratio distributions are generated

Table 3 Summary statistics: census tracts means & standard deviations

Variable	Bridgeport purchases	Bridgeport refinance	New Haven purchases	New Haven refinance	Waterbury purchases	Waterbury refinance
PCTSUB	30.2	32.2	22.3	28.1	21.8	26.1
	11.2	8.2	13.0	13.5	10.3	6.3
PCTOWNBLK	28.5	28.5	33.6	33.6	13.4	13.4
	14.7	14.7	23.3	23.3	13.9	13.9
PCTOWNHISP	23.4	23.4	11.4	11.4	11.8	11.8
	13.8	13.8	11.4	11.4	12.5	12.5
PCTOWNASIAN	2.5	2.5	2.5	2.5	0.9	0.9
	2.1	2.1	4.6	4.6	0.8	0.8
PCTCOLLEGE	10.0	10.0	25.5	25.5	12.0	12.0
	6.9	6.9	20.4	20.4	6.6	6.6
FRCLSRT	.34	.34	.71	.71	.78	.78
	.36	.36	.66	.66	.61	.61
PCTTURNOVER	20.2	20.2	23.8	23.8	15.1	15.1
	14.5	14.5	17.4	17.4	6.1	6.1
CAPRATE	9.1	9.1	8.4	8.4	7.4	7.4
	4.2	4.2	5.7	5.7	1.4	1.4
PCTOWNOCC	39.7	39.7	28.4	28.4	47.3	47.3
	21.5	21.5	18.3	18.3	20.3	20.3
MEDHSAGE	50.1	50.1	49.0	49.0	43.9	43.9
	6.8	6.8	9.3	9.3	13.8	13.8
MEDTRACTINC	36,906	36,906	37,126	37,126	41,954	41,954
	13,435	13,435	15,262	15,262	13,989	13,989
AVGLNAMT	169,622	191,422	189,830	195,793	120,148	126,835
	27,940	25,809	54,650	73,943	127,645	116,536
LOANINC	2.15	2.63	2.24	2.43	1.99	1.98
	1.36	1.36	1.51	1.37	1.24	1.33
NONSUBDENIAL	15.5	24.1	15.0	20.9	13.6	23.9
	4.9	5.8	6.2	6.3	5.7	7.2
NO. OF TRACTS	38	38	29	29	28	28

using 1000 wild bootstrap samples with a HC_2 correction for heteroscedasticity (Flachaire 2005). The empirical distributions are then used to estimate the *p*-values presented in Tables 5, 6 and 7. This method does not depend on asymptotics and therefore should be more reliable than the *t*-distribution in these small-sample cases.[7]

[7] The t-statistic is calculated as (bootstrapped coefficient-original OLS coefficient)/standard error of the bootstrapped coefficient in the bootstrapped regression. The distribution of the t-statistic is then used in conjunction with the t-ratio for the coefficient in the original OLS regression to calculate the *p*-value as the percentage of the t-ratios that are greater than the absolute value of the t-ratio in the original OLS model (Fox 2008, 597-601). White heteroskedasticity-consistent standard errors were also estimated for these equations with similar results.

Table 4 Percent of loans that are subprime, by borrower race, income and ethnicity

Variable	Bridgeport purchases	Bridgeport refinance	New Haven purchases	New Haven refinance	Waterbury purchases	Waterbury refinance
Black	39.9	30.4	31.6	36.7	31.1	34.5
Hispanic	31.0	30.5	38.4	36.5	25.0	26.5
Asian	23.2	18.2	9.8	45.1	14.7	18.2
White	24.5	25.9	18.1	22.8	18.3	20.9
Income < $30 k	13.6	33.8	21.2	32.9	23.2	28.4
$30 k–$49.999 k	27.7	34.2	26.6	40.2	19.6	29.8
$50 k–$74.999 k	32.2	33.4	29.6	33.8	21.4	27.5
$75 k–$99,999 k	34.3	31.1	29.9	28.3	24.0	25.6
$100 k & over	30.7	27.4	18.8	25.3	19.9	15.7

The specification of the logistic loan-level models is given as

$$\mathrm{SUBPRIME}_i = \beta_o + \beta_1 D_i + \beta_2 R_i + \beta_3 P_i + \beta_4 Z_i + \varepsilon_i$$

where SUBPRIME is a dummy variable indicating whether the loan is subprime or not, D, R, S and ε are as defined above, and Z is a vector of individual borrower characteristics. The loan-level models are estimated with clustered standard errors, since loans within tracts have the same values for some demographic and risk characteristics.

Model Results

Tables 5, 6 and 7 present the results of the tract-level equations, and Tables 8, 9 and 10 present the results of the borrower-level models. In all tables, Column A shows the results with only tract demographic variables included; column B includes tract risk variables, and column C adds the non-subprime denial rate. The results are presented separately for refinance and purchase loans for each city.

The tract-level equations produce mixed results for the three cities that are not as conclusive as those in the earlier research upon which they are based; however, some consistent findings are present. The signs on the variables measuring percent of minority owner-occupied homes in the tract are usually positive for African–Americans (PCTOWNBLACK) and Hispanics (PCTOWNHISP), but often negative for Asian households (PCTOWNASIAN). In the purchase equations, these variables tend to be insignificant (significance is recognized only for variables with expected or plausible signs), especially when risk measures are added to the equations. One exception is the percent of Hispanic owner-occupied homes in Waterbury, which is consistently significant and positively signed in all purchase equations, even with the inclusion of all risk measures and the non-subprime denial rate. Also significant in all specifications for Waterbury for both purchase and refinance loans, is the percent of Asian owner-occupied homes. This variable is consistently negatively signed, suggesting that Asian households do not tend to rely on subprime loans in this

Table 5 Tract-level regressions: bridgeport purchase & refinance loans

Variable	Purchase loans			Refinance loans		
	A[b]	B	C	A	B	C
	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
Intercept	48.2691****	22.3660	22.9067	26.3786****	17.0889	8.0773
PctOwnBlk	.0059	−.0330	−.0331	**.1348***	.1010	.0442
PctOwnHis	−.2616	−.2600*	−.2626*	.0558	.0534	.0751
PctOwnAsian	−.0853	.5264	−.5378	**1.5565*****	**.9914***	.1998
PctColl	**−1.0648****	**−1.3892****	**−1.3899****	−.0181	−.1187	**−.3347****
MedInc	−.00003	**.0006****	**.0007***	−.00008	.0001	.0002
PctTurnover		.1551	.1534		−.1168	**−.0989***
CapRate		**.6057***	.6161		.1350	−.3039
PctOwnOcc		**−.3734****	**−.3760*****		−.1595	**−.1603***
MedHsAge		.1744	.1759		.2405	.1924
Foreclsrt		**9.2825***	**9.3634***		.6014	−1.9159
NonSubDenial			−.0267			**.8285****
Adj. R^2	.2157	.3260	.3000	.2077	.1767	.4680
F Stat. ρ-value	.0236	.0166	.0301	.0270	.1104	.0019
No. Obs.	38	38	38	38	38	38

A=demographic variables only B=demographic & risk C=demographic, risk & non-subprime denial rate. Significance: *20% **10% ***5% ****1%. [b] *p*-value based on bootstrapped generated *t*-ratio distribution with HC_2 correction for heteroscedasticity. Bold=significant with expected/plausible sign.

market. In the refinance models, the percent of African–American owner-occupied homes is significant in all towns when only demographic variables are included. However, in New Haven, this variable remains significant and positively signed when risk measures are included, and marginally significant with the addition of the non-subprime denial rate. When the race and ethnicity variables remain significant in the tract-level models with the inclusion of the full set of independent variables, the magnitude of their impact is generally reduced. However, as the results in the tables show, the risk measures tend to be insignificant.

Tract median income (MEDTRACTINC) displays mixed signs for both purchase and refinance models. Significance in the purchase equations is found only for Bridgeport, with a positive sign; this variable is not significant in any of the refinance equations. These opposite signs are consistent with the data in Table 4 noted above, but do differ from the inverse relationship found in earlier research. As noted previously, a positive association between income and subprime loans was found by Scheessele (2002) for neighborhoods with high concentrations of African–Americans. Another possible explanation for the mixed results is that income was not as important a factor in the subprime lending decision in 2006 as it was in 2000, as lenders increased the number of subprime loans they made without regard to borrowers ability to pay.

Table 6 Tract-level regressions: new haven purchase & refinance loans

Variable	Purchase loans			Refinance loans		
	A	B	C	A	B[b]	C
	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
Intercept	31.2256****	23.4352**	25.7154**	20.7568***	24.1767	6.0516
PctOwnBlk	**.0891***	.0637	.0737	**.2046****	**.1751***	**.1197***
PctOwnHisp	**.2201***	.1207	.1101	**.3415***	.0910	.0591
PctOwnAsian	**−.3283***	−.4604	−.5749	**1.9412****	**2.233***	.4682
PctColl	**−.3504****	**−.4659****	**−.3955*****	−.1516	**−.3810****	−.2028
MedInc	−.0001	−.0001	−.0002	−.0002	−.0002	−.0002
PctTurnover		.0252	.0119		**−.3105*****	**−.1798****
CapRate		.0259	−.0483		−.4326***	−.0363
PctOwnOcc		−.0161	.0125			
MedHsAge		.2782	.1273		.3440	**.4065***
Foreclsrt		−.5691	−2.2851		−3.1924	−1.5592
NonSubDenial			.3226			**1.0546*****
AR(1)				.4117		
				.0024		
Adj. R^2	.7943	.7836	.7738	.5248	.4591	.4820
F Stat. ρ-value	.0000	.0000	.0000	.0009	.0119	.0155
No. Obs.	29	29	29	29	29	29

A=demographic variables only B=demographic & risk C=demographic, risk & non-subprime denial rate. Significance: *20% **10% ***5% ****1%. [b] *p*-values based on bootstrapped generated *t*-ratio distribution with HC_2 correction for heteroscedasticity. Bold=significant with expected/plausible sign

AR(1) included to correct for serial correlation.

The percent of the tract population over 25 with at least a bachelor's degree (PCTCOLL) is consistently negatively signed for both purchase and refinance loans, and is significant in over half of the tract-level equations that contain the full set of independent variables. This result is consistent with the findings of Calem et al. (2004a) and (2004b) and suggests, as those authors noted, that more education may be associated with the financial sophistication necessary for qualified borrowers to make the choice to take out prime, rather than subprime loans.

The risk variables do not perform well in the tract-level equations, producing mixed and often insignificant results across cities for both loan types in models with the full set of explanatory variables. Significance with expected signs is found in the purchase equations for the percentage of owner-occupied homes (PCTOWNOCC) and the foreclosure rate (FORECLSRT) in Bridgeport. In the refinance equations, marginal significance with expected signs is found for percent of owner-occupied homes (PCTOWNOCC) and housing turnover (PCTTURNOVER) in Bridgeport; for housing turnover (PCTTURNOVER) and median house age (MEDHSAGE) in New Haven; for the foreclosure rate (FORECLSRT) in Waterbury. The non-subprime

Table 7 Tract-level regressions: waterbury purchase & refinance loans

Variable	Purchase loans			Refinance loans		
	A	B[b]	C[b]	A	B	C
	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
Intercept	.1365	.1302	7.0220	33.1961**	31.8236****	32.8180****
PctOwnBlk	.0129	−.0217	.0235	**.1253****	.0476	.0449
PctOwnHisp	**.8637****	**.7032*****	**.5166****	−.1086**	.0403	.0558
PctOwnAsian	**−6.1809*****	**−5.2745****	**−4.2019***	**−2.0149****	**−2.1682***	**−2.4728***
PctColl	−.3572	−.4546	−.3218	**−.7245****	**−.4707***	−.3906
MedInc	.000002	−.0001	−.0001	.00007	−.0003	−.0003
PctTurnover		−.0468	−.1161		.3030	.2743
CapRate		.2775	.3833		.7058	.3887
PctOwnOcc		.2314	.2139		.2862**	.2772**
MedHsAge		.1769	.1957		−.2124***	−.2067
Foreclsrt		−4.9036	−5.4333		**2.3507*****	**2.3164***
NonSubDenial			.4411			.0949
Adj. R^2	.5750	.6158	.6271	.5314	.6500	.6358
F Stat. ρ-value	.0001	.0013	.0017	.0004	.0006	.0015
No. Obs.	28	28	28	28	28	28

A=demographic variables only B=demographic & risk C=demographic, risk & non-subprime denial rate. Significance: *20% **10% ***5% ****1%. [b] p-values based on bootstrapped generated *t*-ratio distribution with HC_2 correction for heteroscedasticity. Bold=significant with expected/plausible signs

denial rate is significant in two of the refinance models and none of the purchase models, suggesting that subprime may be the mortgage of choice in these markets, at least for home purchases.

The general lack of consistent signs and significance for the property risk variables across models stands in contrast to their performance in earlier studies. Adding the risk measures individually to the equations produced similar results, with variables that are insignificant with the full set of independent variables generally unable to achieve significance individually. Models including only significant risk measures do not tend to restore to significance the race and ethnic variables that are significant when only demographic were included and do not provide new insights. Variance inflation factors (VIFs) are computed for the independent variables in each of the models as a test for multicollinearity. Only three variables exhibit VIFs above the threshold of ten, suggesting that multicollinearity is not a major cause of insignificance of the risk measures in these models.[8] Data for the three towns were

[8] Neter et al. (1990) suggest VIFs over 10 indicate the presence of mullticollinarity. MEDINC and PCTOWNOCC in Waterbury, and MEDINC in Bridgeport had VIFs over 10. Removing these variables from the Bridgeport models did not change the results. Removing them from the Waterbury models resulted in marginal significance for TURN and NONSUBDENIAL and significance for MEDHSAGE in the purchase model only.

Table 8 Loan-level logistic regressions: bridgeport purchase & refinance loans

Variable	Purchase loans			Refinance loans		
	A	B	C	A	B	C
	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
Intercept	−1.3681***	−.9574	−1.0043	−1.6961****	−.7464*	−.9960*
PctOwnBlk	.0033	.0039	.0006	−.0012	.0003	−.0009
PctOwnHisp	**.0126****	**.0118****	**.0127*****	**.0115*****	**.0101****	**.0103****
PctOwnAsian	−.0082	−.0163	.0108	**.0404***	**.0417***	.0360*
PctColl	**−.0410****	**−.0421****	**−.0384****	**−.0182****	−.0137	−.0134
MedInc	**.00001****	**.00003***	**.00002***	.000002	−.000009	−.000009
PctTurnover		−.0013	−.0024		**−.0097****	**−.0099****
CapRate		.0116	.0026		−.0362**	−.0345***
PctOwnOcc		**−.0145****	**−.0131*****		.0018	.0016**
MedHsAge		−.0099	−.0130*		.0020	−.0019
Foreclsrt		.1663	.0791		.0116	−.0049
NonSubDenial			**.0187****			.0111
Black	**.8328******	**.8292******	**.8356******	**.1964***	**.1906***	**.1896***
Hispanic	**.3792******	**.3915******	**.3929******	.1441	.1428	.1427
Asian	.2087	.2323	.2271	−.3281	−.3193	−.3268
AppIncome	**.0012****	**.0012***	**.0012***	−.0007	−.0006	−.0006
LoanInc	−.0965******	−.0964******	−.0978******	**.2102******	**.2101******	**.2101******
Total Obs.	2655	2655	2655	2295	2295	2295
Pseudo-R^2	.0450	.0589	.0596	.0353	.0367	.0369
Prob. LR Stat	.0000	.0000	.0000	.0000	.0000	.0000

A=demographic variables only B=demographic & risk variables C=demographic, risk & non-subprime denial rate. Significance: * 20% ** 10% *** 5% **** 1% ρ- values based on clustered standard errors. Bold=significant with expected or plausible signs. Equations estimated with standard errors clustered by census tract.

also pooled to estimate purchase and refinance models, with essentially the same results for the risk measures. While again exercising caution in the interpretation of these results, they do suggest that lenders in these markets may have paid less attention to risk during the strong growth in subprime lending that occurred between 2000 and 2006.

In contrast to the tract-level equations, the loan-level equations produce more consistent results across cities for borrower demographic measures. Again, equations are first estimated including only neighborhood and borrower demographic variables, followed by the inclusion of risk variables, and lastly, the non-subprime denial rate. The dummy variables for African–American (BLACK) are consistently significant and positively associated with the probability of a subprime loan for purchase and refinance loans, even after controlling for the full set of neighborhood demographic, and individual and property risk measures. The binary variable for

Table 9 Loan-level logistic regressions: new haven purchase & refinance loans

Variable	Purchase loans			Refinance loans		
	A	B	C	A	B	C
	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
Intercept	−.5738*	−1.5270****	−1.5634****	−2.356****	−2.1111****	−3.1853****
PctOwnBlk	**.0033***	.0025	.0024	**.0067****	**.0088****	.0058
PctOwnHisp	.0027	−.0038	−.0039	−.0029	−.0049	−.0060
PctOwnAsian	−.0147	.0102	.0120	**−.0867****	−.0451	**−.0931****
PctColl	**−.0197******	**−.0300******	**−.0307******	−.0126	**−.0165****	−.0111
MedInc	**−.00002******	**−.00001*****	**−.00001****	.000003	.000008	.000004
PctTurnover		.0192	.0198		.0431**	.0367*
CapRate		−.0446**	−.0453**		−.1309**	−.1224**
PctOwnOcc		.0028	.0025		.0049	.0059**
MedHsAge		**.0207******	**.0222******		−.0039	.0075
Foreclsrt		.0027	.0252		−.1021	.0301
NonSubDenial			−.0028			**.0318****
Black	**.7227******	**.7268******	**.7279******	**.7568******	**.7222******	**.7187******
Hispanic	**.9223******	**.9093******	**.9186******	**.7482******	**.7186******	**.7045******
Asian	−.6011	−.5497	−.5515	**1.5909******	**1.6584******	**1.6368******
AppIncome	−.0002	−.0002	−.0002	**.0017***	**.0017***	**.0017***
LoanInc	−.1075****	−.1088****	−.1083****	**.3293******	**.3311******	**.3328******
Total Obs.	1624	1624	1624	1568	1568	1568
Pseudo-R^2	.0946	.1024	.1024	.0929	.0982	.0993
Prob. LR Stat	.0000	.0000	.0000	.0000	.0000	.0000

A=demographic variables only B=demographic and risk C=demographic, risk & non-subprime denial rate. Significance: *20% **10% ***5% ****1% ρ- values based on clustered standard errors. Bold=Significant with expected/plausible signs. Equations estimated with standard errors clustered by census tract.

Hispanic (HISP) is significant in all of the purchase models and in the New Haven refinance models. The dummy variable for Asian borrowers does not exhibit consistency, resulting in mixed signs and significance.

The tract variables measuring minority concentration in owner-occupied homes produce results that are consistent with their performance in the tract models. However, in Bridgeport, PCTOWNHISP is significant and positively signed in all purchase and refinance models, where it was not in the tract equations; and PCTOWNASIAN is significant and directly related to subprime lending in the refinance models, where it was not in the tract equations. PCTOWNHISP is significant and positively signed in all purchase models in Waterbury as it was in the tract models. These results suggest that neighborhood demographic factors may play a role in subprime lending that differs by market, and that Hispanic neighborhoods may factor into subprime lending decisions in this region.

The percent of tract population with at least a bachelor's degree (PCTCOLL) is again consistently inversely related to the probability of obtaining a subprime loan in

Table 10 Loan-level logistic regressions: waterbury purchase & refinance loans

Variable	Purchase loans			Refinance loans		
	A	B	C	A	B	C
	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
Intercept	−1.2770****	−.8508	−1.089*	−1.1874****	−1.8067****	−1.8321****
PctOwnBlk	−.0052	−.0078*	−.0075*	.0035	−.0034	−.0032
PctOwnHisp	**.0445****	**.0453****	**.0423****	−.0046	.0004	.0004
PctOwnAsian	**−.3779****	**−.4374****	**−.4319****	**−.1733*****	**−.1534*****	**−.1415*****
PctColl	−.0151	−.0259	−.0247	**−.0302****	**−.0276****	**−.0315****
MedInc	.000006	**−.00001**	−.000009	−.00004	**−.00001***	−.00001
PctTurnover		.0124	.0123		.0285****	.0305****
CapRate		−.0735	−.0738		**.0559***	**.0706***
PctOwnOcc		.0186*	.0182		.0124	.0217***
MedHsAge		.0058	.0068		−.0094****	−.0098****
Foreclsrt		−.2927***	−.3184****		.0743	**.0788***
NonSubDenial			.0129			−.0055
Black	**.7154****	**.7176****	**.7209****	**.6274****	**.6189****	**.6196****
Hispanic	**.3474****	**.3536****	**.3504****	.1976	.1872	.1896
Asian	−.4664	−.5004	−0.5042	.0171	.0119	.0197
AppIncome	**−.0028****	**−.0033****	**−0.0033****	**−.0020***	**−.0019***	**−.0019***
LoanInc	−.1512****	−.1573****	−.1577****	**.2858****	**.2870****	**.2859****
Total Obs.	2209	2209	2209	1690	1690	1690
McFadden R^2	.0463	.0517	.0519	.0532	.0561	.0562
Prob. LR Stat	.0000	.0000	.0000	.0000	.0000	.0000

A=demographic variables only B=demographic and risk C=demographic, risk & non-subprime denial rate. Significance: *20% **10% ***5% ****1% ρ- values based on clustered standard errors. Bold=Significant with expected/plausible signs. Equations estimated with standard errors clustered by census tract.

models including the full set of independent variables. It is significant in all three models for Bridgeport and New Haven purchase loans, supporting the tract-level findings for those cities. It also is significant in all three refinance models for Waterbury. Census tract median income (MEDTRACTINC) is significant in the Bridgeport purchase loan models, where it is again positively related to the probability of a subprime loan, supporting the tract-level results for this town. In the other models it produces mixed results. Borrower income (APPINC) entered the models with mixed results across towns. This variable is significant and positively signed in the purchase equations for Bridgeport, and significant and negatively signed in refinance equations for Waterbury.[9] The results for both income measures in the borrower-level equations are consistent the results for income in the tract-level

[9] Calem et al. (2004a, b) found a positive association between borrower income and subprime lending for Chicago purchase equations.

models for Bridgeport purchase loans, lending more support to the possibility that neighborhoods with high concentrations of African–Americans exhibit a direct relationship between income and subprime loans. The loan-to-income ratio entered all of the loan-level equations significantly. However, it was negatively signed in the purchase equations and positively signed in the refinance models. In the purchase equations, LOANINC did not result in insignificance of any other variables in the model; however in the refinance equations for Waterbury and Bridgeport, the dummy variable HISP was insignificant with the inclusion of LOANINC. This result suggests that subprime lending may be associated with higher loan-to-income ratios, and in some markets this association is stronger than the association between ethnicity and subprime lending.

In the loan-level models, the risk measures again did not exhibit any consistent pattern of significance across cities. In the purchase models PCTOWNOCC is significant in Bridgeport, and MEDHSAGE is significant in New Haven. In the refinance models, CAPRT is significant in Waterbury, and PCTTURNOVER is significant in the Bridgeport models. The denial rate for non-subprime loans (NONSUBDENIAL) had mixed signs and was significant in the Bridgeport purchase model and in the New Haven refinance model. Thus, as in the tract-level equations, there is not strong evidence that being denied a non-subprime loan is significant factor in borrower decisions to take out a subprime loan for either purchase or refinance across the three cities, suggesting that subprime may be the first choice in mortgage loans for neighborhoods with high concentrations of minority populations.

Additional insights may be gained by comparing some key coefficients in this research with those found in Calem et al. (2004a). Using the specifications that include the full set of independent variables (Columns C in Tables 5, 6, 7, 8, 9 and 10), a comparison is made of the coefficients that are significant and correctly signed for PCTTURNOVER, CAPRT, and FORECLSRT, the three risk variables that are common to both research projects. Marginal effects for PCTTURNOVER, CAPRT and FORECLSRT range from −.06 to −.09, 1.03 to 1.47, and 1.67 to 4.6 respectively in the Calem, et.al. tract models.[10] In the Connecticut tract models, the coefficients for PCTTURNOVER range from −.10 to −.18, and for FORECLSRT range from 2.3 to 9.4. CAPRT is not significant in any of the models with the full set of independent variables. The effects for PCTTURNOVER, CAPRT and FORECLSRT in the loan-level logistic models in Calem, et. al. range from .946 to .997, 1.02 to 1.06, and 1.05 to 1.82 respectively. In the Connecticut models, there is only one significant value of .990 for PCTTURNOVER, one significant value for FORECLSRT of 1.08, and one for CAPRT of 1.07. In the tract and loan-level models, these comparisons suggest mixed, but generally similar marginal effects for the risk variables. However, 78% of

[10] The marginal effects in the tract models give the percentage change in subprime loans in the tract associated with a 1% change in the independent variable. Marginal effects for variables in the loan-level logistic models are computed by raising **e** to the power of the logistic coefficient (Bowerman and O'Connell 2007) and give the change in the odds that a mortgage will be subprime associated with a one-unit change in the independent variable. A marginal effect of 1.002 for a coefficient with a positive sign is a.2% increase in the odds of a subprime loan for each 1 unit change in the independent variable. Negative coefficients lead to marginal effects less than one; a marginal effect of .95 means the odds of a subprime loan become 95% of the previous value with each 1-unit change in the independent variable.

the coefficients in the tract models and 86% in the loan-level logistic models are wrong-signed or insignificant, so the comparisons are based on the few equations in which these variables are significant with the expected signs. As Tables 5, 6, 7, 8, 9 and 10 indicate, insignificant risk variables tend to have marginal effects that are less than those that are significant.

One variable that does perform well in the Connecticut models is the percent of tract residents with at least a college education (PCTCOLL). In the tract models, the coefficients on this variable range from −.05 to −.10 in the Calem, et. al. models. As might be expected from their significance in the Connecticut models, their coefficients are larger, ranging from −.33 to −1.4. The marginal effect of PCTCOLL on the odds of a subprime loan in the logistic models ranges from .962 to .970, slightly less than the .975 to .995 range found in the Philadelphia and Chicago models, indicating marginally lower odds of a subprime loan associated with each percent increase in tract residents with at least a college education.

The Connecticut models find a significant role for Hispanic neighborhoods in subprime lending, with PCTOWNHISP having positive and relatively large marginal effects ranging from .26 to .52 on the percent of subprime loans in the tract models. PCTOWNHISP is also directly related to subprime lending in the loan-level logistic models. In contrast, the Calem, et. al. models, find PCTOWNHISP to be negatively related to the subprime loans, in both the tract and loan-level equations. In the Philadelphia and Chicago tract models, coefficients for PCTOWNBLK range from .11 to .19, while in the Connecticut models, there is only one correctly signed significant coefficient of .12. In the Philadelphia and Chicago models, PCTOWNASIAN has mixed impacts on subprime lending, as it does in the Connecticut models.

Conclusion

This research applies existing models of subprime lending to data for the three Connecticut cities with the largest number of outstanding subprime mortgage loans in the state. Models for subprime purchase and refinance lending are constructed at the census tract and borrower levels using neighborhood and borrower demographic variables and variables serving as proxies for property risk. The borrower-level equations yield a more conclusive picture of the role of demographic and ethnic factors in subprime lending than the tract-level equations. In these models, the binary variable for African–American borrowers is consistently significant and positively associated with the probability of a subprime loan while controlling for property risk measures, the non-subprime denial rate, and neighborhood demographic composition measures. The binary variable for Hispanic borrowers is significant in all purchase models containing the full set of independent variables and also in the refinance models for New Haven. The role of demographic and ethnic factors is not consistent across cities in the tract-level equations, but exhibits some consistency within cities, suggesting that the role these factors play in subprime lending may differ by market. There is evidence of a positive association between subprime lending and Hispanic neighborhoods for purchase loans in Waterbury and between subprime lending and African–American neighborhoods for refinance loans in New Haven. This evidence is further supported in the loan-level equations for these two

cities, in which the neighborhood composition variables for the respective demographic groups remain significant with the inclusion of property risk measures and individual borrower demographic characteristics. The loan-level equations for Bridgeport, provide evidence for an association between Hispanic neighborhoods and subprime lending for both purchase and refinance loans, that was not present in the tract equations. An association between Hispanics and subprime lending is a finding of this study that differs from the earlier study on which it is based. Both tract-level and loan-level models provide fairly strong evidence that the level of education of tract residents is inversely related to subprime lending. When income measures are significant, they have mixed effects on subprime lending, suggesting possible differences that may be related to neighborhood demographic composition, as well as the possibility that income has become less of a factor in subprime lending decisions.

In contrast to earlier studies, the models do not find a clear role for property risk measures in the origination of subprime loans. Risk measures yield mixed effects and are often insignificant or wrong-signed. In the few equations where risk measures are significant, there marginal effects are broadly consistent with the marginal effects found in previous studies, with differences that do not exhibit a consistent pattern. This lack of significance suggests that by 2006, in these cities, risk may not have prominently factored into subprime lending decisions. However, the results must be interpreted with caution since these models were unable to include borrower credit scores, which are assumed to be a factor in mortgage underwriting decisions. An interesting subject for further research would be to see if risk variables that were significant in earlier studies remain significant when those models are re-estimated using more current data.

Acknowledgments The author is grateful to the anonymous reviewer for extensive and insightful suggestions for improving this paper. Gratitude also goes to Stephen L. Ross for providing the wild bootstrap program and to Kam C. Chan for his invaluable assistance and expertise in running the bootstrap models.

References

Apgar, W., Calder, A., & Fauth, G. (2004). Credit, capital and communities: The implications of the changing mortgage banking industry for community based organizations. Joint Center for Housing Studies, Cambridge, MA: Harvard University. http://www.jchs.harvard.edu/publications/community-development/ccc04-1.pdf. Accessed December 14, 2008.

Bowerman, B. L., & O'Connell, R. T. (2007). *Business statistics in practice*. New York: McGraw Hill.

Calem, P. S., Gillen, K., & Wachter, S. (2004). The neighborhood distribution of subprime mortgage lending. *Journal of Real Estate Finance and Economics, 29*(4), 393–410.

Calem, P. S., Hershaff, J. E., & Wachter, S. (2004). Neighborhood patterns of subprime lending: Evidence from disparate cities. University of Pennsylvania Law School Institute for Law and Economics. Research Paper No. 04–14. http://www.whartonrealestate.org/newsletter/pdf/may05.pdf. Accessed December 14, 2008.

Canner, G. B., Passmore, W., & Laderman, E. (1999). The role of specialized lenders in extending mortgages to lower-income and minority homebuyers. *The Federal Reserve Bulletin* (November): 710–723. http://www.federalreserve.gov/pubs/bulletin/1999/1199lead.pdf. Accessed December 14, 2008.

Flachaire, E. (2005). Bootstrapping heteroskedastic regression models: wild bootstrap versus pairs bootstrap. *Computational Statistics and Data Analysis, 49*(2), 361–376.

Fox, J. (2008). *Applied regression analysis and generalized linear models*. Thousand Oaks, CA: Sage Publications.

Immergluck, D. (2000). *Stark differences: The explosion of the subprime industry and racial hypersegmentation in home equity lending*. Chicago, IL: The Woodstock Institute.

Immergluck, D., & Wiles, M. (1999). *Two steps back: The dual mortgage market, predatory lending, and the undoing of community development*. Chicago, IL: The Woodstock Institute.

National Community Reinvestment Coalition (2003). The Broken Credit System: Discrimination and Unequal Access to Affordable Loans by Race and Age: Subprime Lending in Ten Large Metropolitan Areas. Washington, D.C.: National Community Reinvestment Coalition. http://www.ncrc.org/images/stories/pdf/research/ncrcdiscrimstudy.pdf. Accessed December 14, 2008.

Neter, J., Wasserman, W., & Kutner, M. H. (1990). *Applied linear regression models*. New York: Richard D. Irwin.

Pennington-Cross, A., Yezer, A., & Nichols, J. (2000). Credit risk and mortgage lending: who uses subprime and why? Research Institute for Housing America, Working Paper No. 00–003. http://www.housingamerica.org/publications/CreditRiskandMortgageLendingWhoUsesSubprimeandWhy.htm. Accessed December 14, 2008.

Ross, S. L., Turner, M. A., Godfrey, E., & Smith, R. R. (2008). Mortgage lending in Chicago and Los Angeles: a paired testing study of the pre-application process. *Journal of Urban Economics, 63*(3), 902–919.

Scheessele, R. M. (2002). Black and white disparities in subprime mortgage refinance lending. Housing Finance Working Paper Series, HF-014, U.S. Department of Housing and Urban Development. http://www.huduser.org/publications/hsgfin/workpaper14.html. Accessed December 14, 2008.

U.S. Department of Housing and Urban Development (2000). *Unequal Burden: Income & Racial Disparities in Subprime Lending America*. http://www.huduser.org/publications/fairhsg/unequal.html. Accessed December 14, 2008.