HUD's definition also targets in the suburbs as well as in central cities—for example, the average denial rate in underserved suburban areas is almost twice that in the remaining served areas of the suburbs. Low-income and highminority suburban tracts appear to have credit problems similar to their central city counterparts. These suburban tracts, which account for 31 percent of the suburban population, are encompassed by the definition of other underserved areas. Thus, the advantage of HUD's targeted definition of underserved areas is illustrated by sharp differences in measures of mortgage access between served and underserved areas within both central cities and suburbs.

William Shear, James Berkovec, Ann Dougherty, and Frank Nothaft, economists at Freddie Mac, recently completed an analysis of mortgage flows and application acceptance rates in 32 metropolitan areas that also supported a targeted definition of underserved areas.²⁸ These researchers regressed the number of mortgage originations per 100 properties in the census tract on several independent variables that are intended to account for some, but admittedly not all, of the demand and supply (i.e., credit risk) influences at the census tract level. Examples of the demand and supply variables at the census tract level include: tract income relative to the area median income, the increase in house values between 1980 and 1990, the percentage of units boarded up, and the age distributions of households and housing units. The tract's minority composition and central city location were included to test if these characteristics are associated with underserved neighborhoods after controlling for the demand and supply variables. Several of their findings relate to the issue of defining underserved areas:

• Census tracts with high concentrations of African American and Hispanic families have lower rates of applications, originations, and acceptance rates. For instance, the regression estimates suggest that all-White census tracts would have an average 10.5 originations per 100 properties, while all-African American and all-Hispanic census tracts would have about 7 originations per 100 properties.

- Tract income influences mortgage flows—tracts at 80 percent of median income are estimated to have 8.6 originations per 100 owners as compared with 10.8 originations for tracts over 120 percent of median income.
- Once census tract influences are accounted for, central city location has only a minimal effect on credit flows.

Shear, Berkovec, Dougherty, and Nothaft recognized that it is difficult to interpret their estimated minority effects—the effects may indicate lender discrimination, supply and demand effects not included in their model but correlated with minority status, or some combination of these factors. They explain the implications of their results for measuring underserved areas as follows:

* * * While it is not at all clear how we might rigorously define, let alone measure, what it means to be underserved, it is clear that there are important housing-related problems associated with certain location characteristics, and it is possible that, in the second or third best world in which we live, mortgage markets might be useful in helping to solve some of these problems. We then might use these data to help single out important areas or at least eliminate some bad choices. * * * The regression results indicate that income and minority status are better indicators of areas with special needs than central city location.²⁹

HUD Analysis. HUD used 1993 HMDA data to update the analysis of Shear et al. HUD focused on denial and origination rates for conforming conventional applications and included all metropolitan areas in the analysis.³⁰ HUD's analysis also supports a targeted underserved definition. Lower-income census tracts and census tracts with concentrations of African American and Hispanic families have lower origination rates and higher denial rates. For example, the regression estimates suggest that all-White census tracts would have an average 13.7 percent denial rate and 13.4 originations per 100 properties, while census tracts that are 50 percent African American (Hispanic) would have an average 22.3 (19.7) percent denial rate and 9.8 (12.0) originations per 100 properties. Furthermore, the regression analysis indicates central-city location has a minimal effect on denial and origination rates, after controlling for census tract effects.31

Robert Avery, Patricia Beeson, and Mark Sniderman of the Federal Reserve Bank of Cleveland recently presented a paper specifically addressing the issue of underserved areas in the context of the GSE legislation.32 Their study examines variations in application rates and denial rates for all individuals and census tracts included in the 1990 and 1991 HMDA data base. They seek to isolate the differences that stem from the characteristics of the neighborhood itself rather than the characteristics of the individuals that apply for loans in the neighborhood or lenders that happen to serve them. Similar to the two studies of redlining reviewed in the previous section, Avery, Beeson and Sniderman hypothesize that variations in mortgage application and denial rates will be a function of several risk variables such as the income of the applicant and changes in neighborhood house values; they test for independent racial effects by adding to their model the applicant's race and the racial composition of the census tract. Econometrics are used to separate individual applicant effects from neighborhood effects.

Based on their empirical work, Avery, Beeson and Sniderman reach the following conclusions:

• The individual applicant's race exerts a strong influence on mortgage application and denial rates. African American applicants, in particular, have unexplainably high denial rates.

• Once individual applicant and other neighborhood characteristics are controlled for, overall denial rates for purchase and refinance loans were only slightly higher in minority census tracts than non-minority census tracts.³³ For white applicants, on the other hand, denial rates were significantly higher in minority tracts.³⁴ That is, minorities

²⁸ William Shear, James Berkovec, Ann Dougherty, and Frank Nothaft, "Unmet Housing Needs: The Role of Mortgage Markets," presented at mid-year meeting of the American Real Estate and Urban Economics Association, June 1, 1994. See also Susan Wharton Gates, "Defining the Underserved," Secondary Mortgage Markets, 1994 Mortgage Market Review Issue, pp. 34–48.

²⁹ Shear et al., p. 18.

³⁰ Including FHA applications in the analysis—as in Shear *et al.*—does not significantly change the results reported in this section.

³¹ Central city location had no significant effect on origination rates. For denial rates, the difference between the average central city denial rate and the average suburban denial rate was .56 percent.

³² See Avery, et al.

³³ Avery et al. find very large unadjusted differences in denial rates between white and minority neighborhoods, and although the gap is greatly reduced by controlling for applicant characteristics (such as race and income) and other census tract characteristics (such as house price and income level), a significant difference between white and minority tracts remains (for purchase loans, the denial rate difference falls from an unadjusted level of 16.7 percent to 4.4 percent after controlling for applicant and other census tract characteristics, and for refinance loans, the denial rate difference falls from 21.3 percent to 6.4 percent). However, when between-MSA differences are removed, the gap drops to 1.5 percent and 1.6 percent for purchase and refinance loans, respectively. See Avery, et al., p. 16.

³⁴ Avery, *et al.*, page 19, note that, other things equal, a black applicant for a home purchase loan is 3.7 percent more likely to have his/her application denied in an all-minority tract than in an all-white tract, while a white applicant from an all-minority tract would be 11.5 percent more likely to be denied.