RACIAL DISPARITIES IN SUBPRIME HOME MORTGAGE LENDING: CAN THE DIFFERENCE BE EXPLAINED BY ECONOMIC FACTORS?

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By

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Abstract

The 2004 HMDA dataset contains new information on the interest rates of home mortgage loans. The fairness of assigned interest rates has long been disputed by fair-lending advocates, many of whom believe that racial discrimination plays a role in the interest rates lenders assign borrowers. Research suggests that the possibility of racial discrimination in home mortgage loan interest rates cannot be dismissed, but available evidence is weak and mired with a number of methodological and econometric issues. The current study uses the new information in the 2004 HMDA dataset to determine whether there are racial disparities in the likelihood that minorities receive a high-cost loan relative to whites. The present study finds that blacks are, on average, 13 percent more likely to receive a high-cost loan than whites are, when other borrower, lender, and neighborhood characteristics are held constant. The present study does not solve all methodological and econometric issues; therefore, results should be interpreted cautiously. Nevertheless, the gap between black and white borrowers should be further investigated in future
research. The relationship between high-cost loans and predatory lending is discussed.
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Chapter 1. Introduction

The “American Dream” began as the promise held by generations of immigrants and settlers that with hard work and determination they could achieve better lives through financial prosperity. Today, the American Dream is most often equated with owning and successfully maintaining a home.¹ Yet historically, minorities have faced both economic and noneconomic barriers to home ownership, giving rise to a number of federal statutes designed to promote fair lending and to prevent lending discrimination and redlining. However, in keeping with a general expansion of credit opportunities to those previously considered too financially risky,² a “subprime” market for mortgage loans has burgeoned in recent years that has helped those who otherwise would not qualify for a mortgage, but also placed them at increased risk for abuse. While it is reasonable that interest rates would be adjusted upward to compensate for borrowers’ greater credit risk,³ a growing number of unscrupulous lenders are exploiting borrowers via deceptive, unfair and injurious terms, and exorbitant origination fees. The consumers of these “predatory” loans, often elderly, immigrants, and minorities, face strong odds of delinquency and foreclosure. Yet, the

¹ The American Dream Downpayment Initiative, enacted in 2003, is a HUD sponsored grant program aimed at increasing the homeownership rate among low-income minority households.
² Bailey, “Predatory Lending,” 14-16.
³ Gramlich, “Remarks.” Credit risk is generally assessed by factors, including how well borrowers have paid their bills in the past, their income level, the size of their assets, and their employment history. In addition, in deciding whether to offer subprime loans, lenders consider attributes of the property that influence the loan-to-value ratio.
loan originators have little to lose, because, as with conventional mortgages, there is a secondary market for the sale of subprime loans.

Due to an over-representation of minority borrowers among those with high cost loans, many see predatory lending as the latest form of racial discrimination in the area of equal housing.4 However, generating definitive evidence of racial discrimination in this context presents notable methodological challenges, exacerbated by limits in available data. Although both assessments of credit risk as well as the adjudication of lending terms are functions of multiple complex and inter-related factors, most existing studies of racial disparities in mortgage lending lack the necessary data to account for this full range of explanatory variables. Mortgage lenders have not been compelled to provide data on credit scores, debt to income ratios, or appraisal data. To the extent that any of these excluded factors are correlated with race (and presumably each of them is), the estimated effects of race documented in the majority of previous studies are likely to be exaggerated. Even studies that have used novel analysis strategies, such as inferring the economic qualifications of mortgage-holders at the time of the application process from subsequent deferrals and foreclosures, are not completely free of the potential for bias in their race effects.

The aim of the current study is to examine whether there is evidence of racial bias in the proffering of subprime loans using recently updated Home Mortgage
Disclosure Act data (HMDA) from 2004⁵ for the State of Louisiana. The present study examines a subset of the 2004 HMDA data to determine if race plays a role in whether home mortgage loan applicants receive high cost versus prime rate loans, when other borrower characteristics, loan characteristics, neighborhood characteristics, and lender characteristics are constant. In this study, high cost loans are those identified in the dataset with annual percentage rates that exceed the annual treasury security rate by 3 percentage points or greater. Prime rate loans are those with an annual percentage rate that exceed the treasury security rate by less than 3 percentage points. The 2004 HMDA dataset is the first that provides a measure of subprime lending by including information on the annual percentage rate, which allows for the identification of high cost loans.

The present study’s sample includes only those living in one of Louisiana’s eight Metropolitan Statistical Areas (MSAs) as defined by the 2000 census. The State of Louisiana was chosen because descriptive research indicates that the Southeast region of the United States has particularly high rates of subprime lending as compared to other regions.⁶ Given the recent disaster of Hurricane Katrina, which devastated

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⁴ Apgar and Calder, “The Dual Mortgage Market.”
⁵ See www.ffiec.gov. From the Federal Financial Institutions Examination Council (FFIEC). The 2004 HMDA Dataset includes improvements in racial statistics reported by banks and most importantly, reports the rate spreads in high cost loans.
much of Louisiana and wreaked havoc on the local housing market, an examination of
the extent to which racial discrimination impacts home mortgage lending in Louisiana
is particularly timely. This study seeks to examine only the most basic home purchase
loans, excluding loans made to developers or businesses. Therefore, the sample is
limited to only those borrowers that were accepted for a first lien on a conventional
home purchase for an owner-occupied, single-family unit. Excluded from the sample
were second liens, government insured loans, refinance or home improvement loans,
loans for non-owner occupied units, and loans for manufactured or multiple family
homes. While it is important to look at all types of home mortgage lending to ensure
fairness in lending practice, and evidence indicates an increase in predatory and high
cost loans among refinances and second liens, examination of these loan practices is
beyond the scope of the present study.

The present analysis has a number of significant strengths. Using the most
recently released HMDA data, I am able to exploit a wide array of measures including
interest rate spread of the mortgage, borrower characteristics including gender,
ethnicity, co-applicant presence, income, and loan amount, and neighborhood
characteristics including population, median income, percent minority in the
neighborhood, and the number, and type of certain homes in the neighborhood. Access
to this diverse set of measures will help me to isolate whether an applicant’s race is
statistically associated with the probability that a lender originates a high cost versus prime rate mortgage loan, net of other factors that would likely influence the terms of the loan. Further, I utilize a sample that is restricted to mortgage loans originated in the State of Louisiana.

For many Americans, a home is the most expensive and most important purchase they will make in their lifetime, as well as the most realizable bridge to self-sufficiency. Thus, it is imperative to expose inequities in the lending market to ensure that all Americans have a fair chance to cross this bridge. The question posed by this study is also particularly timely given the dramatic increase in subprime lending over the last decade. The share of high cost loans in the mortgage market escalated from $20 billion in 1993\(^7\) to $332 billion in 2003.\(^8\) In 2001, a Center for Responsible Lending report estimated that the economic cost of predatory mortgage loans is $9.1 billion each year.\(^9\) This suggests that predatory lending, a particularly perverse abuse of the most vulnerable segments of the population, may be rising as well.

Only one federal law, the Home Ownership and Equity Protection Act (HOEPA), passed in 1994, seeks to combat predatory lending. HOEPA requires lending institutions to disclose explicitly information about the terms of the loan if the loan exceeds a particular annual percentage rate or has fees that exceed a set percent of

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\(^8\) Center for Responsible Lending, “Predatory Lending Robs Homes,” 2005.
the total loan amount. The information in this study may point to the need for greater protections for consumers against predatory lenders. Although the present analysis cannot identify which loans in the sample are predatory, the results may highlight the areas in which additional information in the data could help locate those loans. Finally, policymakers should be concerned about any racial discrimination in lending because it is both illegal and immoral. This study will help spotlight whether this exists in the mortgage lending market.

Chapter 2. Background and Literature

Beginning with fair housing and fair lending legislation in the 1960s, to the passage of Home Mortgage Disclosure Act and the Community Reinvestment Act in the 1970s, civil rights leaders, community-based advocates and civic-minded legislators have sought protections for minorities against racial discrimination in the housing market. Currently, there are widespread allegations of discrimination in the high cost loan market as well as claims that minorities are specifically targeted by predatory lenders.

Subprime—also known as high cost—loans have higher loan-to-value ratios than prime loans and are often smaller than prime loans. Moreover, subprime loans are more likely to be in serious delinquency, according to the Federal Reserve Board; more than 7 percent of subprime loans are in serious delinquency as compared to only 1 percent of prime loans.\textsuperscript{10} Lending institutions, which include depository institutions such as banks, savings institutions, and credit unions, and nondepository institutions such as for-profit lending institutions, are more likely to assign higher interest rates to subprime loans to account for the increased risk associated with making such loans. It is important to point out that while all predatory loans are subprime, not all subprime loans are predatory. Only a handful of studies have attempted to measure predatory lending specifically.
In the next sections, I provide an overview of operational definitions of discrimination found in the scholarly literature along with various empirical strategies that have been used to document whether racial discrimination exists in different aspects of the mortgage lending process.

**Forms of Discrimination in Mortgage Lending**

Economists generally argue that racial discrimination is a multi-dimensional construct. For example, Berkovec, Canner, Gabriel, and Hannan distinguish between “noneconomic discrimination,” where one exhibits a taste for discrimination, and “statistical discrimination,” where the lender perceives that one group will perform better than another based on unobservable differences and discriminates on that basis.\(^{11}\)

Theoretically, either form could exist in the mortgage lending industry. Behavior indicative of “statistical discrimination” may be seen as a “shortcut” a lender takes to maximize his or her profit without added work. This technique may in fact be profitable to the extent that the lender’s assumptions are consistent with the actual creditworthiness of the group, on average.

Discriminatory behavior that runs counter to economic incentives, such as when denying service to individuals based on race reduces business and thus lowers

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\(^{10}\) Avery, Canner & Cook, “New Information under HMDA,” 2005.

profits, is considered “taste for discrimination” in economic parlance. This is the most overt, and perhaps most discomfiting type of discrimination, and to the extent that it operates in the mortgage industry, it is also the most difficult to measure empirically. Rachlis and Yezer further distinguish between “differential treatment,” where a lender exhibits his or her taste for discrimination by using illegal criteria for evaluating the creditworthiness of a loan applicant, and “adverse impact,” where underwriting policies lead to discrimination, even when there was no intention by the lender to discriminate.¹² In home mortgage lending, both of these practices may yield similar results, though for different reasons.

For some, the intent to discriminate is not the concern, but rather, whether a given practice leads to a disparate impact on blacks versus whites. For example, disparate impact is a legal argument often used in employment cases.¹³ Although in cases of employment, courts have determined that disparate impact may be as problematic as overt discrimination, legally, this line of argumentation is undecided for cases involving mortgage lending. This may be due to the difficulty in documenting racial discrimination in mortgage lending.

¹³ Title VII prohibits employers from discriminating on the basis of certain factors, such as sex or race. The legal doctrines used to determine whether a facially neutral practice which has a disparate impact violates Title VII were developed by the Supreme Court in a series of cases beginning with Griggs v. Duke Power Co. 401 U.S. 424, 432 (1971).
Approaches to Quantifying Discrimination in Lending

Rachilis and Yezer note that the bulk of research on discriminatory practices within mortgage lending falls into one of four categories: mortgage flow, crowding-out, acceptance-rejection, and foreclosure/default models with prohibited variables. More recent research expands this list to include prime-subprime probability models, similar to acceptance-rejection models, and outcome tests that seek to solve the problem of included variable bias. Included variable bias occurs with variables within a statistical model control for nonracial factors but bias the results by masking the existence of racial discrimination.

In a mortgage flow model, mortgage lending activity is evaluated by examining demographic characteristics of neighborhoods or geographic areas. The Woodstock Institute took an approach similar to this by using 2004 HMDA data to compare the prevalence of prime and subprime loans across different Chicago neighborhoods. They found that while 34 percent of subprime loans originated to neighborhoods with more than 80 percent minority populations, only 10 percent of the area’s prime loans were originated to these neighborhoods. Though compelling, these numbers provide only descriptive evidence of how interest rates are dispersed and cannot be used to infer that the distribution is the result of discrimination.

A crowding-out model assumes that the availability of non-discriminatory alternate loan products, such as those that are government insured, drives discriminated-against individuals toward that type of loan. To test this assumption, a choice equation is used to determine the extent to which race, gender, or other demographic characteristics of applicants explain differences in choices of government-insured loan products over conventional loan products. However, this type of model may be less relevant today as relaxed underwriting standards for conventional mortgage loans have reduced the need for lower income consumers to pursue insured loans. Indeed, the number of FHA-insured loans has decreased significantly—from 16 percent in 2000 to 8 percent in 2004, when approximately 90 percent of applications for single-family owner-occupied homes were for conventional loan products.17

Acceptance-rejection models are used to determine whether demographic characteristics of applicants correlate with their likelihood of acceptance. This is the approach used by the Federal Reserve in its analysis of borrower and lender characteristics using the 2004 HMDA data.18 Their findings showed that the percentage of denials among African American loan applicants (18.2 percent) was nearly double that of non-Hispanic white applicants (10.9 percent), controlling for a

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18 Ibid.
number of factors that would be expected to be positively correlated with loan denial.\textsuperscript{19} Indicative of the strong correlations among borrower and lender characteristics and race, the difference in the prevalence of loan denials across African Americans and non-Hispanic whites was considerably more dramatic—24.7 percent and 10.9 percent, respectively—when these factors were not controlled. Recently released research from the California Reinvestment Coalition, the National Community Reinvestment Coalition, and the Consumer Federation of America document racial disparities, using similar analysis strategies.\textsuperscript{20}

An innovative approach to detecting discrimination at the time a mortgage loan is originated is to examine the performance of the loan, or the loan outcome, specifically whether there is a difference in default or foreclosure rates that correlates with individual demographic characteristics of borrowers, such as race. The underlying assumption is that if racial minorities are discriminated against, then only the most-qualified individuals within minority populations will receive loans. Therefore, on average, loans originated to members of minority groups will perform better than loans originated to non-minority groups. Berkovec et al. expand on this idea by also including a measure of local market concentration as a proxy for market competition.

\textsuperscript{19} For home purchase, owner-occupied, site-build homes.

assuming that increased market competition decreases the prevalence of noneconomic discrimination.\textsuperscript{21} The sample used by Berkovec and colleagues includes only FHA-insured loans, which are traditionally considered less-discriminatory than conventional loans. Nevertheless, the results fail to reject the null hypothesis that no noneconomic discrimination exists.

**Methodological Limitations in Existing Research**

A large portion of existing research on racial disparities in home mortgage lending has been produced by anti-predatory lending advocacy organizations.\textsuperscript{22} As already discussed, many of these studies use simple descriptive statistics and show considerable disparities in the number of minorities versus whites that receive subprime loans. Given that a lender’s financial risk is a legitimate determinant of both eligibility for, as well as the terms associated with, mortgage loans and the fact that minorities tend to be more economically disadvantaged than whites are, it would not be surprising to observe some aggregate differences when making comparisons across racial subgroups. Thus, one cannot infer racial discrimination on the basis of these types of findings alone.


\textsuperscript{22} For example, The Center for Responsible Lending, The California Reinvestment Coalition, The Greenlining Institute, ACORN, and Consumer Federation of America.
Owing in large part to limits in data availability, previous scholarly investigations of whether and to what extent racial discrimination operates in the mortgage lending process are plagued by methodological limitations. Rachlis and Yezer argue that existing statistical strategies for measuring racial discrimination fall short of achieving their intended goals and share serious statistical problems.\textsuperscript{23} The first problem highlighted by Rachlis and Yezer is that of partial observability. Results based on analyses using samples of mortgage loan applicants are not necessarily generalizable to those individuals who have not elected to apply for a mortgage loan. To compound this problem, loan applicants may differ from non-applicants in ways that might be very difficult to quantify (i.e., statistically “unobservable”), for example in their degree of risk-aversion. Moreover, lenders are not assigned to borrowers at random, which means that the multiple and complex factors that influence both access to and choices of lenders need to be taken into account to avoid selection bias. In addition to these complexities, study samples used to analyze racial disparities in the terms of mortgage loans narrow even further, excluding those whose loan applications were rejected.

Beyond these difficulties is the fact that researchers have been seriously constrained by lack of access to credit scores, debt to income ratios, or appraisal data.

Each of these is a legitimate factor in determining interest rates and other terms of mortgage loans and is very likely to be correlated with race. Minorities are more likely than whites to have lower wages, fewer assets, and other unfavorable economic circumstances that increase the financial risks for lenders. In addition, neighborhoods with a high concentration of minorities tend to have older housing stocks, lower quality schools, and higher crime rates, along with numerous other characteristics that drive down the assessed value of residential property. This information has been excluded from the dataset due to collection issues and privacy concerns. According to the Federal Reserve Board analysis, about 90 percent of all loans are reported by lending institutions that made only one loan in a particular tract. This information can be matched with publicly available information and used to identify individual borrowers. Lending institutions cite this as a reason they tend to be reluctant to include additional information such as credit scores. Without these controls, the estimated effects of race documented in the majority of previous studies are likely to be exaggerated.

Consequently, some researchers have sought innovative analysis strategies to approach this problem, drawing in part from studies of forms of racial discrimination in other institutional settings.

One way that researchers have tried to correct for the problem of omitted

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variable bias is by examining the outcomes of practices, such as motor vehicle searches with the assumption that individuals respond to the probability of being searched.25, 26 If individuals with a high probability of being searched respond by seldom carrying contraband substances, then we would expect the “hit” rate to be higher for those with a lower probability of being searched. This line of research argues that by measuring outcomes and not including controls for other variables that might be correlated with race, we can detect the presence of racial discrimination without worrying about the impact of omitted or included variable bias.

However, applying this theory to the probability of receiving a high-interest loan is problematic due to the existence of predatory lending in the subprime market. One piece of predatory lending behavior involves assigning high interest rates to borrowers that qualify for lower interest rates and gaining a cash bonus as a reward. This bonus is called a yield spread premium, and the Center for Responsible Lending estimates that these premiums are quite common in subprime loans.27 While not all loans with yield spread premiums are abusive, the Center for Responsible Lending argues that they create an incentive to lenders to give such high interest rates to borrowers that they inhibit a borrower’s ability to build equity on his or her loan. If so, and if lenders assign yield spread premiums in a discriminatory manner, then we would

not expect discrimination to result in better loan performance on average for the group against which lenders discriminate, as the yield spread premiums would in fact drive down the loan performance of those receiving them.

**Improved Data Availability**

The 2004 HMDA data were released in September of 2005. The dataset created a buzz among anti-predatory lending advocates because it included updates useful for estimating the size of the subprime mortgage lending market and determining how subprime lending correlates with race. The most important new part of the dataset, which has been released annually since the passage of HMDA in 1975, is the disclosure of rate spreads, defined by the Federal Reserve of St. Louis as the “difference between the annual percentage rate (APR) on a loan at consummation and the yield of a Treasury security of comparable maturity.”

Rate spreads are reported in the 2004 HMDA dataset if annual percentage rates exceed the Treasury security rate by 3 percentage points for first lien loans and by 5 percentage points for second lien loans. The annual Treasury security rate ranged between 4.67 and 5.54 in 2004, with an

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average rate of 5.02 overall. A rate spread of 3.0 therefore indicates an annual percentage rate of approximately 8.0.

Other important new information being reported under the revised regulation is whether the loan is a first lien, a junior lien, or unsecured (characteristics referred to here as a loan’s lien status), whether it is secured by a manufactured home, and whether it is subject to the protections of the Home Ownership and Equity Protection Act of 1994 (HOEPA). These new pieces of information allow for a better understanding of lending activity in the higher-priced segment of the home-loan market, a segment that was virtually nonexistent a decade or so ago and is now a substantial part of the market.

Since the release of this dataset, a number of papers have been published by organizations seeking to discover whether racial disparities are present in subprime lending, as many have suspected for some time.

The Present Study

The State of Louisiana was chosen for this study because prior research shows that racial disparities in high cost loans are more prevalent in the Southeast than in other regions of the United States and that some of the largest disparities appear in MSAs in Louisiana. Furthermore, an analysis of the subprime market in Louisiana is

29 See Federal Reserve Board’s Schedule C, available at: http://www.ffiec.gov/ratespread/YieldTable.CSV.
particularly timely due to the impact of Hurricane Katrina on the state’s housing market.

The Federal Reserve analysis of the 2004 HMDA data indicated that lending institution may have more explanatory power than race. The analysis found that the greatest reduction in the incidence of high cost loans appeared when the lending institution was controlled in addition to borrower characteristics. Based on this information, the current study controls for lending institution by including a set of dummy variables in the statistical model.
Chapter 3. Data and Methods

Data
The present study uses data collected in accordance with the 2004 HMDA, a dataset that contains detailed information on financial institutions’ mortgage lending activity in the United States. The HMDA is nationally representative but does not include information on all loans made in the U.S. Loans made at small institutions are excluded. Unlike previous versions of these data, the 2004 dataset includes rate spread information for all loans exceeding the treasury securities rate by 3 percent for first lien loans and 5 percent for second lien loans.

Sample
The sample for this analysis is restricted to individuals receiving conventional first-lien home purchase loans for a single-family, owner-occupied home. The sample includes only loans made in the State of Louisiana in one of Louisiana’s eight Metropolitan Statistical Areas (MSAs) as measured by the 2000 census. The final sample contained 30,746 observations, representing approximately 82 percent of all conventional first-lien, single-family, owner-occupied home purchase loans in the state, as reported by HMDA.
**Variables**

The dependent variable is whether an individual applying for a loan receives a prime or high cost loan. For this analysis, a loan is considered high cost if it exceeds an 8 percent interest rate.

The key explanatory variable is the applicant’s minority status, measured using a series of dummy variables indicating whether he or she was black, white, Asian, Native Hawaiian or other Pacific Islander, or American Indian or Native Alaskan. Race was missing for 2,217 or about 7 percent of the sample. To account for the missing information and to help determine if the missing values were systematically different from the non-missing values, a dummy variable was included where 1 indicates missing.

The other explanatory variables are ethnicity, measured as a yes/no variable where 1 equals Hispanic; log of income measured in thousands of dollars; presence of a co-applicant measured as a yes/no variable where 1 equals yes; applicant gender, measured as a dummy variable where 1 equals male and 0 equals female; loan amount, measured in thousands of dollars; neighborhood characteristics, which include neighborhood population measured in thousands, percent minority in neighborhood, number of owner-occupied units in neighborhood, number of 1 to 4 unit single-family homes in neighborhood, median income for the MSA, and the ratio of neighborhood median income to MSA median income; and lending institution. The lending
institution was measured as a set of yes/no variables where 1 indicates yes for a particular institution.

Due multicolinearity issues, banks that made fewer than 250 loans were assigned a single yes/no variable. Beyond the issue of multicolinearity was the question of whether small banks were more likely to originate high cost loans than large banks. The subset of small banks included the vast majority of lenders—398 of the entire sample, which included 422 lending institutions. The remaining 24 institutions were each assigned a unique yes/no variable. In addition to the race variables, missing indicator variables were included for ethnicity, income, gender, and neighborhood characteristics.

Table 1 shows the frequency and proportion of borrower characteristics, including race and gender. There are 30,746 approved loans in this sample. Of those, 4,963, or 16.14 percent, were also high cost loans. Nearly 15 percent of the entire sample of applicants accepted for home mortgage loans was black, compared to more than 36 percent of applicants receiving high cost loans. While nearly 75 percent of the entire sample was white, whites made up only 53 percent of applicants receiving high cost loans. Females made up approximately 29 percent of the sample and received about 35 percent of the high cost loans. Finally, more than 52 percent of high cost loans were made by HUD regulated lenders.
**Limitations**

The information in the HMDA dataset imposes limitations on the proposed model. The key limitation is the dataset’s exclusion of information on the borrower’s creditworthiness. Without such information, it is difficult to truly determine whether differences in the probability of receiving a high cost loan are attributable to race or if in fact much of this difference could be explained by the borrower’s creditworthiness. The omission of this measure could potentially overestimate the effect of race. The dataset is further limited in that it does not include measures of borrower characteristics beyond race, ethnicity, and presence of a co-applicant that might influence the likelihood that an individual receives a high cost loan, such as marital status, number of dependents, and age of the borrower. The dataset is also limited on measures of neighborhood characteristics. The available neighborhood characteristics measure the race, income, and size of each tract, but do not provide information on the local housing market. Economic measures such as median home price, competitiveness of the local housing market, rate of growth or decline in the local housing market, and number of foreclosures in the neighborhood would help better determine how neighborhood characteristics impact the likelihood that a borrower receives a high cost loan.

Additionally, there is no information in the dataset on the performance of the loan after it is originated. Such information on loan performance could give a better
sense of how well assigned interest rates reflect the actual risk lenders undertake in originating loans. Finally, the HMDA data are useful only for detecting racial disparities in high cost loan rates but not useful for detecting the prevalence of predatory lending or determining whether a particular loan is predatory or just subprime. Predatory loans not only have high-interest rates, but also exorbitant fees and highly restrictive payment terms. To properly measure the prevalence of predatory lending, specific information on the loan terms is necessary.

Table 2 presents descriptive information on borrower income, loan amount, and neighborhood characteristics. The average median annual income for all eight MSAs was $50,153.00. The average loan amount taken by applicants in the sample was approximately $141,289.00, while the average amount for applicants receiving high cost loans was $106,504.00 approximately. The average neighborhood in the sample was nearly 26 percent minority; the average minority percentage for applicants receiving high cost loans was 36. Loans made in the Baton Rouge and New Orleans areas made up more than 64 percent of all loans in the sample and more than 60 percent of all high cost loans.

Methods

To address the research question, the proposed study uses several bivariate statistics including: cross-tabulations (chi squared tests), tests for significant
differences in means across applicants in income, race, and race of co-applicant (t-tests), and correlations. The probit model shown below is used to determine the probability that an applicant received a high cost loan versus a prime loan.

\[
\text{HIGHCOST} = \beta_0 + \beta_1 RACE_i + \beta_2 BORROWER_i + \beta_3 LOAN_i + \\
\beta_4 \text{NEIGHBORHOOD}_i \beta_5 \text{LENDER}_i + \beta_6 \text{MISSING}_i + \partial
\]

where:

- \( RACE_i \) - vector of dummy variables for the race/ethnicity of the loan applicant
- \( BORROWER_i \) - vector of demographic characteristics of the applicant
- \( LOAN_i \) - vector of characteristics of the loan
- \( \text{NEIGHBORHOOD}_i \) - vector of neighborhood characteristics of the property to be financed
- \( \text{LENDER}_i \) - vector of dummy variables for the loan’s originating institution
- \( \text{MISSING}_i \) - vector of dummy variables for loan transactions with incomplete information
- \( \beta_0 \) - \( \beta_6 \) - parameters to be estimated
- \( \partial \) - variance not explained by the included variables

Although it would be ideal, it is difficult to construct a plausible two-stage model using HMDA 2004 data alone. To estimate the first model -- selection into the pool of accepted applicants -- it would be necessary to find an instrument to uniquely
identify this equation that while correlated with the individual’s selection, is not statistically associated with the probability of receiving a high cost loan. Because the two dependent variables, probability of loan approval and probability of receiving a high interest rate, are so closely related it is extremely difficult to identify a defensible instrument in practice. Date of loan application might be an appropriate instrument if the treasury securities rate climbed significantly on a particular date, but Schedule C shows no dramatic hike in the securities rate. Furthermore, the HMDA dataset provides no information on loan application date beyond the year.

Another possible instrument could be geographic location if local policies exist in certain locations that limit predatory lending practices. However, such an instrument would be more useful for analyzing state level data due to the limited scope of local legislation. Furthermore, to the extent that the existence of local legislation exists only in areas where predatory lending has been a problem as opposed to areas with highly motivated local policymakers, an instrument of this type may lead to an over/under estimation of the true effect of race on the probability of receiving a high cost loan.
Chapter 4. Results

Tables 3 and 4 show the results from the probit regression model. There is a statistically significant effect for Black on Highcost, such that being black increases the likelihood of receiving a high cost loan by 13.82 percent as compared to being white. There was also a statistically significant effect for Native such that being Native American or Native Alaskan increases the likelihood of receiving a loan with an APR greater than 8.0 percent by 6.92 percent, as compared to being white. Both of these effects included controls for gender, ethnicity, loan amount, income, neighborhood characteristics, and lending institution. The coefficients on Asian and Pacific were small and indicated a slightly reduced likelihood of receiving a high cost loan as compared to White, but both effects were insignificant.

The effect of Hispanic on Highcost indicated a possible increased likelihood for receiving a high cost loan for being Hispanic versus not being Hispanic, but the effect is not statistically significant.

A surprise result is that males have a greater likelihood of receiving a high cost loan than females do, by 1.13 percent. The result is small, as compared to the effect sizes of Black and Pacific, but statistically significant.

The results further indicate a statistically significant effect for having a co-applicant such that applicants with a co-applicant were 2.20 percent less likely to
receive a high cost loan than applicants without a co-applicant were. The results also show statistically significant effects for both loan amount and income, such that as each of these variables increase, the likelihood of receiving a high cost loan decreases. This effect is greater for the applicant’s income than for the loan amount.

The effects for neighborhood characteristics were all statistically significant, but very small. The results show that as the number of single-family homes in a neighborhood increases, the likelihood of receiving a high cost loan decreases. Increasing MSA median income, ratio of tract to MSA median income, and tract population also lead to a decreasing likelihood of receiving a high cost loan. As expected, as the percent of the minority population in a neighborhood increases, so does the likelihood of receiving a high cost loan. Contrary to expectation, increased numbers of owner-occupied units in a neighborhood is also associated with an increased likelihood of receiving a high cost loan.

A troubling result from this regression is the statistical significance found on the dummy variables representing missing values on observations. Statistical significance on these variables indicates that the observations for which no information has been provided are statistically different from the remainder of the sample. In this model, statistically significant missing variables appear for race, gender, income, and neighborhood characteristics. Applicants with missing values on race were 6.29
percent more likely to receive a high cost loan, while applicants with missing values for gender were 3.90 percent less likely to receive a high cost loan. The likelihood of receiving a high cost loan decreased for applicants with missing income information by 2.17 percent. Missing information on these observations was due to one or more of several reasons: the applicant chose not to self-report this information in their mail, internet, or telephone application for the race and gender variables; or the loan was purchased and the purchasing agency failed to report this information. Approximately 1.76 percent of the observations were missing information on race, gender, and income. However, 2.67 percent of all observations are missing on both race and gender, with a statistically significant correlation of $r = 0.56$. Only 883 observations had missing information on gender, as opposed to 2,219 missing on race, but nearly 93 percent of the observations that were missing for gender were also missing for race.

The largest effect from missing data comes from those observations that were missing information on neighborhood characteristics. This information is missing because these observations were also missing information on the census tract for which the loan originated. Those with missing neighborhood data were 17.04 percent more likely to receive a high cost loan than the rest of the sample. However, there are only 42 observations that are missing information on neighborhood characteristics, representing just 0.14 percent of the entire sample. Approximately 82 percent of these
observations are from banks regulated by the Federal Deposit Insurance Corporation or FDIC, which suggests the possibility that the FDIC may have had less restrictive reporting requirements. None of the variables that were missing information on neighborhood characteristics were missing information on race, gender, ethnicity, or income.

This regression also examines the effect of lending institution on the likelihood of receiving a high cost loan. To prevent multicollinearity problems due to lack of variance in banks issuing only a small number of loans, and to investigate the possibility that small banks differ from large banks in their tendency to assign high cost loans, all banks that originated fewer than 250 loans were assigned a single dummy variable, Bank01. The bank that originated the most loans was used as the reference group. This lender, Hibernia Home Loans, based in Baton Rouge, originated 3,102 loans within this sample, which is just over 10 percent of all the loans for the sample. Approximately 0.17 percent of these loans were high cost, which is a much smaller proportion than that of the entire sample where 16.14 percent of all loans were high cost.

In general, the effect for the different lenders, as illustrated in Table 4, was statistically significant and indicated an increased likelihood of receiving a high cost loan as compared to Hibernia Home Loans. Only two banks with negative effects were
also statistically significant, indicating that most of the banks in this sample were more likely to originate high cost loans than Hibernia Home Loans was. These two banks each originated fewer than 1,000 loans, but were still among the institutions originating the greatest number of loans in the sample. The most notable effect sizes are found with Option One Mortgage Company, WMC Mortgage Corporation, Argent Mortgage Company, and Homecomings Financial Network, each of which were more than 50 percentage points more likely to originate high cost loans than Hibernia Home Loans was. However, some of the most frequent originators of high cost loans were among the banks that originated fewer than 250 loans total in the sample; thus, I am unable to detect a pattern for the size of bank that is most likely to originate subprime loans.
Chapter 5. Discussion

The results indicate a large disparate effect for blacks versus whites on the probability of receiving a high cost loan, even when controlling for gender, income, loan amount, and lending institution. However, due to omitted variable bias and systems selection bias, this result must be interpreted cautiously. As shown in the literature on home mortgage loans, income is not a proxy for creditworthiness. As such, the omission of a measure of creditworthiness from this regression likely produces an overestimate of the true effect of being black on the probability of receiving a high cost loan. While this is likely to be the most important omitted variable, it is likely that other variables are also omitted from the model, such as measures of neighborhood median home price, measures of housing market tightness, and other borrower information such as education and marital status. Median home cost, education, and marital status could each potentially produce an upward bias on the probability of receiving a high cost loan, thus leading to further overestimation of the effect of being black when these variables are excluded. It is unclear whether housing market tightness would produce an upward or downward bias on the regression model. In the next stage of this research, I plan to further explore these possibilities.
Finally, Knowles, Persico, and Todd\textsuperscript{30} might argue that the number of potential omitted variables could be endless in a study such as this where the goal of the research is to uncover possible racial discrimination. They would argue that it is necessary to omit all variables that might be correlated with race and instead compare an outcome, such as subsequent loan default, to lender propensity to assign a high cost loan rate versus a prime rate to see whether these outcomes match perceived risk. As discussed previously, this approach would need to be pursued carefully, as the existence of predatory lenders may drive otherwise qualified borrowers to default due to exorbitant fees, excessively high interest rates, and other abusive loan terms.

The other type of bias evident in this sample is systems selection bias. Failure to control for the probability that an individual was approved for a loan prior to receiving a prime or subprime interest rate could influence the results if individuals attempted to maximize their probability of acceptance by selecting into certain lending institutions. We might expect that if individuals were randomly assigned to banks that there would be higher rates of application rejection and fewer subprime loans originated. If this is the case, then the single-level probit model might again overestimate the true effect of being black on the likelihood of receiving a high cost loan.

As previously stated, though not all subprime loans are predatory, all predatory

loans are subprime. It is important to study disparate racial impact within the subprime market because hidden within the data on subprime loans are predatory loans. A booming subprime market may be an indicator of a booming predatory market as well. Predatory lenders often target low-income, low-education minorities and immigrants, as well as the elderly. However, in order to understand fully the nature of the predatory lending market, additional information on both borrowers and lenders is needed. While this study focuses solely on racial disparities in the subprime market, the large apparent effect of being black on the probability of receiving a high cost loan, despite possible flaws in the model, indicates the need for further study.

This study focuses on the State of Louisiana because previous research indicates that the south, and particularly the State of Louisiana, may have large subprime lending markets and significant racial disparities within those markets. Hurricane Katrina has left the housing market in much of the state severely damaged. Many low-income minorities, those most vulnerable to predatory lenders, lost their homes in the catastrophe. It is important for policymakers to understand the nature of the subprime lending market in Louisiana prior to Katrina in order to evaluate the risk residents may face when dealing with lenders as they attempt to rebuild their homes. The results of the current study show a significant gap between the likelihood that blacks versus whites received high cost loans in 2004. These findings reinforce the
need for a legislative policy response to protect consumers from unfair lending practices, particularly in the Gulf Coast region.

A recent report by Oxfam America notes that there is a “disturbing… possibility that promises to ‘build back better’ to confront poverty will go unfulfilled and many poor families and communities may end up worse off, permanently losing what they had August 28.”31 The same report notes that over 100,000 of the homes in the most heavily impacted areas of Louisiana were uninsured. The Oxfam report adamantly claims that rebuilding homes and neighborhoods will be the cornerstone to a successful recovery process. Among its recommendations to governors and state recovery agencies, the report emphasizes the importance of “using federal rebuilding funds to provide homebuyer counseling [and] access to non-predatory mortgage financing…”32 Furthermore, the Brookings Institution found that mortgage delinquency rates increased significantly in the last quarter of 2005.33

Further examination of the subprime lending market, not only in Louisiana, but throughout the U.S., is necessary for determining that mortgage products are originated fairly and for pinpointing abusive lending practices so that policymakers may take the appropriate action to curb this problem.

31 Oxfam America, “Recovering States?” p 3.
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### Tables

#### Table 1. Mean and Frequency of Key Variables: Part I

<table>
<thead>
<tr>
<th>Category</th>
<th>N</th>
<th>%</th>
<th>N for High Cost Loans</th>
<th>% of High Cost Loans</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Race</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>4,564</td>
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<td>Asian</td>
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<td>87</td>
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<td>7</td>
<td>0.14</td>
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<td>4,963</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>817</td>
<td>2.66</td>
<td>134</td>
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<td>26,634</td>
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<td>4,252</td>
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<tr>
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<td>577</td>
<td>11.62</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td>30,746</td>
<td>100%</td>
<td>4,963</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Male</td>
<td>20,819</td>
<td>67.71</td>
<td>3,112</td>
<td>62.70</td>
</tr>
<tr>
<td>Female</td>
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<td>29.42</td>
<td>1,744</td>
<td>35.14</td>
</tr>
<tr>
<td>Missing</td>
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<td>2.87</td>
<td>107</td>
<td>2.16</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>30,746</td>
<td>100%</td>
<td>4,963</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Co-Applicant</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Co-Applicant</td>
<td>12,485</td>
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<td>1,387</td>
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<td>No Co-Applicant or Missing</td>
<td>18,261</td>
<td>59.39</td>
<td>3,576</td>
<td>72.05</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>30,746</td>
<td>100%</td>
<td>4,963</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Regulatory Agency</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
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<td>OCC</td>
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<td>FRS</td>
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<td>794</td>
<td>16.00</td>
</tr>
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<td>FDIC</td>
<td>2,013</td>
<td>6.56</td>
<td>631</td>
<td>12.71</td>
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<td>OTS</td>
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<td>4.21</td>
</tr>
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<td>NCUA</td>
<td>465</td>
<td>1.51</td>
<td>21</td>
<td>0.42</td>
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<tr>
<td>HUD</td>
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<td>28.09</td>
<td>2,618</td>
<td>52.75</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>30,746</td>
<td>100%</td>
<td>4,963</td>
<td>100%</td>
</tr>
<tr>
<td>Category</td>
<td>N</td>
<td>%</td>
<td>N for High Cost Loans</td>
<td>% of High Cost Loans</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>-------</td>
<td>-------</td>
<td>-----------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Income</td>
<td>$74,200.95</td>
<td>$105,666.16</td>
<td>$57,112.96</td>
<td>$83,144.41</td>
</tr>
<tr>
<td>HUD Median Family Income</td>
<td>$50,153.00</td>
<td>$2,503.00</td>
<td>$49,907.00</td>
<td>$2836.00</td>
</tr>
<tr>
<td>Low Income: &lt;50% Median Income</td>
<td>2,210</td>
<td>7.19%</td>
<td>639</td>
<td>12.88%</td>
</tr>
<tr>
<td>Moderate Income: &lt;80% Median Income</td>
<td>5,963</td>
<td>19.39%</td>
<td>1,402</td>
<td>28.25%</td>
</tr>
<tr>
<td>Middle Income &lt;120% Median Income</td>
<td>8,039</td>
<td>26.14%</td>
<td>1,489</td>
<td>30.00%</td>
</tr>
<tr>
<td>High Income &gt; 120% Median income</td>
<td>13,652</td>
<td>44.40%</td>
<td>1,340</td>
<td>27.00%</td>
</tr>
<tr>
<td>Missing</td>
<td>882</td>
<td>2.87%</td>
<td>93</td>
<td>1.87%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>30,746</td>
<td>100%</td>
<td>4,963</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Amount</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Loan Amount</td>
<td>$141,289.53</td>
<td>$92,134.11</td>
<td>$106,504.13</td>
<td>$74,677.81</td>
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<tr>
<td><strong>Tract Data (N = 847)</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tract Population</td>
<td>Avg = 5,489</td>
<td>SD = 2,305</td>
<td>Avg = 5,337</td>
<td>SD = 2,077</td>
</tr>
<tr>
<td>Number 1-4 Single Family Units</td>
<td>Avg = 1,963</td>
<td>SD = 790</td>
<td>Avg = 1909</td>
<td>SD = 736</td>
</tr>
<tr>
<td>Number Owner Occupied Units</td>
<td>Avg = 1,502</td>
<td>SD = 704</td>
<td>Avg = 1418</td>
<td>SD = 658</td>
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<tr>
<td>Percent Minority Population</td>
<td>Avg = 25.82%</td>
<td>SD = 23.63</td>
<td>Avg = 36.95%</td>
<td>SD = 28.98</td>
</tr>
<tr>
<td>Tract to MSA/MD Income %</td>
<td>Avg = 123.25%</td>
<td>SD = 41.40</td>
<td>Avg = 105.44%</td>
<td>SD = 33.98</td>
</tr>
<tr>
<td><strong>MSAs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alexandria- 34 Tracts</td>
<td>904</td>
<td>2.94%</td>
<td>289</td>
<td>5.42%</td>
</tr>
<tr>
<td>Baton Rouge- 120 Tracts</td>
<td>7,261</td>
<td>23.62%</td>
<td>1,229</td>
<td>24.76%</td>
</tr>
<tr>
<td>Houma- 42 Tracts</td>
<td>1,419</td>
<td>4.62%</td>
<td>261</td>
<td>5.26%</td>
</tr>
<tr>
<td>LaFayette- 81 Tracts</td>
<td>2,417</td>
<td>7.86%</td>
<td>286</td>
<td>5.76%</td>
</tr>
<tr>
<td>Lake Charles- 41 Tracts</td>
<td>1,617</td>
<td>5.26%</td>
<td>299</td>
<td>6.02%</td>
</tr>
<tr>
<td>Monroe- 41 Tracts</td>
<td>1,216</td>
<td>3.95%</td>
<td>257</td>
<td>5.18%</td>
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<tr>
<td>New Orleans- 394 Tracts</td>
<td>12,578</td>
<td>40.91%</td>
<td>1,780</td>
<td>35.87%</td>
</tr>
<tr>
<td>Shreveport-Bossier City- 94 Tracts</td>
<td>3,334</td>
<td>10.84%</td>
<td>582</td>
<td>11.73%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>30,746</td>
<td>100%</td>
<td>4,983</td>
<td>100%</td>
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</table>
Table 3. Likelihood of Receiving a High Cost Loan: Part I

<table>
<thead>
<tr>
<th>Race/gender dummies:</th>
<th>dF/dx</th>
<th>Std. Err.</th>
<th>z</th>
<th>P&gt;z</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blackº</td>
<td>0.14</td>
<td>0.01</td>
<td>22.83</td>
<td>**0.00</td>
<td>0.15</td>
</tr>
<tr>
<td>Asianº</td>
<td>-0.01</td>
<td>0.01</td>
<td>-1.18</td>
<td>0.24</td>
<td>0.02</td>
</tr>
<tr>
<td>Nativeº</td>
<td>0.07</td>
<td>0.03</td>
<td>2.41</td>
<td>**0.02</td>
<td>0.00</td>
</tr>
<tr>
<td>Pacificº</td>
<td>-0.02</td>
<td>0.03</td>
<td>-0.59</td>
<td>0.55</td>
<td>0.00</td>
</tr>
<tr>
<td>Missing Raceº</td>
<td>0.06</td>
<td>0.01</td>
<td>6.51</td>
<td>**0.00</td>
<td>0.07</td>
</tr>
<tr>
<td>Hispanicº</td>
<td>0.01</td>
<td>0.01</td>
<td>1.40</td>
<td>0.16</td>
<td>0.03</td>
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<tr>
<td>Missing Ethnicityº</td>
<td>0.01</td>
<td>0.01</td>
<td>3.08</td>
<td>**0.00</td>
<td>0.68</td>
</tr>
<tr>
<td>Maleº</td>
<td>-0.02</td>
<td>0.01</td>
<td>-3.94</td>
<td>**0.00</td>
<td>0.03</td>
</tr>
<tr>
<td>Missing Sexº</td>
<td>-0.02</td>
<td>0.01</td>
<td>-3.94</td>
<td>**0.00</td>
<td>0.03</td>
</tr>
</tbody>
</table>

Loan Characteristics

| Co-Applicantº | -0.02 | 0.00 | -5.73 | **0.00 | 0.41 |
| Loan amount in $1000s | 0.00 | 0.00 | -12.26 | **0.00 | 141.29 |
| Log of Income in $1000s | -0.02 | 0.00 | -4.20 | **0.00 | 4.08 |
| Missing Incomeº | -0.02 | 0.01 | -2.19 | **0.03 | 0.03 |

Neighborhood Characteristics

| # 1-4 Single family homes in Neighborhood | 0.00 | 0.00 | -1.75 | *0.08 | 1962.97 |
| MSA Median Income | 0.00 | 0.00 | -8.48 | **0.00 | 50153.10 |
| Percent Minority in Neighborhood | 0.00 | 0.00 | 3.15 | **0.00 | 25.82 |
| # Owner-Occupied Units in Neighborhood | 0.00 | 0.00 | 5.71 | **0.00 | 1502.07 |
| Neighborhood Population | 0.00 | 0.00 | -2.91 | **0.00 | 5489.50 |
| Ratio Tract to MSA median family income | 0.00 | 0.00 | -12.16 | **0.00 | 123.25 |
| Missing Neighborhood Characteristicsº | 0.17 | 0.07 | 3.42 | **0.00 | 0.00 |

| obs. P | 0.1613973 |
| pred. P | 0.0908457 (at x-bar) |

Note: z and P>z are the test of the underlying coefficient being 0
Note: (*) dF/dx is for discrete change of dummy variable from 0 to 1
Note: (**) is for statistical significance P>z 0.01
Table 4. Likelihood of Receiving a High Cost Loan: Part II

<table>
<thead>
<tr>
<th>Bank Dummy Variables</th>
<th>df/dx</th>
<th>Std. Err.</th>
<th>z</th>
<th>P&gt;z</th>
<th>Mean</th>
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</thead>
<tbody>
<tr>
<td>Banks with &lt; 250 loans</td>
<td>0.27</td>
<td>0.01</td>
<td>21.61</td>
<td>**0.00</td>
<td>0.39</td>
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<td>Option One Mortgage Corpº</td>
<td>0.62</td>
<td>0.03</td>
<td>19.14</td>
<td>**0.00</td>
<td>0.01</td>
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<td>American Home Mortgageº</td>
<td>0.19</td>
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<td>6.05</td>
<td>**0.00</td>
<td>0.01</td>
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<td>0.03</td>
<td>-0.94</td>
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<td>0.01</td>
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<td>0.04</td>
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<td>0.01</td>
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<td>0.04</td>
<td>12.83</td>
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<td>0.01</td>
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<tr>
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<td>6.34</td>
<td>**0.00</td>
<td>0.01</td>
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<tr>
<td>Irwin Mortgage Corporationº</td>
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<td>Argent Mortgage Companyº</td>
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<td>Homecomings Financial Networkº</td>
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<tr>
<td>Amsouth Bankº</td>
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<tr>
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<td>Union Planters Bankº</td>
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<td>National City Bank INº</td>
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</table>

Reference: Hibernia National Bank

Note: z and P>z are the test of the underlying coefficient being 0
Note: (*) df/dx is for discrete change of dummy variable from 0 to 1
Note: (*) is for statistical significance P>z 0.10
Note: (**) is for statistical significance P>z 0.01

obs. P 0.1613973
pred. P 0.0086457 (at x-bar)