c. Recent HMDA Studies—Controlling for Applicant Credit Risk

An important question is whether variations in denial rates reflect lender bias against certain kinds of neighborhoods and borrowers, or simply the credit quality of the mortgage (as indicated by the applicant's available assets, credit rating, employment history, etc.). The technical improvements offered by recent studies of credit disparities have attempted to control for credit risk factors that might influence a lender's decision to approve a loan. Without fully accounting for the creditworthiness of the borrower, racial differences in denial rates cannot be attributed to lender bias. The best example of accounting for credit risk is the study by researchers at the Federal Reserve Bank of Boston, which analyzed mortgage denial rates.[13] To control for credit risk, the Boston Fed researchers included 38 borrower and loan variables indicated by lenders to be critical to loan decisions. They found that minorities' higher denial rates could not be explained fully by income and credit risk factors. Blacks and Hispanics were about 60 percent more likely to be denied credit than Whites, even after controlling for credit risk characteristics such as credit history, employment stability, liquid assets, self-employment, age, and family status and composition. Although almost all highly-qualified applicants of all races were approved, differential treatment was observed among borrowers with lesser qualifications.[14]

A recent HUD study also found minority denial rates to be higher in ten metropolitan areas, even after controlling for credit risk.[15] In addition, the higher denial rates observed in minority neighborhoods were not purely a reflection of the higher denial rates experienced by minorities. Whites experienced higher denial rates in some minority neighborhoods than in some predominantly white neighborhoods.

The Boston Fed and HUD studies concluded that the effect of borrower race on mortgage rejections persists even after controlling for legitimate determinants of lenders' credit decisions. Thus, they give some legitimacy to denial rate comparisons such as those in Tables B.1 and B.2. However, the independent race effect identified in these studies is still difficult to interpret. In addition to lender bias, access to credit can be limited by loan characteristics that reduce profitability[16] and by underwriting standards that have disparate effects on minority and lower income borrowers and neighborhoods.[17]

d. Recent HMDA Studies—Controlling for Neighborhood Risk and Demand and Tests of the Redlining Hypothesis

Two recent statistical studies sought to test the redlining hypothesis by more completely controlling for differences in neighborhood risk and demand. These studies do not support claims of racially induced mortgage redlining—the explanatory power of neighborhood race is reduced to the extent that the effects of neighborhood risk and demand are accounted for. However, these studies cannot reach definitive conclusions about redlining because of the correlation of neighborhood race with other explanatory variables included in their models.

First, Andrew Holmes and Paul Horvitz used 1988–1991 HMDA data to examine the flow of conventional mortgage originations across census tracts in Houston.[18] Their regression model included as explanatory variables the economic viability of the loan and residents of the tract (e.g., house value, income, age distribution and education level), measures of demand (e.g., recent movers and change in owner units between 1980 and 1990), and measures of credit risk (defaults on government-insured loans and change in tract house values between 1980 and 1990). To determine the existence of racial redlining, the model also included as explanatory variables the percentages of Black and Hispanic residents in the tract and the increase in the tract's minority percentage between 1980 and 1990. Most of the neighborhood risk and demand variables were significant determinants of the flow of conventional loans in Houston. The coefficients of the racial composition variables were insignificant which led Holmes and Horvitz to conclude that allegations of redlining could not be supported, at least in the Houston market.

One of their more interesting findings, however, was that the racial composition variables became significant and negative, thus suggesting the existence of redlining, when they re-estimated their model twice, once without the credit risk variables and once without the demand variables. This finding is consistent with earlier credit flow studies that concluded that redlining exists. Holmes and Horvitz caution against relying on findings from these earlier studies because they did not adequately account for differences in neighborhood risk and demand. The authors conclude that ''a claim of racially based geographic discrimination in mortgage lending must be based on a consideration of race *after* (emphasis added) taking account of variables that are rationally connected with the economics of the mortgage lending process.'' [19]

In the second study, Michael Schill and Susan Wachter attempt to improve on earlier studies of redlining by examining whether mortgage denials are related to neighborhood racial composition.[20] Schill and Wachter argue that HMDA data on mortgage rejections, first released in 1990, allow researchers to address perhaps the major shortcoming of earlier credit flow studies—the inability to separate demand influences from supply influences. Analyzing information on whether lenders accept or reject individual loan applicants permits Schill and Wachter to study the determinants of the supply decision separately.[21]

In their empirical work, Schill and Wachter focused on loan acceptances rather than denials. Their model posits that the probability that a lender will accept a specific mortgage application depends on characteristics of the individual loan application[22] and characteristics of the neighborhood where the property collateralizing the loan is located. Because they rely on public data, Schill and Wachter do not have information on several loan and property risk variables, such as loan-to-value ratio, that are known to affect the mortgage

[13] Alicia H. Munnell, Lynn E. Browne, James McEneaney, and Geoffrey M. B. Tootell, ''Mortgage Lending in Boston: Interpreting HMDA Data,'' Federal Reserve Bank of Boston, Working Paper Series, No. 92–7, October 1992.

[14] This study was the subject of substantial criticism with regard to data quality and model specification, but even after accounting for these problems, the race conclusions were found to persist in a re-estimation of the model by Fannie Mae. See James H. Carr and Isaac F. Megbolugbe, ''The Federal Reserve Bank of Boston Study on Mortgage Lending Revisited,'' *Journal of Housing Research*, Volume 4, Issue 2, 1993, pp. 277–313. Other criticisms, however, have also been mentioned. For instance, the fact that the credit risk variables included in the model are correlated with the minority variable suggests that the latter may be picking up the effects of still other credit risk variables omitted from the model. See John Straka, ''Boston Federal Reserve Study of Mortgage Discrimination,'' *Secondary Mortgage Markets*, Volume 10, No. 1, Winter 1993, pp. 8–9, for a useful discussion of other aspects of the Boston Fed study.

[15] ICF Incorporated, Ann B. Schnare, and Stuart A. Gabriel, ''The Role of FHA in the Provision of Credit to Minorities,'' prepared for the U.S. Department of Housing and Urban Development, April 25, 1994.

[16] Lenders are discouraged from making smaller loans in older neighborhoods. Since upfront loan fees are frequently determined as a percentage of the loan amount, such loans generate lower revenue and thus are less profitable to lenders.

[17] Standard underwriting practices may exclude lower income families that are, in fact, creditworthy. Such families tend to pay cash, leaving them without a credit history. In addition, the usual front-end and back-end ratios applied to applicants' housing expenditures and other on-going costs may be too stringent for lower income households, who typically pay higher shares of their income for housing than higher income households.

[18] Holmes and Horvitz also analyzed the flow of government-insured loans and obtained what are now standard results in the literature—compared with conventional loans, government-insured loans are more targeted to lower income and risky neighborhoods.

[19] Holmes and Horvitz, page 97. The authors recognize that many of the risk and demand variables in their model are rather highly correlated with the racial composition variables also included in their model. Thus, one could argue that their risk and demand variables are serving, to a certain extent, as proxies for race, which would mean that their results suggest a high degree of redlining in the Houston market. Holmes and Horvitz dismiss this argument by stating that several of their non-racial variables are reasonable proxies for other prudent lending variables such as wealth and job stability for which they did not have direct data.

[20] Schill and Wachter. Although its methodology and findings are similar to those of studies discussed in the next section, it is informative to review Schill and Wachter's study in detail because it illustrates issues that must be dealt with before one can reach definitive conclusions about redlining.

[21] Perle also agrees that micro-based models of mortgage denial rates are more appropriate for studying redlining than macro-based credit flow models that fail to separate demand and supply effects.

[22] Individual loan characteristics include loan size (economies of scale cause lenders to prefer large loans to small loans) and all individual borrower variables included in the HMDA data (the applicant's income, sex, and race).