Mortgage Lending in Boston: Interpreting HMDA Data

by
Alicia H. Munnell
Lynn E. Browne
James McEneaney
Geoffrey M. B. Tootell

Federal Reserve Bank of Boston

No. 92–7 October 1992

Working Paper

Mortgage Lending in Boston: Interpreting HMDA Data

by
Alicia H. Munnell
Lynn E. Browne
James McEneaney
Geoffrey M. B. Tootell

October 1992
Working Paper No. 92–7

Federal Reserve Bank of Boston

Mortgage Lending in Boston: Interpreting HMDA Data

by

Alicia H. Munnell, Lynn E. Browne, James McEneaney, and Geoffrey M.B. Tootell*
Federal Reserve Bank of Boston

*Director of Research, Deputy Director of Research for Regional Affairs, Research Department Administrator, and Economist, respectively, Federal Reserve Bank of Boston. The views expressed are those of the authors, and do not necessarily reflect official positions of the Federal Reserve Bank of Boston or the Federal Reserve System.

The authors are grateful to the many persons who contributed to this study. Early discussions within the Boston Fed with Bob Augusta and Allen DeYoung of the Examination Department and Patricia Allouise of the Legal Department contributed greatly to the design and strategy. Members of the Consumer Advisory Council of the Board of Governors, bankers, and underwriters provided insights on the workings of the mortgage lending market. The other supervisory agencies, including the OCC, the FDIC, OTS, and HUD, provided strong support for undertaking the survey. Martha Bethea and Glenn Canner of the Board staff greatly facilitated getting the survey launched. Once the questionnaires were returned, numerous summer interns and research assistants provided months of assistance under the able management of Betsy Morgan. Special thanks go to interns Janet Feldstein and Virginia Genao, to research assistants Thomas Miles, Faith Kasirye, and Meeta Anand, and to Computer Liaison staff Mary Chamberlain, Luci Rexroad, and Diana Stanevicz, and to consultant Anne Kinsella. Two drafts were read by experts within the Federal Reserve including Paul Calem of the Philadelphia Fed, Brian Cromwell of the San Francisco Fed, Mark Sniderman of the Cleveland Fed, and Glenn Canner: their comments and suggestions were invaluable. Robert Avery of Cornell University also provided useful comments on an early draft. John F. Kain of Harvard University, representatives of the other federal supervisory agencies, and Fannie Mae and Freddie Mac provided extensive and insightful comments on a revised version of the study. Joan Poskanzer edited and re-edited the document. Finally, the authors wish to thank all those financial institutions who responded to the questionnaire, making this study possible.

The Home Mortgage Disclosure Act (HMDA) data for 1990, which were released in October 1991, showed substantially higher denial rates for black and Hispanic applicants than for white applicants. These minorities were two to three times as likely to be denied mortgage loans as whites. In fact, high-income minorities in Boston were more likely to be turned down than low-income whites. The 1991 HMDA data, which are being released currently, show a similar pattern.

This pattern has triggered a resurgence of the debate on whether discrimination exists in home mortgage lending. Some people believe that the disparities in denial rates are evidence of discrimination on the part of banks and other lending institutions. Others, including lenders, argue that such conclusions are unwarranted, because the HMDA data do not include information on credit histories, loan-to-value ratios, and other factors considered in making mortgage decisions. These missing pieces of information, they argue, explain the high denial rates for minorities.

Because the applicant and loan characteristics collected under HMDA are indeed limited, the Federal Reserve Bank of Boston, with the support of the other supervisory agencies, asked financial institutions operating in the Boston Metropolitan Statistical Area (MSA) to provide additional information on the financial and employment variables that lenders have indicated are relevant to the mortgage lending decision. This information was requested for all applications for conventional mortgage loans made by blacks and Hispanics in 1990 and for a random sample of 3300 applications made by whites. Substantial lender cooperation resulted in a very good response rate and high-quality data. The additional data, combined with Census information on neighborhood characteristics, were used to develop a model of the determinants of mortgage lending decisions in the Boston area. This model was then

employed to test whether race was a significant factor in the lending decision once financial, employment, and neighborhood characteristics were taken into account.

The results of this study indicate that minority applicants, on average, do have greater debt burdens, higher loan-to-value ratios, and weaker credit histories and they are less likely to buy single-family homes than white applicants, and that these disadvantages do account for a large portion of the difference in denial rates. Including the additional information on applicant and property characteristics reduces the disparity between minority and white denials from the originally reported ratio of 2.7 to 1 to roughly 1.6 to 1. But these factors do not wholly eliminate the disparity, since the adjusted ratio implies that even after controlling for financial, employment, and neighborhood characteristics, black and Hispanic mortgage applicants in the Boston metropolitan area are roughly 60 percent more likely to be turned down than whites. This discrepancy means that minority applicants with the same economic and property characteristics as white applicants would experience a denial rate of 17 percent rather than the actual white denial rate of 11 percent. Thus, in the end, a statistically significant gap remains, which is associated with race.

The information gathered in this survey provides some insight into how this outcome emerges. Many observers believe that no rational lender would turn down a perfectly good application simply because the applicant is a member of a minority group. The results of this survey confirm this perception; minorities with unblemished credentials are almost (97 percent) certain of being approved. But the majority of borrowers - both white and minority - are not perfect, and lenders have considerable discretion over the

extent to which they consider these imperfections as well as compensating factors.

To take just one example, two key standards for selling mortgage loans in the secondary market are the "obligation ratios," which relate the applicant's housing expense to total income and total debt burden to total income. Secondary market guidelines suggest benchmarks of 28 percent and 36 percent, respectively, although they go on to add that "a lender may use a higher ratio... when there are fully documented compensating factors ..." (Fannie Mae 1992, p. 654). More than one-half of the applications in this sample exceeded one of these benchmarks, and lenders approved and sold into the secondary market some loans with ratios in excess of 36 percent and 44 percent, respectively.

The secondary market's flexibility in this area undoubtedly increases the general availability of mortgage funds for both minorities and whites. Moreover, this willingness to lend to imperfect borrowers is justified: historically, residential mortgages have been very safe investments. The difficulty is that unless primary market lenders apply the flexibility in a nondiscriminatory manner, minority applicants will not benefit to the same degree as white applicants. The results of this study suggest that for the same imperfections whites seem to enjoy a general presumption of creditworthiness that black and Hispanic applicants do not, and that lenders seem to be more willing to overlook flaws for white applicants than for minority applicants.

The preponderance of flawed applicants and the significant discretion accorded lenders have important implications for the efficacy of bank examinations for compliance with the fair lending laws. Since the bulk of applications contain some flaws, most denials will appear legitimate by some

objective standard. Moreover, this study found that denied black/Hispanic applications on average have poorer objective qualifications than denied white applications; that is, as measured by the median value, denied minorities had lower income and wealth, higher obligation and loan-to-value ratios, and worse credit histories than denied whites. If these patterns hold true elsewhere, a systematic bias in mortgage lending is very difficult to document at the institution level, particularly when the number of minority applications is small, as it is in the vast majority of institutions. It becomes apparent only when many applications are aggregated. As the supervisory agencies themselves have already recognized, under existing examination procedures, examiners can be expected to uncover only the most flagrant abuses.

I. The Boston Area and the Boston Fed's 1989 Study of Mortgage Lending

Boston is the eighth largest metropolitan statistical area in the nation, with a population in 1990 of 2.9 million.[1] The area comprises more than 100 politically distinct cities and towns. The largest of these communities is the City of Boston, with a population of 574,000. Boston is an old city with long-established neighborhoods, many of which are defined along ethnic and racial lines. The communities surrounding the City of Boston were also founded many years ago and their development has taken varied paths. Some are lightly populated, almost exclusively residential communities. Others function as small cities in their own right, as well as suburbs to the City of Boston.

---

[1] Boston is actually considered a primary metropolitan statistical area (PMSA), meaning that it falls within an even larger agglomeration called a consolidated metropolitan statistical area (CMSA). The Boston CMSA is the seventh largest in the nation and stretches north into New Hampshire.

About 15 percent of the Boston area population is minority (Table 1). As can be seen from the map, the minority population, especially the black population, is concentrated in the City of Boston and surrounding communities. Seventy percent of blacks live in the City, where they make up 24 percent of the population. Within the City, blacks also tend to be very concentrated; many live in neighborhoods where more than 50 percent of the population is black. The Hispanic population tends to live in the area's smaller cities as well as in the City of Boston. Both blacks and Hispanics are underrepresented in the more residential, suburban communities. Many of the more rural communities are almost entirely white.

A relatively small proportion of the Boston PMSA housing stock is in single-unit structures and a relatively large fraction is made up of properties with two to four units. Single-unit properties are especially scarce, and two- to four-unit properties are most common in the City of Boston and some of the small cities. This pattern may have some bearing on mortgage lending decisions, because evaluating an application to purchase a property with more than one unit requires an assessment of the stream of rental income that will be generated by the additional units.

In 1989, the Federal Reserve Bank of Boston examined the pattern of mortgage lending in the City of Boston and concluded that housing and mortgage credit markets were functioning in a way that hurt black neighborhoods (Bradbury, Case, and Dunham 1989). The number of mortgage originations relative to the owner-occupied housing stock was 24 percent lower in black neighborhoods than in white neighborhoods, after taking account of economic variables such as income, wealth, and other factors.[2] The study, however,

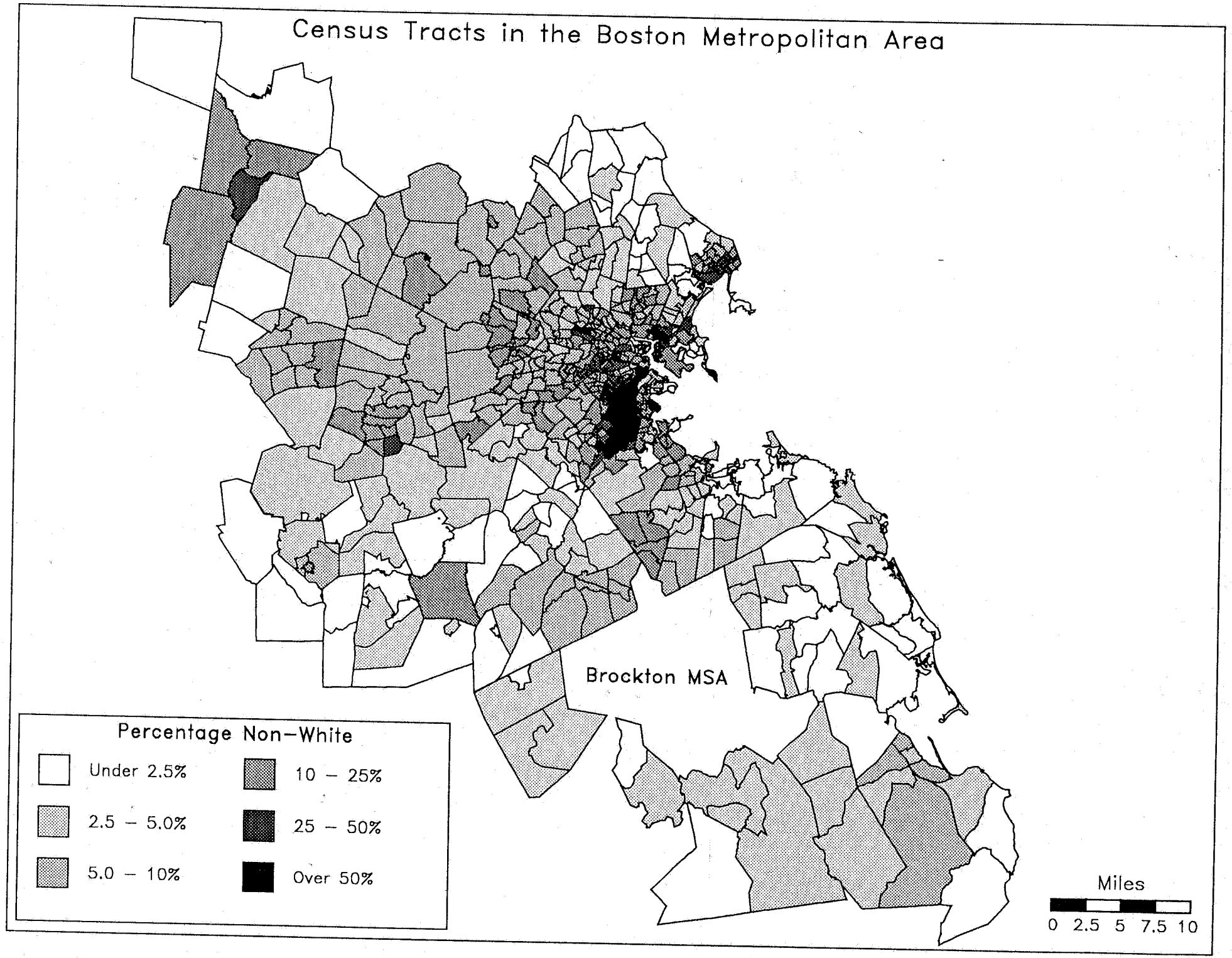
[2]The results were consistent with some earlier studies that have found evidence of redlining (Avery and Buynak 1981; Dedman and others 1988; Gabriel and Rosenthal 1991). Three other studies, however, found no conclusive

Table 1
Characteristics of the Boston Primary Metropolitan Statistical Area

Area	Total Population 000s	Percent Distribution by Race			
		White[a]	Black[a]	Hispanic	Other[a]
Boston PMSA	2,870.7	85.0	6.8	4.5	3.7
City of Boston	574.3	59.0	23.8	10.8	6.4
Other Central City[b]	299.9	80.0	7.1	7.5	5.4
Not in Central City	1,996.5	93.2	1.9	2.2	2.7

[a]Not of Hispanic origin.
[b]Cambridge, Framingham, Lynn and Waltham. Only Cambridge borders the City of Boston.

Source: U.S. Bureau of the Census, 1990 Census of Population and Housing.


Census Tracts in the Boston Metropolitan Area
Brockton MSA
Percentage Non-White
Under 2.5%
2.5 – 5.0%
5.0 – 10%
10 – 25%
25 – 50%
Over 50%
Miles
0 2.5 5 7.5 10

could not distinguish between discrimination in the housing market and discrimination in the mortgage market. From the available data, it was not possible to sort out the precise role played by lenders, as opposed to buyers, sellers, developers, realtors, appraisers, insurers, and others. Thus, a possible interpretation of the earlier study was that fewer mortgages were made in black neighborhoods because people in black neighborhoods did not buy houses as frequently as residents of white neighborhoods and therefore did not apply for as many mortgages.

The results of this study do not suffer from this ambiguity. Instead of analyzing the location of mortgage loans, this study explores the factors affecting the decision to approve or deny mortgage applications. In other words, it bypasses the contention that blacks and Hispanics never enter the doors of financial institutions and looks at what happens to individuals after they are inside the institution and actually apply for a mortgage loan. Such a study is possible because amendments to HMDA in 1989 required that lenders report not only the location of loans actually made but also the sex, race, and income of individual applicants and whether the application was approved or denied.[3] Thus, 1990 was the first year for which information was

---

evidence that redlining had been practiced by lenders (Benston, Horsky, and Weingartner 1978; Canner, Gabriel, and Woolley 1991; Schafer and Ladd 1981). The different results from these studies appear to depend on the definition of redlining used by the researcher. Studies that characterized redlining in terms of the amount of lending in a particular area were more likely to find evidence of redlining. Others that looked at differences in the terms of mortgage loans across neighborhoods found no conclusive evidence of redlining.

[3]The Home Mortgage Disclosure Act was enacted in 1975 in response to concerns voiced by community activists that banks had demarcated areas in cities where they were unwilling to make mortgage loans. The legislation required that banks report the number of mortgage loans made by location of property. These data, however, were never particularly useful in evaluating banks' performance, since standards were not available against which to evaluate bank lending patterns nor was information available on individual applicants.

available about the applicant as well as the property and about applications that were denied as well as approved. The new data changed the focus of concern from "redlining," that is, differential treatment by lenders based on location of a property, to discrimination, that is, differential treatment of applicants based on race or other personal, rather than economic, characteristics.[4]

II. The Mortgage Lending Decision

In order to determine whether race plays a role in the lending decision, it is necessary first to account for all the economic factors that might bear on the financial institution's decision. If relevant economic variables are not considered and they vary across racial groups, then a rational and legitimate decision to deny a mortgage may appear to be based on race. For

---

[4]Although HMDA did not provide information on mortgage applications until 1990, three major studies of applications data were conducted in the late 1970s. In 1977, the Comptroller of the Currency and the Federal Deposit Insurance Corporation sponsored a nationwide survey to determine what economic characteristics were important in bank lending decisions and whether race or sex entered into the determination (Black, Schweitzer, and Mandell 1978). Based on an analysis of roughly 5,000 completed returns, the researchers found that race played a statistically significant, although not particularly large, role in the lending decision.

In 1981, the MIT-Harvard Joint Center for Urban Studies published an extensive study of mortgage lending decisions in New York and California; one portion of this study focused on individual applications (Schafer and Ladd 1981). Mortgage application data were provided by state-regulated savings and loans in California and all state-regulated commercial banks, mutual savings banks, and savings and loans in New York. Based on the information included in a very large sample of loans, the authors determined that blacks had a much greater chance of denial than white applicants with equivalent socioeconomic, property, and neighborhood characteristics.

The third study was conducted in 1978 by the Federal Home Loan Bank Board (King 1980). Examiners collected data for 4,776 mortgage applications in a special examination of federally insured savings and loan associations in Miami, San Antonio, and Toledo. The study found statistically significant evidence that black and Hispanic applicants were more likely to be denied than comparable white applicants. The researchers speculated that differences in credit histories might have contributed to this result, but lacked the data to test this hypothesis.

example, if minority applicants have poorer credit records than whites, minorities will be rejected at a higher rate than whites. If credit information is not included in the analysis, the higher minority denial rate would appear to be discrimination even if race were never considered by the lender. The only way to determine whether lenders' decisions are influenced by race is to include in a model all the economic variables that are available to the lender and that might cause a loan to be denied, and then test to see whether race is still a significant and important factor in the decision.

The Mortgage Application Process

The mortgage application and approval procedure is complex and far from mechanical. It generally consists of three steps - a quick review of the application for viability, verification of the information and an appraisal of the property, and an evaluation of the numbers and consideration of any "compensating factors."

An applicant who has decided to purchase a property selects a lender, based on proximity, attractiveness of rates and fees, or some other factor, and fills out a standard loan application form, such as Fannie Mae Form 1003. This can be done at the lender's site, by mail or via telephone, or by a mortgage broker at the applicant's home. The information contained on the application is used by the intake person or the loan officer to make an immediate decision as to the ultimate viability of the loan. If the loan does not appear viable, the lender may make its credit decision at that time and deny the application. This initial review process saves some borrowers application fees, but also represents the first level of discretion in the process.[5]

---

[5]This paragraph describes the appropriate form of an initial review, which involves the completion of an application and an explicit denial or encouragement by the lender. Examiners, however, are very concerned about the

If the lender believes that the applicant has a reasonable chance of approval, the process enters a more comprehensive stage. The lender attempts to verify the information to ensure that the applicant has the financial ability and inclination to repay the loan, and sufficient liquid funds for a down payment and closing costs. Verification of employment provides some assurance about both the adequacy of the income and the likelihood of continuation of the current employment. A credit history report may provide some information about the applicant's commitment to paying debts. A verification of bank deposits indicates whether liquid assets are sufficient; this step also provides some information about whether a gift, grant, or loan, rather than savings, serves as the down payment.

If the information on the application is verified, the lender will take a hard look at the numbers, such as the ratios of monthly housing expense to income and total obligations to income. These ratios are important indicators of the ability to sell the mortgage in the secondary market. Secondary market purchasers, such as Fannie Mae and Freddie Mac, use 28 percent and 36 percent, respectively, as maximum guidelines for these ratios, but these are guidelines, and subject to considerable discretion on the part of the lender. Assuming the application is still viable, the lender will proceed with an appraisal and calculate the loan-to-value ratio. The secondary market uses 80 percent as a threshold for loan to value, but with private mortgage insurance higher ratios are permitted.

At this point, the lender is in a position to approve or deny the loan. If the credit history is clean, the applicant has a good supply of cash, all

---

prevalence of informal pre-screening where applicants are discouraged from even filing a formal application or are not provided with the adverse action notice, which is required by law when the informal process is pursued to the point where the lender, in fact, makes a credit decision.

the debt and loan-to-value ratios are within the guidelines, and the property is a single-family home in a desirable neighborhood, the decision is relatively easy and, indeed, the application could probably be analyzed and approved by a computer. However, few (less than 20 percent) borrowers are without blemish and, therefore, lenders are left considerable room for subjectivity and discretion. To offset negatives, lenders can use a host of "compensating factors." For example, to compensate for high debt-to-income ratios, lenders might note a large down payment, a good record of carrying high housing expenses, a strong propensity to save and a high level of liquid assets, and an excellent potential for future earnings based on education and training. Similarly, to compensate for credit history problems, lenders might be willing to accept favorable letters from creditors, extenuating circumstances such as an adverse judgment in a civil suit, or simply prior life circumstances that have changed for the better. In other words, many flawed loan applications can be brought to a viable status and even made eligible for sale in the secondary market.

A Model of Mortgage Lending

The information gathered and analyzed in the mortgage application process can be used to model the mortgage lending decision. Because little is known about the relationship between applicant characteristics and actual loan performance, any model must by necessity explain what lenders actually consider when making their decisions rather than what they ought to consider.

Mortgage lenders are assumed to maximize the expected profit of the institution. This goal requires that financial institutions attempt to minimize the probability and costs of default associated with each mortgage

loan.[6] This means that the probability of a lender denying a mortgage application P(D) is a function of the applicant's ability to carry the loan (F), the risks of default (R), the potential loss associated with default and foreclosure (L), and the terms of the loan (T). Although these factors are listed separately, they are all interrelated; for example, an applicant's ability to carry a loan depends on the terms of the loan. If the lender's judgment is influenced by the race or other personal characteristics of the applicant (C), that will also affect the likelihood of denial. That is,

$$P(D) = f(F,R,L,T,C).$$

The original HMDA data include only one piece of economic information about the applicant - namely, income. Income alone actually has less explanatory power than one might expect, because lower-income borrowers usually buy lower-priced homes. Moreover, as the discussion above suggests, many other variables affect the mortgage lending decision. Thus, the Federal Reserve Bank of Boston attempted to augment the 1990 HMDA report by gathering information on 38 additional variables. These variables were selected on the basis of numerous conversations with lenders, underwriters, and others familiar with the lending process. Most of the variables come from standard loan application forms; several are taken from credit reports and a few from lenders' worksheets. The following is a brief summary of the major groupings of variables.

---

[6]Maximizing expected profit requires maximizing the difference between the return on mortgage lending and the cost of funds to the lender. In the case of home mortgages, however, applications are usually either rejected or accepted at the market interest rate. Given expectations of inflation, the market rate should generate a profit on loans that fulfill monthly payment commitments. Thus, the primary task facing the lender is avoiding default and any associated losses. Even if the lender sells the loan on the secondary market, default remains a concern, as the purchaser can return the loan to the originator. At a minimum, secondary market buyers will not continue to buy from lenders whose loans frequently default.

Ability of applicant to support loan. The original HMDA data did not include information on two financial concepts - obligation ratios and wealth - that could have considerable bearing on the applicant's ability to carry and repay the mortgage loan. "Obligation ratios," which measure proposed housing expenses relative to income and total debt payment obligations relative to income, indicate whether the applicant can afford the mortgage more clearly than income alone. In addition, because the secondary market has established guidelines for these ratios and because today most mortgages are sold in the secondary market, lenders must be concerned about how the obligation ratios affect the loans' marketability.

Economists contend that wealth may also be important to the lender's decision, since substantial wealth can make debt repayment easy even when income is low and obligation ratios are high. Not only can wealthy individuals spend down their wealth, but also liquid assets can be a cushion that prevents a temporary job loss or other income disruption from resulting in a mortgage default. Bankers and other lenders who were consulted said, however, that the available wealth information is not very reliable, and, for this reason, they tend to place little weight on wealth, with the exception of verifiable liquid assets. Nevertheless, information was collected on total assets and total liabilities, as well as liquid assets.

Risk of default. Two groups of variables - one relating to applicants' reliability as borrowers and one pertaining to the stability of the applicants' income - were collected in order to capture the possibility that the applicants' circumstances might change and their commitment or ability to repay the loan might decline.

Reliability of Borrower: Lenders state that they place considerable weight on applicants' credit histories in judging their commitment to meeting

mortgage obligations. The contention is that past behavior may signal creditworthiness in the future; some people may be more responsible about credit obligations than others and, therefore, less likely to default. Loan underwriters tend to view certain elements of the credit report as more important than others. For example, failure to meet previous mortgage commitments is said to be viewed more seriously than a late credit card payment. Likewise, public record of default, foreclosure, or bankruptcy is considered especially damaging to the borrower. This study constructed a concise outline of the prospective borrower's past creditor relationships that provides substantial detail about different credit categories.

Stability of Income: Mortgage application forms devote considerable space to questions concerning the labor force status of the applicant. In addition to earnings, the lender collects information on industry, profession, seniority, years in this type of employment, age, and education. These questions are aimed at determining how easily the applicant will be able to carry the mortgage not only now, but also over an extended period. This information was used to calculate a rough estimate of the probability that the applicant will become unemployed.[7] If, because of differences in education and skills or labor market discrimination, minorities are concentrated in jobs that have a higher risk of unemployment, then unstable incomes could be the reason for denials that appear to be attributable to differential treatment in the lending decision. Only by explicitly including a variable representing

[7]A more sophisticated approach is also being investigated, which builds on the job clustering work by Gittleman and Howell (1992) and the information on individual spells of unemployment, given age, seniority, education level, and experience, from the University of Michigan's Panel Study of Income Dynamics. The simpler approach adopted for this study, which uses 1989 unemployment rates in the Boston area for the major industrial groups, does, however, capture the concept and also has the advantage of incorporating the local unemployment situation.

the probability of becoming unemployed is it possible to distinguish discrimination in the mortgage market from effects related to race in the rest of the economy.

Similarly, the earnings of the self-employed are thought to be more variable than the earnings of those employed by others. Increased variance of future income increases the riskiness of the loan. Thus, whether or not the applicant is self-employed may bear on his ability to get a mortgage loan.

Potential default loss. While credit history and employment stability provide information about the possibility of default, several other variables collected provide some indication of the magnitude of the loss should default and foreclosure occur. These variables include the loan-to-value ratio, the availability of private mortgage insurance, and neighborhood characteristics that might affect the stability of the value of the mortgaged property.

Loan-to-Value Ratio: The study collected information on the appraised value of the home; from these appraised values, loan-to-value ratios were calculated to measure the borrower's equity in the property. Loan-to-value ratios are potentially important indicators of both the risk of default and the magnitude of a potential loss in the event of foreclosure. The more equity borrowers have in their properties, the less likely that declining property values will cause them to abandon their homes to the lender. A larger cushion also protects lenders from loss.

Private Mortgage Insurance: Since some of the loss associated with default can be absorbed by insurers of mortgage loans, the survey collected information on whether applicants applied for private mortgage insurance and whether their application was approved or denied. To the extent that an applicant applies for and receives private mortgage insurance, the potential loss to the lending institution is reduced. More important, the secondary

market will not accept a mortgage loan that has a loan-to-value ratio in excess of 80 percent without private mortgage insurance protection. Thus, any applicant with a high loan-to-value ratio who is refused private mortgage insurance is likely to be denied the loan. As will be discussed later, the fact that the insurers are basing their decisions on the same factors as the lenders makes it difficult to determine the appropriate treatment of private mortgage insurance in a model of mortgage lending.

Stability of Value: Because of a variety of neighborhood features, inner-city properties are often thought to carry a higher risk of capital loss than properties in other areas. While the appraised value should reflect expectations that the property will rise or decline in value, it may not capture the uncertainties surrounding these expectations. Risk-averse lenders will avoid loans with the same expected probability and costs of default but higher variability of potential losses. As a result, lenders could be economically motivated to avoid investing in areas that are perceived to be risky.

Some researchers have included a separate variable for each Census tract in their analysis to standardize for neighborhood characteristics. This approach has serious drawbacks when minorities are heavily concentrated in a few Census tracts because the racial composition of the tract as well as the race of the applicant may be relevant in the lending decision. A better approach is to estimate directly the risk associated with the value of property in different tracts. For this study, the measure adopted was the ratio of rent to the value of the rental housing stock in the Census tract where the property is located, which can be calculated from Census data. To compensate investors for the higher risk, the same amount of capital invested

in an area with greater potential for loss should generate a higher stream of earnings.

Loan characteristics. In order to isolate the effect of race on the lending decision, it is necessary to hold constant the characteristics of the loan. The sample was limited to conventional mortgages because FHA and VA loans are uncommon in the Boston metropolitan area.[8] The follow-up survey secured additional information on the duration of the loan, for example 15 years or 30 years; whether the interest rate was fixed or adjustable; and whether the application was made under a program designed for low-income individuals. The survey also asked whether the property was a single-family home, a condominium, or a building with two to four units.

Personal characteristics. The original HMDA data included information on the sex and race of the applicant and co-applicant. The follow-up survey requested data on age, marital status, and the number of dependents. Age could be an indicator of future earnings potential, as earnings tend to rise with age over the average person's working life. Similarly, lenders could be interested in the number of dependents, because the more dependents for any given level of income, the less money the applicant is likely to have available to carry the loan.

In summary, the questions in the follow-up survey were designed to secure all the financial, employment, and demographic information that lenders may include in their determination to approve or deny a loan application.

---

[8]In the Boston metropolitan area in 1990 only 4 percent of all home-purchase applications (only 4.5 percent of applications by blacks and 3.5 percent of applications by Hispanics) were for government-backed mortgages. Thus, the conventional mortgage represented the norm in Boston for blacks, Hispanics, and whites.

III. Survey Design and Results

It may be helpful to say a few words about how the sample was designed and how the data were collected before looking at the results. Because the high denial rates for minorities prompted the survey and because only 1,200 blacks and Hispanics applied for mortgages in Boston in 1990, the goal was to collect information on every black and Hispanic applicant. A sample of 3,300 whites was chosen to identify those characteristics that result in rejections when race is not a factor; this information provides a base against which to assess the extent to which race contributes to the high rejection rate for minority applicants. To determine the cause of rejections among whites requires that the sample include a sufficient number of white rejections; since the white rejection rate is only 11 percent, a large number of white applicants was required.

Practical considerations required limiting the institutions surveyed to those that had received at least 25 mortgage applications from borrowers of all races. This reduced the pool of applications only slightly, but cut the number of institutions to be contacted from 352 to 131. The Boston Fed sent each of the 131 lending institutions a survey document in the form of an expanded HMDA register. The register contained the identification number and the HMDA data that the institution had originally submitted for all its black and Hispanic applicants and for the random sample of white applicants selected by the Federal Reserve Bank of Boston.[9] For each applicant, 38 additional pieces of information were requested. (The survey questions are presented in

[9]The sample of applications by whites was selected randomly rather than matched with black and Hispanic applications by institution or key borrower characteristics, because matching would have required prejudging the causes of rejection and precluded an evaluation of the role that the variables used in the matching process played in determining rejection rates.

Appendix A.) The completed forms were returned to the Federal Reserve Bank of Boston for analysis.

Final Sample

A high degree of cooperation by lenders and considerable follow-up resulted in a very high response to the survey, as can be seen in Table 2.[10] The largest part of the divergence between the survey as designed and the responses submitted by the institutions was caused by the closing of some banks that had been significant lenders in 1990. A second source of difference was that lenders, in the process of providing additional data, checked their earlier entries and made corrections. In one of the more notable examples, 51 applications that a suburban bank had coded as Hispanic on its original HMDA submission were found to be white. Some institutions were simply unable to locate all their loan files.

The survey response was further refined to derive a sample of completed applications for conventional loans for the acquisition of residential property. This required eliminating any application that, upon review, was for refinancing as opposed to home purchase or for the acquisition of nonresidential as opposed to residential property, and any application with missing data for one of the key variables. In addition, the decision was made to exclude applications that were withdrawn.

---

[10]The institutions participating in the survey were requested to keep track of the expenses they incurred in supplying the information. Only sixteen of the 131 institutions responded with estimates of the hours devoted to the survey or with dollar expenditure figures. According to these estimates, the time required to supply all the information for a single loan averaged about an hour and the dollar cost averaged $30 per loan, a figure generally consistent with the hourly estimate. These costs are probably indicative of those experienced by the other lenders participating in the survey. Applying these estimates to the entire sample indicates that approximately 4,500 hours were expended in complying with this survey request and that the total dollar cost was $135,000.

Table 2
Comparison of Final Sample with Original HMDA 1990 Reports, Boston MSA

Source	Total Number of Applications	White		Black/Hispanic	
		Number	Percent Denied	Number	Percent Denied
Original HMDA Reports[a]	18,838[a]	16,019	11.0	1,210	30.7
Survey Design	4,443	3,300	11.0	1,143	30.4
Survey Response[a]	4,153[a]	3,123	11.4	1,013	27.6
Final Sample	3,062	2,340	10.3	722	28.1

[a]Includes applicants of races other than white, black, or Hispanic.
Note: The survey response (4,153) falls short of the survey design (4,443) because of the closing of some banks that had been significant lenders in 1990, the inability of some lenders to find some loan files, and corrections to earlier submissions. The final sample (3,062) falls short of the survey response (4,153) because some loans had missing data (618), some were withdrawals (232), some were refinancings (200) or for nonresidential property (24) that lenders had originally coded as home purchase mortgages, and some applicants proved to be neither white, black, or Hispanic (17).

Some experts have suggested that withdrawals may be hidden rejections. That is, in the process of verifying an application, the lender could encourage the applicant to withdraw rather than be rejected. However, applicants might withdraw for a host of other reasons. In particular, the property might fail an inspection report or the buyer might simply get cold feet. Withdrawals accounted for roughly 8 percent of both black/Hispanic and white applications. An examination of the pattern of withdrawals in the sample revealed, at most, a weak link to race or creditworthiness. Since retaining withdrawals in the study would have complicated the econometric presentation that follows and produced uninteresting results, they are not included in the sample. Despite the reduction in the number of applicants in the final sample, the pattern of denial rates is fairly close to that reported in the original HMDA data.

The pattern of lending by type of institution is also very similar to that reported for the original HMDA data. In both cases, applications are split relatively evenly between depository institutions and mortgage companies; this is true for blacks/Hispanics as well as for whites (Table 3).

Values of Key Variables

The values of key variables collected in the follow-up survey are presented in Table 4 for black/Hispanic applicants and white applicants, both approved and denied. (Appendix Table A1 presents values for the complete list of variables.) These data and all subsequent analyses combine applications by blacks and Hispanics. Both blacks and Hispanics had substantially higher denial rates than whites and the number of applications by Hispanics was too small to analyze separately. Moreover, statistical tests confirmed that the

Table 3. Institutions Providing Mortgage Loans and Denial Rates, Final Sample

Institution	Total Applications		White Applications		B/H Applications	
	Number	Percent Denied	Number	Percent Denied	Number	Percent Denied
Banks, Thrifts, and Credit Unions	1,638	14.0	1,265	9.6	373	28.6
Mortgage Companies	1,424	15.1	1,075	11.1	349	27.5
Subsidiaries	1,297	15.3	979	11.3	318	27.7
Independents	127	12.6	96	8.3	31	25.8
Total	3,062	14.5	2,340	10.3	722	28.1

Table 4
Key Characteristics of Mortgage Applicants, by Race and Loan Disposition

Variable	White		Black/Hispanic	
	Approved	Denied	Approved	Denied
Ability to Support Loan				
Housing Expense/Income (percent)[a]	26.0	26.6	26.0	28.0
Total Debt Payments/Income (percent)[a]	33.0	37.0	34.0	38.0
Net Wealth ($)[a]	93,000	75,000	39,000	33,000
Monthly Income ($)[a]	4,666	4,471	3,333	3,600
Liquid Assets ($)[a]	38,000	28,000	19,000	15,500
Risk of Default				
Percent with Poor Credit History[b]	14.6	38.9	23.4	51.5
Probability of Unemployment	3.2	3.2	3.2	3.2
Percent Self-Employed	12.0	22.4	7.5	7.4
Potential Default Loss				
Loan/Appraised Value (percent)[a]	77.3	83.1	85.0	90.0
Rent/Value in Tract (percent)	4.6	4.9	7.3	8.9
Percent Applied for Private Mortgage Insurance	21.6	17.1	42.2	26.6
Percent Denied Private Mortgage Insurance[c]	.7	75.0	1.3	82.5
Loan Characteristics				
Percent Purchasing Two- to Four-Family Homes	7.7	18.3	24.8	34.4
Percent Fixed-Rate Loans	68.6	62.8	60.6	69.6
Percent 30-Year Loans	85.9	83.3	91.1	91.3
Percent in Special Loan Programs	12.6	16.1	40.6	40.3
Personal Characteristics				
Age[a]	34.0	35.0	36.0	36.0
Percent Married	63.0	53.2	53.7	55.0
Percent with Dependents	37.6	39.9	52.6	52.2

[a]Median value.
[b]Poor credit defined as having more than two late mortgage payments or delinquent consumer credit histories (more than 60 days past due) or bankruptcies or other public record defaults.
[c]Base is those applying for private mortgage insurance.
See Appendix Table A1 for complete list of variables.

independent variables affected the probability of denial for the two groups similarly.

The data show that black and Hispanic applicants in the Boston area differ from white applicants in a number of ways. These differences tend to support arguments that the higher denial rates experienced by minorities are attributable, at least in part, to financial characteristics, credit histories, and other economic factors. As reported in other surveys, black and Hispanic applicants have considerably less net wealth and liquid assets than whites. Black and Hispanic applicants also tend to have poorer credit histories than whites.

Blacks and Hispanics in Boston are substantially more likely than whites to be purchasing a two- to four-family home. The higher proportion of two- to four-family homes among denied applicants, for whites as well as for blacks and Hispanics, suggests that lenders perceive more risk associated with financing the purchase of such properties. Blacks and Hispanics also make lower down payments and have higher loan-to-value ratios than whites. Since the secondary market will not accept a mortgage with a loan-to-value ratio in excess of 80 percent without mortgage insurance, minorities apply more frequently for private mortgage insurance.

Blacks and Hispanics have lower incomes than white applicants. They also purchase less costly homes, however, so their obligation ratios are similar. Supporting the view that obligation ratios rather than incomes are the critical variable is the fact that the median income of white applicants whose loans were approved was virtually the same as the median income of applicants whose loans were denied; in the case of minority applicants, the median income of denied applicants actually slightly exceeded the median income of those whose loans were approved.

IV. The Role of Race in the Mortgage Lending Decision

While the data in Table 4 suggest that financial and other differences between black/Hispanic and white applicants account for a large part of the disparity in mortgage denial rates, determining whether race plays an independent role, and how great a role, requires statistical techniques that hold these characteristics constant. This can be done by estimating an equation which makes the probability of being denied a mortgage loan a function of obligation ratios, wealth variables, credit histories, and other factors thought to affect the mortgage decision. Race is then added to the equation to determine whether it has any independent effects after the other factors have been taken into account.

Regression Results

Table 5 presents the results of a logit regression using the equation that most closely represents the model discussed earlier. Many other equations were also estimated, in order to test the robustness of these results and to incorporate variables used in previous studies or thought to be important to the mortgage lending decision. A sample of these additional equations is presented in Appendix B, and it confirms the stability of the results.[11]

The first column of Table 5 reports the coefficient associated with each variable. The "t-statistic" in parentheses indicates the statistical significance of the coefficient; a t-statistic in excess of 2 means that the coefficient is statistically significant. With the exception of wealth, all

---

[11]As discussed earlier, little is known about the link between applicant characteristics and loan performance; thus, the results describe what lenders actually consider in their decision to approve or deny a loan, but these are not necessarily the factors that would provide the best predictions of repayment or default.

Table 5
Determinants of Probability of Denial of Mortgage Loan Application

Variable	Coefficient (t-Statistic)	Impact of Variable on Probability of Denial[a] (Percent)
Constant	-6.61 (-17.0)	
Ability to Support Loan		
Housing Expense/Income	.47 (3.2)	33.9
Total Debt Payments/Income	.04 (6.6)	33.0
Net Wealth	.00008 (1.1)	4.5
Risk of Default		
Consumer Credit History	.33 (9.8)	37.2
Mortgage Credit History	.35 (3.0)	11.4
Public Record History	1.20 (7.0)	113.7
Probability of Unemployment	.09 (3.3)	11.4
Self-Employed	.52 (2.8)	35.1
Potential Default Loss		
Loan/Appraised Value	.58 (3.2)	11.5
Denied Private Mortgage Insurance	4.70 (9.6)	596.0
Rent/Value in Tract	.68 (3.5)	9.3
Loan Characteristics		
Purchasing Two- to Four-Family Home	.58 (3.6)	42.4
Personal Characteristics		
Race	.68 (5.0)	56.0
Number of Observations	3062	
Percent of Correct Predictions[b]	89	

[a]For variables entered as 0 or 1 (see the notes to this table), the increase in the probability of denial associated with the variable. For continuous variables, the increase in the probability of denial associated with a change in the variable equal to one standard deviation.
[b]The number of applicants with a probability of denial greater than 50 percent who were denied, plus the number of applicants with a probability of approval greater than 50 percent who were approved, as a percent of the total sample.

Notes to Table 5

Dummy Variable Definitions:

Housing Expense/Income	= 1	if greater than .30,
	0	otherwise
Total Debt Payments/Income	=	value of question #46
Net Wealth	=	value of question #36 less question #38
Consumer Credit	= 1	if no "slow pay" account (code 1 in question #43)
	= 2	if one or two slow pay accounts (code 2)
	= 3	if more than two slow pay accounts (code 3)
	= 4	if insufficient credit history for determination (code 0)
	= 5	delinquent credit history with 60 days past due (code 4)
	= 6	serious delinquencies with 90 days past due (code 5)
Mortgage Credit	= 1	if no late payments (code 1 in question #42)
	= 2	if no payment history (code 0)
	= 3	if one or two late payments (code 2)
	= 4	if more than two late payments (code 3)
Public Record	= 1	if any public record of credit problems (codes 1, 2, 3, 4 in question #44),
	0	otherwise
Probability of Unemployment	=	1989 Massachusetts unemployment rate for applicant's industry
Self-Employed	= 1	if self-employed
	0	otherwise
Loan/Appraised Value	=	value of loan amount divided by question #50
Percent Denied Private Mortgage Insurance	=	derived from question #53
Rent/Value in Tract	=	rental income divided by estimate of value of rental property from Census
Two to Four-Family Homes	= 0	if purchasing a single-family or a condo,
	= 1	if purchasing a two to four-family home
Race	= 1	if applicant was black or Hispanic,
	= 0	otherwise

Means and Standard Deviations:

Variable	Mean	Standard Deviation
Total Debt Payments/Income	33.46	11.26
Net Wealth ($)	230,160	979,245
Consumer Credit History	2.18	1.70
Mortgage Credit History	1.75	.53
Probability of Unemployment	3.82	2.07
Loan/Appraised Value	.77	.33
Rent/Value in Tract	.09	.23

the variables in the equation have a statistically significant impact on the probability of denial.

The importance of the variables to the denial decision cannot be interpreted solely from the t-statistics or from the coefficients themselves, but rather depends on the values of the variables in the equation. Thus, the second column presents a measure of the impact of each variable on the probability of denial. For variables that have values of 0 or 1, such as self-employed, the figures in the second column represent the increase in the probability of denial associated with having that particular characteristic. That is, the probability of denial increases 35 percent for a person who is self-employed.[12] Since the average denial rate for the sample as a whole is 14.5 percent, the probability of denial for the average applicant who happens to be self-employed would be roughly one-third greater than the average, or 19.6 percent. For continuous variables, such as the total obligation ratio,

---

[12]Logit regressions are particularly suited to modelling discrete outcomes, such as approval or denial. However, the resulting equations are nonlinear and, therefore, calculating the impact of changes in variables is more complicated than in the more familiar ordinary least squares and other linear regression forms. In deriving the impact values reported in Table 5, the first step is to determine the probability of denial in the absence of a particular characteristic, such as being self-employed. This requires determining for each non-self-employed applicant the probability of denial based on the coefficients of the equation reported in Table 5. These estimated probabilities for each applicant are then averaged to get a single figure for the group. The second step is to add to each non-self-employed applicant's probability of denial the impact of being self-employed (the coefficient 0.52 multiplied by 1). These new probabilities are averaged. The figure reported in the second column is the percent difference between the average probability of denial for the non-self-employed with the self-employment effect and the probability for the non-self-employed without it.

For a continuous variable, such as the total obligation ratio, the procedure is slightly different. In this case, the first step is to determine the estimated probability of denial for each applicant in the sample, and then average the probabilities. The second step is to add one standard deviation to the total obligation ratio for each applicant, recalculate the estimated probabilities of denial, and average the probabilities. As before, the value reported in the second column is the percent difference between these two average probabilities.

the figures in the second column represent the increase in the probability of denial associated with a one standard deviation change in that variable. That is, if the total obligation ratio rises 11 percentage points (one standard deviation), the probability of denial increases by 33 percent.

Ability of applicant to support loan. As expected, the results confirm that high obligation ratios increase the probability of having a loan application denied. Because the two obligation ratios tend to move together, that is, an applicant with a high housing expense ratio generally also has a high ratio of total debt payments to income, it is difficult to sort out precisely the relative importance of the two ratios. Suffice it to say that these measures are crucial to the lending decision. As discussed above, one standard deviation increase in the total obligation ratio raises the probability of denial by 33 percent.

Economists have long argued that perhaps one of the reasons that minorities are denied mortgage loans more frequently than whites is that they have less wealth. The net wealth coefficient is not statistically significant, however, a result that supports lenders' claims that they do not place much weight on wealth.[13] As reported in Appendix B, liquid assets also do not appear to affect the probability of denial, although they are cited in secondary market guidelines as a compensating factor and are frequently mentioned by lenders as an important consideration. The answer may be that liquid assets are frequently used for the down payment and therefore their effect is captured by the loan-to-value ratio. Pre-screening may also exclude people without enough cash to settle.

---

[13]An equation was also estimated including income, liquid assets, and the ratio of base to total income as alternative measures of the applicant's ability to carry a loan. None of these variables has a statistically significant effect on the probability of being denied; the results can be found in Appendix Table B1.

Risk of default. Credit information was categorized by the severity of the problem in the consumer, mortgage, and public records areas; the precise definitions can be found in the notes to Table 5. The results show clearly that an increase in credit problems raises the probability of having the loan denied. A problem in the public records area, such as a bankruptcy, raises the probability of denial 114 percent.[14] Thus, if an applicant with average characteristics of the sample had a bankruptcy, this person's probability of denial would roughly double from 14.5 percent to 31.0 percent.

Instability of income, whether stemming from a higher likelihood of becoming unemployed or from being self-employed, increases the probability of denial. Self-employment has by far the larger effect, however, raising the probability of denial by 35 percent.[15]

Potential default loss. A high loan-to-value ratio raises the probability of denial, but the effect is relatively small. This result occurs because virtually all applicants with loan-to-value ratios over 80 percent must secure private mortgage insurance. Thus, as shown in Table 5, the denial of private mortgage insurance virtually precludes attaining a mortgage. It should be noted, however, that very few applicants were turned down for private mortgage insurance. The large impact, therefore, means that those who were turned down were very unlikely to get a mortgage, not that denial of

---

[14]An alternative characterization of credit history, which treats the credit information as individual dummies rather than as semi-continuous variables, is presented in Appendix Table B2. The results are fully consistent with those in Table 5.

[15]An equation was estimated that also included years on the job and the presence of a co-signer. Secondary market guidelines request documentation for applicants who have been on the job less than two years, and the presence of a co-signer reduces the risk of default. The results, which can be seen in Appendix Table B3, have the expected signs, but neither variable has a statistically significant effect on the probability of denial.

private mortgage insurance was the most important reason to be denied a mortgage loan.

The appropriate way to treat private mortgage insurance was a difficult decision, because these insurers consider the same information provided the financial institutions. Thus, in one sense, they could be considered simply another lender and the mortgage insurance variable omitted from the equation. On the other hand, insurers could be viewed as outside the direct lending market, and, to the extent that their denials fell disproportionately on minorities, excluding a variable representing denial of mortgage insurance from the equation would ascribe to lenders differential treatment occurring elsewhere in the system. For this reason, the denial of mortgage insurance was included in the equation.

Since the treatment of private mortgage insurance is controversial, it should be noted that excluding private mortgage insurance from the equation has little impact on the coefficients of the other variables; the exception, not unexpectedly, is the loan-to-value ratio, which takes on somewhat greater importance in the absence of private mortgage insurance (Appendix Table B4). Similarly, estimating the equation excluding those applicants who were denied private mortgage insurance has little impact on the basic results; again the exception is the loan-to-value ratio.[16]

Finally, the theoretical construct to standardize for the riskiness of the neighborhood in which the property was located entered the equation with the expected sign and was statistically significant. That is, the greater the rent-to-value ratio, which attempts to measure the variability of housing

---

[16]In terms of the determinants of private mortgage insurance itself, nearly all the variables included in the mortgage loan decision equation, including race, appear to be relevant. The effect of race disappears, however, with the addition of information about the racial composition of the tract in which the applicant is purchasing the property (Appendix Table B5).

value from tract to tract, the greater the likelihood the applicant will be denied a mortgage loan.[17] An equation was also estimated that included a dummy variable for each of the more than 500 tracts in the sample - the ultimate exercise in controlling for neighborhood characteristics. The inclusion of these additional variables has a modest impact on most of the other coefficients in the original equation; the exception is the coefficient on race, which increases (Appendix Table B9).[18]

Loan characteristics. The loan characteristic that turned out to be important is whether the applicant was applying for a mortgage for a two- to four-family home.[19] Financial institutions clearly are less willing to make

---

[17]Equations were also estimated with several alternative indicators of the risk of loss arising from the property's location (Appendix Table B6); these include vacancy rates, the appreciation in housing values, and a dummy for tracts with more than 30 percent minority population. These variables do not alter the basic equation appreciably. It appears that although blacks and Hispanics tend to reside in minority areas, they are not being denied mortgages because of where they live. Minorities living in white areas are also denied mortgages at higher rates.

The foreclosure rate by tract was also included in the basic equation as a measure of neighborhood risk, but its coefficient was statistically insignificant and it had no impact on the race coefficient (Appendix Table B7). It should be noted that most of the neighborhoods with large minority populations do not have high rates of foreclosure (Appendix Table B8).

[18]The race coefficient might increase for two reasons. First, the racial composition of the tract affects the denial rates for both white and minority applicants. For whites the denial rate increases from 10 percent in predominantly white tracts to 16 percent in tracts with 30 percent or more minority population; the comparable figures for minority applicants are 25 percent and 33 percent, respectively. Since white applicants are hurt relatively more by buying property in minority tracts, excluding tract information could artificially raise the denial rate for white applicants and reduce the effect of being a minority on the probability of denial. Including the tract information, therefore, raises the coefficient on race. The second possible explanation is that tracts vary by many characteristics other than race, and many predominantly white tracts may simply have poor quality housing and other factors that affect the risk of the loan.

[19]The duration of the loan and whether the rate was fixed or variable were also tried, but proved not to add any information. The results of this exercise are shown in Appendix Table B10. Also tried were whether the loan was applied for under a special program and whether a gift or a grant contributed to the down payment; the latter slightly reduced the probability of denial, but had little impact on the rest of the basic equation.

loans on two- to four-family housing that involves rental arrangements. The positive coefficient says that if the property is a multi-unit dwelling, the probability of denial rises 42 percent.

Personal characteristics. The only personal characteristic that appears to enter into the loan denial decision is the race of the applicant.[20] The positive and statistically significant coefficient suggests that after accounting for obligation ratios, wealth, credit histories, stability of the applicants' incomes, loan-to-value ratios, private mortgage insurance, and neighborhood characteristics, the race of the applicant still plays a role in the lender's decision to approve or deny the loan. Thus, for an individual with average white economic characteristics and minority race, the probability of denial increases 56 percent.

Evaluation of the results. A logical question is "How good are these results?" This question can be broken into four parts. The first pertains to the robustness of the results with regard to race; the second pertains to the broader issue of how much of the variability in approval and denial rates is explained by the equation; the third relates to whether the results can be explained by variations in underwriting standards among lenders; and the fourth relates to the pervasiveness of the behavior captured in the equation.

With regard to the race variable, nearly every equation that was estimated had virtually the same coefficient and degree of statistical significance. As shown by the supplementary equations reported in Appendix B, adding variables to the equation reported in Table 5 had little impact on the coefficient of race or for that matter on most of the other coefficients in

[20]The age, sex, marital status, and number of dependents do not affect the probability of having a loan application denied (Appendix Table B11).

the equation.[21] In short, the effect of race on the probability of denying a loan application was consistently positive, large, and statistically significant.[22]

Robustness of the race coefficient in and of itself does not fully answer the question of how much credibility should be given to these results. If important variables that differed by race were missing from the analysis, the race variable could be picking up their effect. Two responses address the issue of omitted variables. First, the survey included every variable mentioned as important in numerous conversations with lenders, underwriters, and examiners and no reviewer suggested any other economic factor that should be included in the equation.

Second, the variables included in the equation do a good job of explaining the decision to approve or deny. Although no simple measure of "goodness of fit" exists for equations that estimate the probability of an action, the explanatory power of the equation can be assessed. The first column of Table 6 reports actual denial rates for applicants in the survey by total obligation ratio; that is, the denial rate for very good credits

---

[21]Various interaction terms were tested to examine whether a combination of certain variables was essential to the mortgage lending decision. Interaction between the loan-to-value ratio and the obligation ratios and credit history variables, as well as the interplay between the obligation ratios and the credit variables were all tested. Only the loan-to-value ratio and consumer payments interaction term was statistically significant. The importance of this variable, however, derived solely from its severe collinearity with the consumer payments index; the consumer payments variable becomes insignificant when this interactive term is included, and the correlation between the two variables is 0.9. None of these interactive terms affected the race coefficient or its statistical significance. Finally, some non-linearity in the obligation ratios and the loan-to-value ratio was examined, but it did not improve the fit of the equation or change any of the results for the other variables.

[22]As shown in the correlation matrix (Appendix Table B14), multicollinearity between any two independent variables is not affecting the results.

Table 6
Explanatory Power of the Regression Equation

Total Obligation Ratio	Denial Rates			
		Predicted from Equation Based on		
	Actual Sample	Full Model	Original HMDA Data[a]	Key Variables[b]
36 percent or lower	9.9	10.6	14.0	12.4
Between 36 percent and 40 percent	14.4	16.2	15.2	16.2
Greater than 40 percent	38.8	32.3	16.2	22.9

[a]Equation includes race, sex, and income of the applicant and the loan amount.
[b]Key variables add to the original HMDA data a dummy when the ratio of housing expense to total income exceeds 30 percent, a measure of the applicant's consumer payment credit history, and the applicant's loan-to-value ratio.

(obligation ratios 36 percent or lower) is 9.9 percent and for poor credits (obligation ratios in excess of 40 percent) is 38.8 percent. The second column reports the denial rates predicted by the equation for each group. For the good credits, the equation performs remarkably well, predicting 10.6 percent compared with the actual of 9.9 percent. The results for the denial rates for poor credits are also quite good, 32.3 percent compared to the actual of 38.8 percent.

In order to have a better sense of how good the equation results are, it is useful to compare the predictions with those that emerge from an equation using only information from the original HMDA data - namely, race, sex, and income of the applicant and loan amount. As shown in the third column of Table 6, these four variables produce a flat distribution of predicted denial rates, explaining none of the difference between good and poor credits. In other words, the additional variables included in the full model explain a lot compared to the basic HMDA data. To provide just one more point of comparison, the last column shows the predicted denial rates from an equation that adds only three additional variables to the original HMDA data - a dummy for a ratio of housing expense to total income in excess of 30 percent, consumer payment credit history, and loan-to-value ratio. This equation begins to pick up some of the tilt in denial rates as applicants move from poor to good credits, but a substantial gap remains between actual and predicted rates.

Third, the question arises about the pervasiveness of the results. That is, does the impact of race come from a single large institution operating in a discriminatory manner or is the practice widespread? To test whether race was consistently an important factor in the mortgage lending decision, the sample was divided into large lenders and small lenders. Large lenders, which

accounted for only 5 percent of the institutions, received exactly 50 percent of minority applications; the other 50 percent of minority applications were distributed among the remaining 95 percent of the institutions. Separate equations were then estimated for the two sub-samples. The results indicate that the model is stable across institutions of vastly different size, and that race is an important explanatory factor in mortgage lending decisions among both small and large lenders (Table 7). In short, the results represent a widespread phenomenon, not just the behavior of a single institution.

Finally, even though the variables in Table 5 standardize for applicant and property characteristics, the argument remains that minorities may be treated the same as whites within any given institution, but may simply frequent institutions with tougher lending standards. To test this hypothesis, a "tough" lender variable was added to the basic equation. This variable was constructed by estimating the equation for white applicants only and including a separate dummy variable for each lender, and then designating specific lenders as "tough" based on the coefficients of the lender dummies. The inclusion of this variable, however, had virtually no effect on the coefficients of the other variables and the variable itself was statistically insignificant (Appendix Table B12). This result was not unexpected given that most lenders conform to secondary market guidelines. Including separate dummy variables for all institutions in the sample alters the coefficients slightly, but does not change the basic results.

This assessment shows that the results presented in Table 5 merit serious consideration. The coefficient of the race variable is stable and always statistically significant; it is difficult to think of omitted variables linked with race that could be biasing the race coefficient; and the overall equation does a very good job of explaining the variation in denial

Table 7
Determinants of Probability of Denial for Large Lenders and Small Lenders

Variable	Coefficient (t-Statistic) Small Lenders	Large Lenders
Constant	-6.59 (14.1)	-7.53 (9.6)
Ability to Support Loan		
Housing Expense/Income	.50 (2.5)	.39 (1.7)
Total Debt Payments/Income	.04 (4.6)	.07 (5.3)
Net Wealth	.0001 (1.7)	-.0001 (0.5)
Risk of Default		
Consumer Credit History	.36 (7.7)	.30 (6.2)
Mortgage Credit History	.35 (2.4)	.27 (1.3)
Public Record History	1.07 (4.7)	1.65 (5.8)
Probability of Unemployment	.13 (3.7)	.03 (0.7)
Self-Employed	.41 (1.8)	.94 (3.1)
Potential Default Loss		
Loan/Appraised Value	.39 (2.0)	1.54 (2.9)
Denied Private Mortgage Insurance	4.96 (7.7)	4.50 (5.9)
Rent/Value in Tract	.38 (1.2)	1.02 (3.7)
Loan Characteristics		
Purchasing Two- to Four-Family Home	1.16 (5.3)	-.09 (0.4)
Personal Characteristics		
Race	.51 (2.6)	.68 (3.4)
Number of Observations	1968	1094
Percent of Correct Predictions[a]	92	87

[a]The number of applicants with a probability of denial greater than 50 percent who were denied, plus the number of applicants with a probability of approval greater than 50 percent who were approved, as a percent of the total sample.

rates. Moreover, the equation is describing widespread behavior, not simply that of a single large institution or of particular types of institutions, and variation in lending standards does not appear to explain the results.

An Alternative Approach

Estimating an equation that includes an explicit measure for race is not the only way to test whether race is an important factor in the mortgage lending decision. An equally good alternative is to estimate an equation for white applicants and then plug in the obligation ratios, loan-to-value ratio, credit history, and other values for each black/Hispanic applicant to calculate that applicant's probability of denial. The resulting discrepancy between the actual minority denial rate and the estimated minority denial rate based on the white equation can be interpreted as the effect of race on the mortgage lending decision.

The equations estimated separately for white and black/Hispanic applicants are reported in Appendix Table B13 and the results of estimating the probability of denial based on the white equation are shown in Table 8. If blacks/Hispanics had their own characteristics, that is, high obligation ratios, weaker credit histories, higher loan-to-value ratios, and less likely to buy a single-family home, but were treated by lenders like whites, their average denial rate would be 20.2 percent rather than the actual 28.1 percent experienced by minority applicants. In other words, economic, property and neighborhood characteristics explain much of the higher minority denial rate, but 7.9 percentage points remain unexplained.

If the 7.9 percentage point discrepancy is attributed to the effect of race on the lending decision, this amount can be added to the white denial rate to estimate the racial impact starting from the white base. That is, the third line in Table 8 shows what the denial rate would have been for black and

Table 8
Probability of Black/Hispanic Denials Based on White Experience

Characteristics and Experience	Denial Rates (percent)
Actual Denial Rate for Blacks/Hispanics in Sample	28.1
Denial Rate for Blacks/Hispanics with Black/Hispanic Characteristics but White Experience	20.2
Denial Rate for Blacks/Hispanics with White Characteristics but Black/Hispanic Experience	18.2
Actual Denial Rate for Whites in Sample	10.3
Addendum: Ratios of Black/Hispanic to White Denial Rates	
Actual (28.1/10.3)	2.7
Based on Black/Hispanic Characteristics (28.1/20.2)	1.4
Based on White Characteristics (18.2/10.3)	1.8

Hispanic applicants if they had white obligation ratios, loan-to-value ratios, credit histories, and other characteristics but were treated by lenders like minorities. Thus, even if minorities had all the economic and property characteristics of whites, they would have experienced a denial rate of 18.2 percent, 7.9 percentage points more than the actual white denial rate of 10.3.

Some ambiguity arises when these various denial rates are used to characterize the ratio of minority to white denial rates. If the ratio is calculated using black/Hispanic characteristics, the ratio is 1.4 to 1; if white characteristics are used, the ratio is 1.8 to 1. The 1.8 to 1 ratio is the appropriate comparison with the 2.7 to 1 ratio of unadjusted denial rates, since both use the white experience as the base.

The important point, however, is that the ratios bracket the 56 percent increase in the probability of denial for minority applicants reported in Table 5. This confirmation of the earlier results lends additional support to their credibility.

VI. Conclusions

This study has examined one avenue through which differential treatment could affect minorities' access to credit and opportunities for homeownership. It found that black and Hispanic mortgage applicants in the Boston area were more likely to be turned down than white applicants with similar characteristics.

It is important to clarify the limited focus of this analysis; it abstracts from discrimination that may occur elsewhere in the economy. For example, if minorities are subject to discrimination in education or labor markets, they will have lower incomes and their applications may reflect higher obligation ratios, greater loan-to-value, or poorer credit history.

Similarly, if blacks and Hispanics are discouraged from moving into predominantly white areas, they will limit their search to neighborhoods sanctioned for minorities. These tend to be older central cities with high-density housing, such as two- to four-family homes. Denial of a mortgage loan application on the basis of either these economic or property characteristics would not be considered discriminatory for the purposes of this study.

Even within the specific focus of conventional lenders, the reported measure of the hurdles faced by minorities should be placed in perspective; differential treatment can occur at many stages in the lending process. For example, minorities may be discouraged from even applying for a mortgage loan as a result of a pre-screening process. Similarly, if white applicants are more likely than minority applicants to be "coached" when filling out the application, they will have stronger applications than similarly situated minorities. In this case, the ratios and other financial information in the final application, which were the focus of this analysis, may themselves be the product of differential treatment. This study does not explore the extent to which coaching occurs, but rather focuses on the impact of race on lenders' decisions regarding the final applications received from potential borrowers.

The results of this study indicate that race does play a role as lenders consider whether to deny or approve a mortgage loan application. The impact of race is substantially less than indicated by the original 1990 HMDA data, which showed that black and Hispanic applicants for mortgages in the Boston metropolitan area in 1990 were turned down at a rate 2.7 times that for white applicants. As it turns out, the higher denial rate for minorities in Boston is accounted for, in large part, by their having higher loan-to-value ratios and weaker credit histories than whites. They are also more likely to be trying to purchase a two- to four-unit property rather than a single-family

home. Nevertheless, after taking account of such factors, a substantial gap remains.

A black or Hispanic applicant in the Boston area is roughly 60 percent more likely to be denied a mortgage loan than a similarly situated white applicant. This means that 17 percent of black or Hispanic applicants instead of 11 percent would be denied loans, even if they had the same obligation ratios, credit history, loan to value, and property characteristics as white applicants. In short, the results indicate that a serious problem exists in the market for mortgage loans, and lenders, community groups, and regulators must work together to ensure that minorities are treated fairly.

Appendix A

Attachment 1
FEDERAL RESERVE SYSTEM
FOLLOW-UP TO 1990 HOME MORTGAGE DISCLOSURE ACT (HMDA) REPORTS

INSTRUCTIONS FOR COMPLETING LOAN/APPLICATION REGISTER (LAR)

Our records indicate that your institution listed (XX) applications from blacks and Hispanics in your 1990 HMDA Report; all of their identification numbers and basic HMDA information are reproduced in Attachment 4, the Loan/Application Register. As a control group, we have randomly selected (XX) white applicants; the information for the white applicants also appears in the Register. Although this information is taken directly from your submissions, it would be useful for you to check it for accuracy.

In addition, please review "Reasons for Denial" (column 19), and if you have not already included the reasons, please enter that information at this time. The reasons should conform to Attachment 2, Regulation B, Form C-1 "Sample Notice of Action Taken and Statement of Reasons" (Adverse Action Notice). The reasons (up to three) should be entered on the Register, from left to right in the space provided.

Thirty-eight questions, listed below, have been added to the Register. All requested information should be provided from the loan documentation as of the date of decision for the loan. Please enter the requested data for each of the (XXX) applicants on the expanded Register. If any of the requested information was not collected, put "X" in the column.

A. Data from Residential Loan Application (Fannie Mae Form 1003), see sample on Attachment 3.

Note: Information for loan applications which were approved should come from the standard loan application. Some of the requested information for denials may have to be obtained from other documentation in the loan folder.

Column 20: Number of units in property purchased

21: Applicant age
- A - Applicant
- C - Co-applicant

22: Years of school
- A - Applicant
- C - Co-applicant

23: Marital status (use codes below)
- A - Applicant
- C - Co-applicant

Codes:
- M - Married
- U - Unmarried (includes single, divorced and widowed)
- S - Separated

24: Number of dependents
- A - Applicant
- C - Co-applicant

25: Years employed in this line of work (NE if not employed)
- A - Applicant
- C - Co-applicant

26: Years employed on this job (NE if not employed)
- A - Applicant
- C - Co-applicant

27: Self-employed (Y or N)
A - Applicant
C - Co-applicant
28: Position/title (NE if not employed)
A - Applicant
C - Co-applicant
29: Type of business (NE if not employed)
A - Applicant
C - Co-applicant
30: Base employment monthly income (in dollars)
A - Applicant
C - Co-applicant
31: Total monthly income (in dollars)
A - Applicant
C - Co-Applicant
32: Proposed monthly housing expense (in dollars)
33: Purchase price (in thousands)
34: Other financing (in thousands)

For the next four columns, sum applicant and co-applicant information if separate statements were completed.

35: Liquid assets (in thousands)
36: Total assets (in thousands)
37: Total nonhousing monthly payments (in dollars)
38: Total liabilities (in thousands)

B. Data Relating to Credit History

Column 39: List the number of commercial credit reports in the file
40: Did the applicants' credit history meet your loan policy guidelines for approval? (Y or N)
41: List the number of separate consumer credit lines on the credit report
42: Credit history - Mortgage payments (see instructions, next page)
43: Credit history - Consumer payments (see instructions, next page)
44: Credit history - Public records (see instructions, next page)

C. Obligation Ratios (from lender worksheets)

Column 45: Debt-to-income ratio (housing expense/income)
46: Debt-to-income ratio (total obligations/income)

D. Loan Characteristics

Column 47: Fixed or adjustable rate (F or A)
48: Term of loan (months)
49: If the loan application was for a special (e.g. low income) loan program, please provide the name of the program
50: Appraised value (in thousands)
51: Type of Property Purchased
Codes:
1 - Condominium
2 - Single family
3 - 2-4 family
52: Was private mortgage insurance sought? (Y or N)
53: Was private mortgage insurance approved? (Y or N)
54: Did a gift or a grant account for any part of the down payment? (Y or N; answer N if not known)
55: Did someone, other than the co-applicant, co-sign this application? (Y or N)

E. Unverifiable Information

Column 56: Type of information on the application which could not be verified

0 - Not applicable (all verifiable)
1 - Credit references
2 - Employment
3 - Income
4 - Residence
5 - Other

F. Underwriting Information

Column 57: List total number of times application was reviewed by the underwriter before the final loan decision was made.

INSTRUCTIONS FOR COMPLETING COLUMNS #42-44

Enter the number that best describes the credit history (from the commercial credit report) of the applicant(s). Note that these columns should be completed <u>regardless</u> of the loan disposition or your answer to #40.

CREDIT HISTORY CODES - Mortgage Payments (Column 42):

0 - no mortgage payment history
1 - no late mortgage payments
2 - one or two late mortgage payments
3 - more than two late mortgage payments

CREDIT HISTORY CODES - Consumer Payments (Column 43):

Note: Consider consumer payment history for previous two years only.

0 - Insufficient credit history or references for determination
1 - no "slow pay" or delinquent accounts, but sufficient references for determination
2 - one or two "slow pay" account(s) (each with one or two payments 30 days past due)
3 - more than two "slow pay" accounts (each with one or two payments 30 days past due); or one or two chronic "slow pay" account(s) (with three or more payments 30 days past due in any 12-month period)
4 - delinquent credit history (containing account(s) with a history of payments 60 days past due)
5 - serious delinquencies (containing account(s) with a history of payments 90 days past due)

CREDIT HISTORY CODES - Public Records (Column 44):

0 - no public record defaults
1 - bankruptcy
2 - bankruptcy <u>and</u> charge-offs
3 - one or two charge-off(s), public record(s), or collection action(s), totalling less than $300.
4 - charge-off(s), public record(s), or collection action(s) totalling more than $300.
5 - information not considered

Appendix Table A
Values of Variables Collected on Follow-Up Survey, Boston MSA

Loan Application Register No.	Characteristic	Approved and Denied Applicants White	Approved and Denied Applicants Black/Hispanic
20	Median number of units in property purchased	1	1
21	Median age of applicant	34	36
	co-applicant	29	28
22	Median years of school of applicant	16	14
	co-applicant	12	12
23	Percent of applicants married	61.9	54.1
	co-applicants	82.2	72.3
24	Median number of dependents of applicant	0	1
25	Median number of years in line of work: applicant	9	7
	co-applicant	6	5
26	Median number of years on current job: applicant	4	4
	co-applicant	3	3
27	Percent of applicants self-employed	13.1	7.4
	co-applicants	5.8	1.8
28	Position/title	n.a.	n.a.
29	Type of business	n.a.	n.a.
30	Median base monthly income of applicant ($)	3,250	2,400
	co-applicant ($)	754	1,123
31	Median total monthly income of applicant ($)	3,658	2,725
	co-applicant ($)	910	1,176
32	Median proposed monthly housing expense ($)	1,308	1,154
33	Median purchase price ($)	160,000	139,000
34	Percent with other financing	3.5	8.2
35	Median value liquid assets ($)	37,000	18,000
36	Median value total assets ($)	121,000	48,000
37	Median total nonhousing monthly payments ($)	308	292
38	Median value total liabilities($)	14,000	8,000
39	Median number of commercial credit reports on file	1	1
40	Percent meeting credit history guideline for approval	90.6	74.5
41	Median number of credit lines on report	12	9
42	Percent with more than two late mortgage payments	1.0	.8
43	Percent with delinquent consumer credit accounts	14.0	26.8
44	Percent with some public record defaults	6.2	15.3
45	Median obligation ratio (housing expense/income)	26.0	27.0
46	Median total obligation ratio (total obligations/income)	33.1	35.0
47	Percent of loans with fixed rates	67.9	63.2
48	Percent of loans with 30-year terms	85.0	90.7
49	Percent of loans in special loan programs	13.0	40.5
50	Median appraised value of property ($)	165,000	142,000
51	Type of property		
	Percent single-family	68.1	39.1
	Percent condominium	23.0	33.3
	Percent 2-4 family	8.9	27.6
52	Percent seeking private mortgage insurance	20.7	36.8
53	Percent approved for private mortgage insurance	19.0	30.0
54	Percent with a gift or grant account used as part of the down payment	16.8	18.4
55	Percent with co-signer on application	3.4	4.0
56	Percent with unverifiable information	4.9	11.8
57	Percent reviewed more than once by underwriter	*	*

n.a. = not applicable
*Number of responses was too small to be meaningful
Note: Percentage base for each item does not include applicants for whom information was missing.

Appendix B
Alternative Specifications of the Probability of Denial of the Mortgage Application

Alternative specifications of the probability that a mortgage application will be denied are presented in this appendix. The additional variables are based on the model of mortgage lending outlined in the text and the suggestions of experienced researchers in this field. The primary conclusion is that the equation whose results are shown in Table 5 of the text is very robust. Adding more variables has little effect on the coefficients of most of the "basic" variables listed in Table 5. Of particular importance to the conclusions drawn from this analysis, race continues to have a statistically significant effect on the probability of being denied a mortgage after the additional variables have been taken into account.

Ability to Support Loan

Table B1 compares the basic equation from Table 5 with an equation incorporating additional measures of the applicant's ability to support the loan. As can be seen, the coefficients of most of the basic variables are affected only modestly by the addition of income, liquid assets, and the ratio of base income to total income. The coefficient for race remains almost the same. In both this equation and those that follow, changes in sample size may account for some of the changes in coefficients.

None of the additional variables has a statistically significant influence on the probability of being denied a mortgage. As noted in the text, people with lower incomes tend to buy lower-priced homes and, thus, the obligation ratio is a better indicator of the financial constraints on the borrower. It is more surprising that liquid assets do not reduce the probability of denial, especially as liquid assets are cited in Fannie Mae's secondary market guidelines as a factor that can compensate for other weaknesses in the application.

Risk of Default

Credit History. Two alternative characterizations of the mortgage history and consumer credit history variables are presented in Table B2. In the equation in Table 5, the progression of credit problems is pre-specified as described in the table notes. In Table B2 a dummy variable represents each credit history code and the regression is allowed to determine the weights attached to each code. The base for both mortgage and consumer credit history is no late payments; thus, the dummy variables measure the increase in the probability of denial from this standard. As can be seen, the regression produces a ranking very similiar to that specified in the credit variables in Table 5; a log likelihood test indicates that one cannot reject the hypothesis that the coefficients of the credit variables are the same as assumed in the specification in Table 5. Perhaps the most interesting result from the finer breakdown is confirmation that borrowers with insufficient consumer credit history to make a determination of their payment record face a higher

probability of being denied a mortgage than borrowers with some late payments. The finer breakdown of credit history does not alter the coefficients of the other variables, including race.

The third equation appearing in Table B2 adds a dummy variable for those applicants with a prior mortgage payment history to the basic equation. The reasoning was that borrowers who already owned a home might be more likely to have their applications approved; however, the variable provides no additional information beyond that contained in Table 5.

Seniority and Co-signer. In Table B3 the applicant's years on the job and the presence of a co-signer are added to the basic equation. While frequent job changes could be a sign of upward mobility, they may also indicate a higher risk of unemployment. The applicant may be unable to hold a position or may be limited to jobs where the last hired is the first fired. Fannie Mae guidelines require additional documentation for applicants who have been at their current job less than two years. The presence of a co-signer reduces the risk of default, since the co-signer's financial strength as well as the applicant's stands behind the loan.

Although the signs are as expected, the additional variables do not have a statistically significant effect on the probability of a mortgage application being denied and the coefficients of most of the basic variables do not change very much. Again, the race coefficient remains large and statistically significant. Replacing years on the job with a dummy variable indicating the applicant had more than two years on the job produced similiar results.

Potential Default Loss

Private Mortgage Insurance. As discussed in the text, the appropriate treatment of private mortgage insurance is unclear. If race enters into the insurance decision, the inclusion of a variable representing the denial of insurance will understate the difficulties that minorities face in securing mortgages, since the effect of race on the ability to get insurance and, therefore, to get a mortgage would be subsumed in the mortgage insurance variable. Accordingly, Table B4 shows the effect of omitting this variable. Also shown is an equation in which all mortgage applicants who were denied mortgage insurance are omitted from the sample. In both cases, the coefficients for the other variables, including race, are similiar to those in Table 5. These results suggest that the probability of denial facing minority applicants is not substantially understated by including the mortgage insurance variable in the basic equation.

Table B5 presents two equations that relate the denial of private mortgage insurance to the economic characteristics gathered for this study. Controlling for the characteristics in the basic equation, minority applicants are more likely to be denied private mortgage insurance than white applicants. Adding a variable for the racial composition of the census tract in which the property is located, however, causes the racial coefficient to become statistically insignificant. These equations must be viewed with caution, since the number of observations is much smaller than in the other equations

and since the variables collected for this study were not gathered for this purpose.

Location. Table B6 adds to the equation in Table 5 several indicators of the risks of loss arising from the property's location. In the basic equation, the riskiness of the neighborhood is represented by the ratio of rental income to the value of the rental housing stock in the relevant census tract. While this measure is justified by theory and the results in Table 5 are as predicted, lenders may rely on other indicators of neighborhood risk, such as vacancy rates or the appreciation in housing prices in the tract. A dummy variable indicating that minorities comprise more than 30 percent of the tract population is also included. Although the racial composition of the neighborhood is not an appropriate criterion for lending decisions, it was routinely considered in appraisals and lending policies until the 1970s.

As can be seen, adding these variables does not alter the basic equation appreciably. In particular, the coefficient for race remains significant after taking account of the racial composition of the neighborhood. Although blacks and Hispanics in the Boston area tend to live in minority neighborhoods, they are not being denied mortgages solely because of where they live. Blacks and Hispanics seeking to buy homes in predominantly white areas also face a higher risk of being denied mortgages than comparably situated whites.

Foreclosures. Some researchers have suggested the foreclosure rate as a measure of neighborhood risk. This has considerable intuitive appeal, since the lender's objective is to minimize the probability and costs of foreclosure. The direction of causality is ambiguous, however. A high foreclosure rate could be the result of lenders' reluctance to make loans in a neighborhood as well as a cause of such reluctance. Homeowners who fall behind in their mortgage payments will not be able to get out from under their troubles by selling their properties if prospective buyers cannot get loans.

Foreclosures were very infrequent in the Boston area until 1990 and, thus, lenders making decisions in 1990 did not have much foreclosure history to guide them. Since foreclosure is a lengthy process, however, lenders might have had some knowledge of foreclosures that were in the works. If so, it did not affect their decision-making. As can be seen from Table B7, the effect of the tract foreclosure rate on the probability of being denied a mortgage was insignificant.

Table B8 shows the pattern of foreclosures in the planning districts of the City of Boston along with the racial composition of the districts. The districts with the very highest foreclosure rates were predominantly white. Foreclosure rates in predominantly minority areas ranged from high (Mattapan) to quite low (South End).

Tract Dummy Variables. As a final test of whether the coefficient on race might be representing lenders' concerns about the location of the property, a dummy variable was used to represent each of the more than 500 census tracts in which applicants were attempting to purchase homes. This is a crude approach. It provides no indication of why lenders might deny mortgages in a particular area, and if minorities tend to be concentrated in particular neighborhoods it risks attributing rejections that are influenced

by the applicant's race to location. Nevertheless, as can be seen from Table B9, the inclusion of dummy variables for each census tract actually increased the coefficient for the race variable.

Loan Characteristics

Table B10 adds more loan characteristics to the basic equation. As before, these do not change the coefficients for the basic variables. Whether the rate was fixed or variable had no effect on the probability of denial. The effect of longer loan terms also was not statistically significant. The presence of a gift or grant reduced the probability that the loan would be denied, and the effect approached statistical significance.

Gifts are intended to give the borrower sufficient funds for the down payment. Since the loan-to-value ratio has already been included in the equation, it is not obvious why a gift would increase the likelihood of approval. Perhaps it implies access to the resources of a parent or some other source of financial strength.

Applications that were not made under special programs were denied more frequently, but the effect was not statistically significant. Many of these special programs are offered by the Massachusetts Housing Finance Agency. These are intended to encourage lending to lower-income and minority borrowers and to first-time home buyers. Another large group consisted of First-Time Homebuyer programs offered by various banks.

Personal Characteristics

Additional personal characteristics do not alter the basic results (Table B11). The age, sex, and number of dependents of the applicant have no significant effect on the probability of denial. The variable representing marital status approached statistical significance, with applicants who were not married facing a higher probability of being denied a mortgage, other things equal.

Lender Standards

The equations in Table B12 attempt to take account of differential lender standards. It has been suggested that black and Hispanic applicants go disproportionately to institutions that have higher than average credit standards and, therefore, higher denial rates for both whites and minorities. This is a controversial hypothesis, since it implies that minority mortgage applicants act against their own best interest; alternatively, the institutions with higher denial rates may be more aggressive in soliciting minority applications.

A "tough" lender variable was constructed by estimating the basic equation with a dummy variable for each lender over the sample of white applicants only. The coefficients of these dummies were then used to create a dummy variable indicating that the lender had "tough" standards and the

equation was estimated over the entire sample of applicants. As can be seen from Table B12, the "tough" lender variable is not statistically significant and does not alter the results. The inclusion of separate dummy variables for each lender when the equation is estimated over the entire sample does reduce the coefficient of the race variable; but it remains large and statistically significant.

Separate Equations for White and Minority Applicants

An implicit assumption underlying the equation in Table 5 is that lenders treat white and minority applicants the same except for their race. In other words, lenders accord the same weights to credit history, obligation ratios, location risk, and all the other characteristics of white and minority applicants. An alternative possibility is that lenders assess the creditworthiness of minorities quite differently than they do that of whites, so credit history or obligation ratios are viewed differently if the applicant is black or Hispanic.

To test this possibility, the basic equation from Table 5 was run with and without the race variable and separately for white applicants and for black and Hispanic applicants. The four equations are shown in Table B13. Comparing the residuals of the white and minority equations with those of the equation excluding the race variable produces a chi-squared of 37.2 compared to a critical value of 23.7. This result implies that lenders do not treat whites and minorities the same, but does not indicate whether the source of the difference lies in the constant or in the coefficients of the other independent variables. The race variable in the basic equation allows the constant to differ for minority and white applicants. When the separate white and minority equations are compared with the basic equation, the chi-squared is 12.8 compared to a critical value of 22.7. Thus, the hypothesis that lenders treat blacks and whites the same, except for race, cannot be rejected.

Correlation Matrix

Table B14 presents a matrix showing the correlations among the variables used in the basic equation. As can be seen, multicollinearity between any two independent variables is not driving the results, because no two variables are strongly correlated.

Appendix Table B1
Alternative Specifications of Probability of Mortgage Denial
Ability to Support Loan

Variable[a]	Basic Equation Coefficient (t-Statistic)	Coefficient (t-Statistic)
Constant	-6.61	-6.17
	(-17.0)	(-13.0)
Ability to Support Loan		
Housing Expense/Income	.47	.47
	(3.1)	(3.1)
Total Debt Payments/Income	.04	.04
	(6.6)	(6.2)
Net Wealth	.00008	-.000003
	(1.1)	(-.03)
Income		.000013
		(.8)
Liquid Assets		.0002
		(.7)
Base Income/Total Income		-.53
		(-1.7)
Risk of Default		
Consumer Credit History	.33	.33
	(9.8)	(9.8)
Mortgage Credit History	.35	.33
	(3.0)	(2.8)
Public Record History	1.20	1.20
	(7.0)	(7.0)
Probability of Unemployment	.09	.09
	(3.3)	(3.4)
Self-Employed	.52	.56
	(2.8)	(3.0)
Potential Default Loss		
Loan/Appraised Value	.58	.60
	(3.2)	(3.2)
Denied Private Mortgage Insurance	4.70	4.73
	(9.6)	(9.6)
Rent/Value in Tract	.68	.67
	(3.5)	(3.5)
Loan Characteristics		
Two- to Four-Family Home	.58	.57
	(3.6)	(3.4)
Personal Characteristics		
Race	.68	.70
	(5.0)	(5.1)
Number of Observations	3062	3030
Percent Correct Predictions[b]	89	89

[a]See notes to Appendix Tables following Appendix Table B14, for variable definitions and sources.
[b]The number of applicants with a probability of denial greater than 50 percent who were denied, plus the number of applicants with a probability of approval greater than 50 percent who were approved, as a percent of the total sample.

Appendix Table B2
Alternative Specifications of Probability of Mortgage Denial
Risk of Default - Credit History

Variable	Basic Equation Coefficient (t-Statistic)	Coefficient (t-Statistic)	Coefficient (t-Statistic)
Constant	-6.61	-6.04	-6.68
	(-17.0)	(-17.1)	(-16.4)
Ability to Support Loan			
Housing Expense/Income	.47	.46	.48
	(3.1)	(3.0)	(3.2)
Total Debt Payments/Income	.04	.05	.04
	(6.6)	(6.7)	(6.5)
Net Wealth	.00008	.00007	.00007
	(1.1)	(1.0)	(1.0)
Risk of Default			
Consumer Credit History	.33		.33
	(9.8)		(9.8)
Mortgage Credit History	.35		.38
	(3.0)		(3.0)
Public Record History	1.20	1.22	1.20
	(7.0)	(7.1)	(7.0)
Consumer: Insufficient History		1.55	
		(5.8)	
Consumer: One or Two Slow Accounts		.62	
		(3.4)	
Consumer: More than Two Slow Accounts		.94	
		(3.9)	
Consumer: Delinquencies		1.32	
		(6.6)	
Consumer: Serious Delinquencies		1.65	
		(8.5)	
Mortgage: No History		.30	
		(1.8)	
Mortgage: One or Two Late		.73	
		(1.9)	
Mortgage: More than Two Late		1.12	
		(2.4)	
Mortgage: Prior History			.09
			(.5)
Probability of Unemployment	.09	.09	.09
	(3.3)	(3.2)	(3.3)
Self-Employed	.52	.51	.51
	(2.8)	(2.7)	(2.7)
Potential Default Loss			
Loan/Appraised Value	.58	.60	.58
	(3.2)	(3.2)	(3.2)
Denied Private Mortgage Insurance	4.70	4.73	4.70
	(9.6)	(9.6)	(9.6)
Rent/Value in Tract	.68	.64	.68
	(3.5)	(3.2)	(3.5)
Loan Characteristics			
Two-to-Four-Family Home	.58	.58	.58
	(3.6)	(3.6)	(3.6)
Personal Characteristics			
Race	.68	.67	.69
	(5.0)	(4.8)	(5.0)
Number of Observations	3062	3062	3062
Percent Correct Predictions	89	89	89

Appendix Table B3
Alternative Specifications of Probability of Mortgage Denial
Risk of Default - Years on Job; Co-signer

Variable	Basic Equation Coefficient (t-Statistic)	Coefficient (t-Statistic)
Constant	-6.61	-6.62
	(-17.0)	(-16.3)
Ability to Support Loan		
Housing Expense/Income	.47	.44
	(3.1)	(2.9)
Total Debt Payments/Income	.04	.05
	(6.6)	(6.4)
Net Wealth	.00008	.0001
	(1.1)	(1.3)
Risk of Default		
Consumer Credit History	.33	.33
	(9.8)	(9.9)
Mortgage Credit History	.35	.31
	(3.0)	(2.6)
Public Record History	1.20	1.23
	(7.0)	(7.1)
Probability of Unemployment	.09	.09
	(3.3)	(3.4)
Self-Employed	.52	.55
	(2.8)	(3.0)
Years on Job		-.003
		(-.3)
Presence of Co-signer		-.55
		(-1.5)
Potential Default Loss		
Loan/Appraised Value	.58	.59
	(3.2)	(3.2)
Denied Private Mortgage Insurance	4.70	4.73
	(9.6)	(9.6)
Rent/Value in Tract	.68	.74
	(3.5)	(3.7)
Loan Characteristics		
Two-to-Four-Family Home	.58	.60
	(3.6)	(3.6)
Personal Characteristics		
Race	.68	.71
	(5.0)	(5.1)
Number of Observations	3062	2997
Percent Correct Predictions	89	89

Appendix Table B4
Alternative Specifications of Probability of Mortgage Denial
Default Loss - Private Mortgage Insurance

Variable	Basic Equation Coefficient (t-Statistic)	Coefficient (t-Statistic)	Excluding PMI Denials[a] Coefficient (t-Statistic)
Constant	-6.61 (-17.0)	-6.57 (-17.4)	-6.61 (-16.9)
Ability to Support Loan			
Housing Expense/Income	.47 (3.1)	.44 (3.2)	.48 (3.2)
Total Debt Payments/Income	.04 (6.6)	.05 (7.1)	.04 (6.5)
Net Wealth	.00008 (1.1)	.00005 (.7)	.00008 (1.1)
Risk of Default			
Consumer Credit History	.33 (9.8)	.31 (9.8)	.33 (9.9)
Mortgage Credit History	.35 (3.0)	.35 (3.1)	.34 (2.9)
Public Record History	1.20 (7.0)	1.17 (7.1)	1.19 (7.0)
Probability of Unemployment	.09 (3.3)	.09 (3.5)	.09 (3.2)
Self-Employed	.52 (2.8)	.44 (2.5)	.51 (2.7)
Potential Default Loss			
Loan/Appraised Value	.58 (3.2)	.75 (3.4)	.62 (3.2)
Denied Private Mortgage Insurance	4.70 (9.6)		
Rent/Value in Tract	.68 (3.5)	.60 (3.1)	.68 (3.5)
Loan Characteristics			
Two-to-Four-Family Home	.58 (3.6)	.64 (4.2)	.59 (3.6)
Personal Characteristics			
Race	.68 (5.0)	.71 (5.5)	.69 (5.0)
Number of Observations	3062	3062	2983
Percent Correct Predictions	89	88	89

[a]Sample excludes applicants denied private mortgage insurance.

Appendix Table B5
Factors Affecting Probability of Private Mortgage Insurance Denial

Variable	Coefficient (t-Statistic)	Coefficient (t-Statistic)
Constant	-7.31	-7.30
	(-5.6)	(-5.6)
Ability to Support Loan		
Housing Expense/Income	.44	.43
	(1.3)	(1.3)
Total Debt Payments/Income	.07	.07
	(4.0)	(3.8)
Net Wealth	-.0004	-.0004
	(-.7)	(-.7)
Risk of Default		
Consumer Credit History	.20	.20
	(2.7)	(2.7)
Mortgage Credit History	-.08	-.13
	(-.2)	(-.3)
Public Record History	1.02	1.02
	(2.5)	(2.5)
Probability of Unemployment	.07	.06
	(1.0)	(1.0)
Self-Employed	.63	.64
	(1.1)	(1.1)
Potential Default Loss		
Loan/Appraised Value	1.53	1.72
	(1.9)	(2.1)
Rent/Value in Tract	-1.13	-1.78
	(-.8)	(-1.0)
Minority Population Share		.55
		(1.4)
Loan Characteristics		
Two-to-Four-Family Home	.55	.52
	(1.7)	(1.6)
Personal Characteristics		
Race	.59	.34
	(2.0)	(1.0)
Number of Observations	723	723
Percent Correct Predictions	90	90

Appendix Table B6
Alternative Specifications of Probability of Mortgage Denial
Potential Default Loss - Tract Characteristics

Variable	Basic Equation Coefficient (t-Statistic)	Coefficient (t-Statistic)
Constant	-6.61 (-17.0)	-6.92 (-15.9)
Ability to Support Loan		
Housing Expense/Income	.47 (3.1)	.47 (3.0)
Total Debt Payments/Income	.04 (6.6)	.05 (6.6)
Net Wealth	.00008 (1.1)	.00008 (1.1)
Risk of Default		
Consumer Credit History	.33 (9.8)	.34 (9.7)
Mortgage Credit History	.35 (3.0)	.34 (2.7)
Public Record History	1.20 (7.0)	1.19 (6.7)
Probability of Unemployment	.09 (3.3)	.10 (3.4)
Self-Employed	.52 (2.8)	.58 (3.1)
Potential Default Loss		
Loan/Appraised Value	.58 (3.2)	.59 (3.1)
Denied Private Mortgage Insurance	4.70 (9.6)	4.64 (9.3)
Rent/Value in Tract	.68 (3.5)	.66 (3.1)
Housing Units Boarded Up		-.02 (-1.2)
Housing Units Vacant		-.004 (-.3)
Housing Value Appreciation		.0009 (1.6)
Minority Population Share (>30 Percent)		.08 (.3)
Loan Characteristics		
Two-to-Four-Family Home	.58 (3.6)	.63 (3.7)
Personal Characteristics		
Race	.68 (5.0)	.62 (3.9)
Number of Observations	3062	2788
Percent Correct Predictions	89	89

Appendix Table B7
Alternative Specifications of Probability of Mortgage Denial
Potential Default Loss - Foreclosure Rate

Variable	Basic Equation Coefficient (t-Statistic)	Coefficient (t-Statistic)
Constant	-6.61	-6.64
	(-17.0)	(17.1)
Ability to Support Loan		
Housing Expense/Income	.47	.47
	(2.8)	(3.1)
Total Debt Payments/Income	.04	.04
	(6.6)	(6.6)
Net Wealth	.00008	.00008
	(1.1)	(1.1)
Risk of Default		
Consumer Credit History	.33	.33
	(9.8)	(9.8)
Mortgage Credit History	.35	.35
	(3.0)	(3.0)
Public Record History	1.20	1.22
	(7.0)	(7.1)
Probability of Unemployment	.09	.09
	(3.3)	(3.3)
Self-Employed	.52	.53
	(2.8)	(2.9)
Potential Default Loss		
Loan/Appraised Value	.58	.58
	(3.2)	(3.2)
Denied Private Mortgage Insurance	4.70	4.70
	(9.6)	(9.6)
Rent/Value in Tract	.68	.61
	(3.5)	(3.1)
Foreclosures/Owner-occupied Units		8.41
		(1.4)
Loan Characteristics		
Two-to-Four-Family Home	.58	.55
	(3.6)	(3.3)
Personal Characteristics		
Race	.68	.67
	(5.0)	(4.9)
Number of Observations	3062	3062
Percent Correct Predictions	89	89

Appendix Table B8
Foreclosure[a] Rates and Racial Composition of City of Boston Planning Districts
Percent

Planning District	Foreclosures[b] as a Percent of Owner-Occupied Units	Total Foreclosures as a Percent of Total Housing Units	Percent Black and Hispanic in Population
East Boston	.37	.40	18.9
South Boston	.34	.37	1.9
Mattapan	.33	.37	94.5
Charlestown	.32	.35	2.1
Fenway/Kenmore	.24	.32	17.6
South Dorchester	.18	.23	46.7
North Dorchester	.18	.16	36.8
Allston/Brighton	.18	.18	15.5
Jamaica Plain	.17	.18	43.2
Roxbury	.16	.23	90.2
Back Bay/Beacon Hill	.14	.29	5.5
West Roxbury	.14	.15	3.2
South End	.13	.17	52.3
Central	.12	.13	7.0
Hyde Park	.07	.08	27.1
Roslindale	.05	.05	18.1
City of Boston	.27	.22	34.3

[a]Foreclosures are for the years 1988 through 1990.

[b]All sellers are persons; commercial entities are excluded.

Source: Foreclosures were supplied by Banker & Tradesman; housing units are from 1990 Census of Population and Housing.

Appendix Table B9
Alternative Specifications of Probability of Mortgage Denial
Potential Default Loss - Tract Dummy Variables

Variable	Basic Equation Coefficient (t-Statistic)	Coefficient (t-Statistic)
Constant	-6.61	*
	(-17.0)	
Ability to Support Loan		
Housing Expense/Income	.47	.63
	(3.1)	(3.3)
Total Debt Payments/Income	.04	.06
	(6.6)	(6.4)
Net Wealth	.00008	.00005
	(1.1)	(.6)
Risk of Default		
Consumer Credit History	.33	.47
	(9.8)	(8.3)
Mortgage Credit History	.35	.57
	(3.0)	(2.1)
Public Record History	1.20	1.69
	(7.0)	(7.0)
Probability of Unemployment	.09	.13
	(3.3)	(3.6)
Self-Employed	.52	.46
	(2.8)	(1.9)
Potential Default Loss		
Loan/Appraised Value	.58	.81
	(3.2)	(2.5)
Denied Private Mortgage Insurance	4.70	5.68
	(9.6)	(8.9)
Rent/Value in Tract	.68	-829.7
	(3.5)	(-13.9)
Census Tract		*
Loan Characteristics		
Two-to-Four-Family Home	.58	.54
	(3.6)	(2.6)
Personal Characteristics		
Race	.68	.93
	(5.0)	(4.1)
Number of Observations	3062	3062
Percent Correct Predictions	89	n.a.[a]

* Constant is included in the dummy variables for the census tracts. These are not shown because they are so numerous.
[a]The large number of variables in this equation required a more powerful computer and the regression package available did not calculate percent correct predictions.

Appendix Table B10
Alternative Specifications of Probability of Mortgage Denial
Loan Characteristics

Variable	Basic Equation Coefficient (t-Statistic)	Coefficient (t-Statistic)
Constant	-6.61	-6.57
	(-17.0)	(-11.8)
Ability to Support Loan		
Housing Expense/Income	.47	.49
	(3.1)	(3.2)
Total Debt Payments/Income	.04	.05
	(6.6)	(6.7)
Net Wealth	.00008	.00007
	(1.1)	(1.0)
Risk of Default		
Consumer Credit History	.33	.33
	(9.8)	(9.8)
Mortgage Credit History	.35	.38
	(3.0)	(3.2)
Public Record History	1.20	1.20
	(7.0)	(6.9)
Probability of Unemployment	.09	.08
	(3.3)	(3.0)
Self-Employed	.52	.53
	(2.8)	(2.8)
Potential Default Loss		
Loan/Appraised Value	.58	.62
	(3.2)	(3.4)
Denied Private Mortgage Insurance	4.70	4.81
	(9.6)	(9.7)
Rent/Value in Tract	.68	.70
	(3.5)	(3.6)
Loan Characteristics		
Two-to-Four-Family Home	.58	.61
	(3.6)	(3.7)
Fixed-Rate Loan		-.13
		(-1.0)
Not a Special Loan Program		.23
		(1.4)
Term of Loan		-.0009
		(-.8)
Gift or Grant in Down Payment		-.32
		(-1.9)
Personal Characteristics		
Race	.68	.73
	(5.0)	(5.2)
Number of Observations	3062	3055
Percent Correct Predictions	89	90

Appendix Table B11
Alternative Specifications of Probability of Mortgage Denial
Personal Characteristics

Variable	Basic Equation Coefficient (t-Statistic)	Coefficient (t-Statistic)
Constant	-6.61	-6.88
	(-17.0)	(-13.4)
Ability to Support Loan		
Housing Expense/Income	.47	.46
	(3.1)	(3.0)
Total Debt Payments/Income	.04	.05
	(6.6)	(6.8)
Net Wealth	.00008	.00008
	(1.1)	(1.1)
Risk of Default		
Consumer Credit History	.33	.33
	(9.8)	(10.0)
Mortgage Credit History	.35	.35
	(3.0)	(2.9)
Public Record History	1.20	1.18
	(7.0)	(6.8)
Probability of Unemployment	.09	.09
	(3.3)	(3.3)
Self-Employed	.52	.52
	(2.8)	(2.8)
Potential Default Loss		
Loan/Appraised Value	.58	.63
	(3.2)	(3.3)
Denied Private Mortgage Insurance	4.70	4.70
	(9.6)	(9.5)
Rent/Value in Tract	.68	.66
	(3.5)	(3.4)
Loan Characteristics		
Two-to-Four-Family Home	.58	.58
	(3.6)	(3.6)
Personal Characteristics		
Race	.68	.65
	(5.0)	(4.7)
Age		.006
		(.9)
Sex		-.21
		(-1.2)
Number of Dependents		.04
		(.6)
Marital Status (Not Married = 1)		.27
		(1.8)
Number of Observations	3062	3027
Percent Correct Predictions	89	89

Appendix Table B12
Alternative Specifications of Probability of Mortgage Denial
Lender Standards

Variable	Basic Equation Coefficient (t-Statistic)	Coefficient (t-Statistic)	Coefficient (t-Statistic)
Constant	-6.61	-6.65	*
	(-17.0)	(16.9)	
Ability to Support Loan			
Housing Expense/Income	.47	.47	.47
	(3.1)	(3.1)	(2.8)
Total Debt Payments/Income	.04	.04	.05
	(6.6)	(6.6)	(6.4)
Net Wealth	.00008	.00008	.00007
	(1.1)	(1.1)	(.7)
Risk of Default			
Consumer Credit History	.33	.33	.39
	(9.8)	(9.8)	(10.0)
Mortgage Credit History	.35	.36	.40
	(3.0)	(3.1)	(3.1)
Public Record History	1.20	1.20	1.51
	(7.0)	(7.0)	(7.3)
Probability of Unemployment	.09	.09	.08
	(3.3)	(3.3)	(2.7)
Self-Employed	.52	.52	.67
	(2.8)	(2.8)	(3.2)
Potential Default Loss			
Loan/Appraised Value	.58	.59	.67
	(3.2)	(3.2)	(3.2)
Denied Private Mortgage Insurance	4.70	4.70	4.85
	(9.6)	(9.6)	(8.8)
Rent/Value in Tract	.68	.68	.56
	(3.5)	(3.5)	(2.6)
Loan Characteristics			
Two-to-Four-Family Home	.58	.58	.64
	(3.6)	(3.6)	(3.5)
Lender			
Tough Lender		.09	
		(.5)	
Lender Dummy			*
Personal Characteristics			
Race	.68	.68	.54
	(5.0)	(5.0)	(3.4)
Number of Observations	3062	3062	3061
Percent Correct Predictions	89	89	91

* Constant is included in the dummy variables for the lenders. These are not shown because they are so numerous.

Appendix Table B13
Alternative Specifications of Probability of Mortgage Denial

Variable	Basic Equation Coefficient (t-Statistic)	No Race Coefficient (t-Statistic)	White Coefficient (t-Statistic)	Black and Hispanic Coefficient (t-Statistic)
Constant	-6.61	-6.56	-6.22	-7.33
	(-17.0)	(-17.0)	(-14.6)	(-7.6)
Ability to Support Loan				
Housing Expense/Income	.47	.51	.44	.46
	(3.1)	(3.4)	(2.3)	(1.9)
Total Debt Payments/Income	.04	.05	.04	.07
	(6.6)	(6.6)	(4.9)	(4.8)
Net Wealth	.00008	.00005	.00008	-.0002
	(1.1)	(.7)	(1.3)	(-.5)
Risk of Default				
Consumer Credit History	.33	.35	.32	.33
	(9.8)	(10.6)	(7.5)	(6.1)
Mortgage Credit History	.35	.39	.28	.63
	(3.0)	(3.3)	(2.1)	(2.5)
Public Record History	1.20	1.27	1.33	1.07
	(7.0)	(7.6)	(5.9)	(4.0)
Probability of Unemployment	.09	.08	.09	.08
	(3.3)	(2.8)	(3.0)	(1.4)
Self-Employed	.52	.46	.65	.15
	(2.8)	(2.5)	(3.1)	(.4)
Potential Default Loss				
Loan/Appraised Value	.58	.63	.56	.79
	(3.2)	(3.1)	(2.9)	(1.2)
Denied Private Mortgage Insurance	4.70	4.71	5.00	4.12
	(9.6)	(9.7)	(8.0)	(5.3)
Rent/Value in Tract	.68	.74	.55	.98
	(3.5)	(3.9)	(2.1)	(3.0)
Loan Characteristics				
Two-to-Four-Family Home	.58	.76	.78	.38
	(3.6)	(4.8)	(3.4)	(1.7)
Personal Characteristics				
Race	.68			
	(5.0)			
Number of Observations	3062	3062	2340	722
Percent Correct Predictions	89	89	92	81

Appendix Table B14
Correlation Matrix

		1 RACE	2 HEXP	3 DTOI	4 NETW	5 CONSPAY	6 MORTPAY	7 PUBREC	8 UR	9 LTV	10 Rent	11 PMI	12 2 to 4	13 SELF
1	Race	1.00												
2	Housing Expenses/Income	.06	1.00											
3	Total Debt Payments/Income	.07	.37	1.00										
4	Net Wealth	-.08	-.03	-.08	1.00									
5	Consumer Credit History	.20	.01	.06	-.03	1.00								
6	Mortgage Credit History	.14	.06	.06	-.11	.15	1.00							
7	Public Record History	.14	.05	.10	.01	.31	.07	1.00						
8	Probability of Unemployment	-.05	-.01	.03	-.01	-.02	.03	.01	1.00					
9	Loan/Appraised Value	.14	.04	.08	-.07	.05	.12	.05	-.01	1.00				
10	Rent/Value in Tract	.10	-.02	-.02	.04	.03	.02	.02	.001	.02	1.00			
11	Denied Private Mortgage Insurance	.10	.05	.08	-.03	.07	.05	.07	.01	.15	-.0003	1.00		
12	Two- to Four-Family Home	.23	-.01	.01	-.01	.07	.06	.04	.05	.07	.11	.09	1.00	
13	Self-Employed	-.07	-.003	.02	.12	-.02	-.05	.02	.16	-.03	-.03	-.02	.03	1.00

Number of Observations: 3062

Variable Definitions and Sources

Question numbers refer to the questions listed in Appendix A.
Data from lenders' HMDA reports were supplied by the lenders as part of their normal Home Mortgage Disclosure Act filing.

Dependent Variable	= 1	if applicant was denied a mortgage
	0	if application was accepted
Housing Expense/Income	= 1	if greater than .30,
	0	otherwise (from question #45)
Total Debt Payments/Income	=	value of question #46
Net Wealth	=	value of question #36 less question #38
Income	=	sum of applicant and co-applicant total monthly income (question #31)
Liquid Assets	=	value of question #35
Base Income/Total Income	=	applicant and co-applicant base income relative to total income (derived from questions #30 and #31)
Consumer Credit History	= 1	if no "slow pay" account (code 1 in question #43)
	= 2	if one or two slow pay accounts (code 2)
	= 3	if more than two slow pay accounts (code 3)
	= 4	if insufficient credit history for determination (code 0)
	= 5	delinquent credit history with 60 days past due (code 4)
	= 6	serious delinquencies with 90 days past due (code 5)
Mortgage Credit History	= 1	if no late payment (code 1 in question #42)
	= 2	if no payment history (code 0)
	= 3	if one or two late payments (code 2)
	= 4	if more than two late payments (code 3)
Public Record	= 1	if any public record of credit problems (codes 1,2,3,4 in question #44)
	0	otherwise
Consumer: Insufficient History	= 1	if code 0 in question #43; 0 otherwise
Consumer: One or Two Slow Accounts	= 1	if code 2 in question #43; 0 otherwise
Consumer: More than Two Slow Accounts	= 1	if code 3 in question #43; 0 otherwise
Consumer: Delinquencies	= 1	if code 4 in question #43; 0 otherwise
Consumer: Serious Delinquencies	= 1	if code 5 in question #43; 0 otherwise
Mortgage: No History	= 1	if code 0 in question #42; 0 otherwise
Mortgage: One or Two Late	= 1	if code 2 in question #42; 0 otherwise
Mortgage: More than Two Late	= 1	if code 3 in question #42; 0 otherwise
Mortgage: Prior History	= 1	if code was not 0 in question #42; 0 otherwise
Probability of Unemployment	=	1989 Massachusetts unemployment rate for applicant's industry (from question #29) Unemployment rates from U.S. Bureau of Labor Statistics, Geographic Profile of Employment and Unemployment, 1989
Self-Employed	= 1	if applicant was self-employed
	0	otherwise (from question #27)
Years on Job	=	value for applicant for question #26
Presence of Co-signer	= 1	if affirmative response to question #55
	0	otherwise

Loan/Appraised Value	=	value of loan amount from original HMDA report divided by question #50
Denied Private Mortgage Insurance	= 1	if negative response to question #53
	0	otherwise
Rent/Value in Tract	=	rental income divided by value of rental housing stock in census tract in which property was located. Derived from U.S. Bureau of the Census, 1990 Census of Population and Housing, Summary Tape File 3 (1990 Census)
Housing Units Boarded Up	=	percent of housing units in census tract in which property was located that were boarded up Source: 1990 Census
Housing Units Vacant	=	percent of housing units in census tract in which property was located that were vacant Source: 1990 Census
Housing Value Appreciation	=	percent change in the median value of owner-occupied housing between 1980 and 1990 in the census tract in which in which the property was located Source: Derived from 1990 Census and 1980 Census of Population and Housing, Summary Tape File 3
Minority Population Share (>30 Percent)	= 1	if minorities comprise more than 30 percent of the tract population
	0	otherwise Source: 1990 Census
Foreclosure Rate	=	total foreclosures divided by owner-occupied housing units Source: Foreclosures from Banker & Tradesman; housing units from 1990 census
Census Tract Dummy Variable (for each tract)	= 1	if property was located in census tract; 0 otherwise
Two- to Four-Family Homes	= 1	if purchasing a two- to four-family home
	0	otherwise (question # 51)
Fixed-Rate Loan	= 1	if fixed rate
	0	otherwise (question #47)
Not a Special Loan Program	= 1	if not applying under a special loan program
	0	otherwise (question #49)
Term of Loan	=	value from question #48
Gift or Grant in Down Payment	= 1	if affirmative response to question #54; 0 otherwise
Lender Dummy Variable (for each lender)	= 1	if application made to lender; 0 otherwise
Race	= 1	if applicant was black or Hispanic,
	= 0	otherwise (lenders' HMDA report)
Age	=	applicant age from question #21
Sex	= 1	if applicant was male
	0	otherwise (lenders' HMDA report)
Number of Dependents	=	number of applicant's dependents (question # 24)
Marital Status	= 0	if applicant was married
	1	otherwise (question #23)
Tough Lender	= 1	if lender had a high denial rate for white applicants, as described in Appendix B
	0	otherwise

References

Avery, Robert B. and Thomas M. Buynak. 1981. "Mortgage Redlining: Some New Evidence." Economic Review, Federal Reserve Bank of Cleveland, Summer, pp. 15-31.

Barth, James R., Joseph J. Cordes, and Anthony M. J. Yezer. 1979. "Financial Institution Regulations, Redlining and Mortgage Markets." In The Regulation of Financial Institutions, Federal Reserve Bank of Boston Conference Series No. 21, pp. 101-43.

Benston, George J., Don Horsky, and H. Martin Weingartner. 1978. "An Empirical Study of Mortgage Redlining." Monograph Series in Finance and Economics No. 5. New York: Salomon Brothers Center for the Study of Financial Institutions.

Black, Harold, Robert L. Schweitzer, and Lewis Mandell. 1978. "Discrimination in Mortgage Lending." The American Economic Review, vol. 68, no. 2, pp. 186-91.

Bradbury, Katharine L., Karl E. Case, and Constance R. Dunham. 1989. "Geographic Patterns of Mortgage Lending in Boston, 1982-87." New England Economic Review, September/October, pp. 3-30.

Canner, Glenn B. 1982. "Redlining: Research and Federal Legislative Response." Board of Governors of the Federal Reserve System, October.

Canner, Glenn, Stuart A. Gabriel, and J. Michael Woolley. 1991. "Race, Default Risk and Mortgage Lending: A Study of the FHA and Conventional Loan Markets." Southern Economic Journal, vol. 58 (1), pp. 249-62.

Dedman, Bill and others. 1988. "The Color of Money." A Compendium. The Atlanta Journal and the Atlanta Constitution. May 1-4.

Federal National Mortgage Association. 1992. Fannie Mae Guides, Vol. 1 Selling, pp. 601-94. Washington, D.C.: FNMA.

Gabriel, Stuart A. and Stuart S. Rosenthal. 1991. "Credit Rationing, Race and the Mortgage Market." Journal of Urban Economics, vol. 29, pp. 371-79.

Galster, George C. 1977. "A Bid-Rent Analysis of Housing Market Discrimination." The American Economic Review, vol. 67, no. 2, pp. 144-55.

Gittleman, Mary B. and David R. Howell. 1992. "Labor Market Segmentation, Employment Restructuring and Earnings Inequality by Race and Gender in the 1980's." Mimeo. Jerome Levy Economics Institute. June.

King, Thomas A. 1979. "Redlining: A Critical Review of the Literature with Suggested Research." Federal Home Loan Bank Board, Working Paper No. 82.

_____. 1980. "Discrimination in Mortgage Lending: A Study of Three Cities." Federal Home Loan Bank Board, Working Paper No. 91.

Schafer, Robert and Helen F. Ladd. 1981. Discrimination in Mortgage Lending. MIT-Harvard Joint Center for Urban Studies. Cambridge, MA: The MIT Press.

Yinger, John. 1986. "Measuring Racial Discrimination with Fair Housing Audits: Caught in the Act." The American Economic Review, vol. 76, no. 5, pp. 881-93.