RACE, REDLINING, AND RESIDENTIAL MORTGAGE DEFAULTS: EVIDENCE FROM THE FHA-INSURED SINGLE-FAMILY LOAN PROGRAM

James A. Berkovec, Glenn B. Canner, Timothy H. Hannan, and Stuart A. Gabriel

Recent years have witnessed widespread controversy and policy debate concerning allegations of racial discrimination in mortgage lending. Those allegations derive in part from data assessments resulting from the Home Mortgage Disclosure Act (HMDA), which indicate significantly damped rates of mortgage lending among minority applicants and neighborhoods, even after controlling for applicant income class and neighborhood socioeconomic status.

Although the racial patterns observed in the HMDA data raise the specter of widespread discrimination in mortgage lending, those results may derive as well from unobserved indicators of borrower default risk correlated with applicant race or neighborhood racial composition. As has been argued for some time, evaluation of racial patterns in mortgage lending—including assessment of possible discriminatory lending practices—should be undertaken in a manner that adequately controls for borrower and locational default risk.

Recent contributions to the credit rationing literature (see, for example, Stiglitz and Weiss 1981; Williamson 1986; and Lang and Nakamura 1993) provide the theoretical underpinnings to assessments of default risk in mortgage lending. This literature argues that lenders may apply binding credit constraints to loan applicants due either to uncertainties surrounding timely repayment of the loan or because of factors that may adversely affect the collateral value of the property. In a competitive loan market, it is economically rational for lenders to apply tighter credit conditions to more risky loan applicants, irrespective of whether the risk derives from the attributes of the applicant or from those associated with the neighborhood where the property is located.

Given those formal studies, empirical assessments of default risk focus on variables that represent borrower ability to service the mortgage as scheduled, borrower equity in the property, and transactions costs associated with default (see, for example, reviews of the default literature by Neal 1989 and Quercia and Stegman 1992). Historically, most analyses of default have emphasized factors known to the lender at the time of origination. In these studies, a vector of borrower financial and socioeconomic characteristics typically denotes the likelihood of timely loan repayment. More recently, attention has centered as well on events that may trigger default. In these analyses, borrower equity and ability to pay are sometimes measured contemporaneously. Although recent empirical studies may provide more accurate assessments of events that trigger default, few of those analyses have explicitly examined any residual effects of borrower race or neighborhood racial composition on mortgage loan performance. Further, whereas analysis of triggering events reveals many useful insights, at the time of loan origination, creditors can only assign probability weights to those factors they believe are related to loan performance. Consequently, assessment of creditor behavior at the time of loan origination should focus on information available to the lender at that time.

In a nondiscriminatory world, lenders engage in credit rationing only as required to maximize profits. In that sense, mortgage lenders should be willing to offer credit to those applicants whose loan requests are expected to yield a positive (risk-adjusted) return, and would presumably deny applications that are expected to yield a negative expected return. For the most part, creditors do not ration home purchase loans by varying the price of the credit. Rather, they establish minimum acceptable standards of creditworthiness that prospective buyers and the properties they seek to offer as collateral must meet. The principal exception pertains to the treatment of borrowers seeking loans with high loan-to-value (LTV) ratios. In the conventional loan market, borrowers seeking loans with LTV ratios greater than 80 percent generally pay higher rates because the lenders normally require private mortgage insurance. Private mortgage insurance premiums generally increase in line with increases in the LTV ratio between 80 and 95 percent (the legislative maximum for private insurance). In the Federal Housing Administration (FHA) loan market, borrowers during the period in which the loans in the study we describe here were originated paid a flat insurance premium of 3.8 percent of the loan amount. Given limited variation in the price of FHA mortgage credit, one would expect returns to home lending—

upon accounting for loan amount—to be directly related to losses from default.

As documented in this chapter, minority loan applicants and neighborhoods are often characterized by higher levels of default risk, relative to the applicant pool as a whole. However, to the extent that loan underwriting requirements fully account for borrower and locational default risk, and hence coincide closely with actual loan performance, applicant and neighborhood racial composition should play no residual role in the credit extension decision. Alternatively, as suggested by Peterson (1981) and Van Order, Westin, and Zorn (1993), the prevalence of systematic racial discrimination or redlining may result in lenders' holding minority applicants or applicants from minority neighborhoods to loan qualification standards well in excess of those required by true assessments of default risk. Following Peterson (1981) and others, we refer to this type of discrimination as *uneconomic discrimination*, since it is not in the profit-maximizing interest of the lender to engage in this kind of activity. In this context, uneconomic racial discrimination may be defined as the rejection or discouragement of minority home loan applicants whose credit requests have a positive expected return and/or the acceptance of nonminority applicants whose loan requests have a negative expected return. This kind of discriminatory behavior then would likely result in higher returns to home loans—as evidenced by lower default rates or smaller dollar losses—among minority borrowers or neighborhoods than those observed for nonminority borrowers or neighborhoods.

In contrast to uneconomic racial discrimination, economic racial discrimination, which is also illegal, occurs when creditors use the race of the applicant as a proxy for risk-related characteristics that are either unobservable or costly to obtain. Discrimination of this type may be consistent with profit-maximizing behavior, since race is employed as an indicator of risk. This type of discrimination, as discussed later in this chapter, implies a different relationship between race and observed default rates than that implied by uneconomic discrimination.

The study we conducted evaluates the default risk characteristics and the performance of FHA-insured, single-family residential mortgages. In so doing it assesses any residual effects of borrower race or neighborhood racial composition on the likelihood of loan default. The analysis is undertaken using formerly unavailable individual loan records from the U.S. Department of Housing and Urban Development (HUD), augmented with 1980 census-tract-level data to identify neighborhood locational attributes potentially associated with default risk.

This chapter is organized as follows. The next section places the current study in the context of recent analyses of race, default risk, and mortgage lending. In so doing, we point to methodological or data limitations of previous analyses that are addressed in the current research. The third section provides data and model specification, and the fourth section presents the results of the model's estimation. A summary section concludes the chapter.

RACIAL DISCRIMINATION AND RESIDENTIAL MORTGAGE DEFAULTS

Analyses of mortgage defaults focus fundamentally on variables influencing borrower equity in the property and borrower ability to service the loan as scheduled. Equity is important because default can be seen as the option to return the mortgage to the lender at the par value of the loan. From a strict options perspective, this "put option" would be exercised when borrower negative equity in the property exceeds the homeowner's costs associated with default. In this framework the decision to default is based fully on homeowner loss minimization; the borrower's income and employment situation are taken to be largely irrelevant in that decision. The ability-to-pay approach focuses on events that trigger default, in that negative equity is typically found to be a necessary, but not a sufficient, condition for default.

Unlike early studies, which restricted evaluation of borrower equity to measures available at the time of loan origination, more recent analyses (Campbell and Dietrich 1983; Vandell and Thibodeau 1985) have modeled the mortgage put option using proxies that include estimates of the contemporaneous borrower equity in the property. These studies specify contemporaneous mortgage LTV ratios through variables that measure fluctuations in both the numerator and denominator of that ratio. In Campbell and Dietrich's (1983) study, for example, property value fluctuations were represented using nonquality-adjusted state housing price appreciation rates; borrower equity was further adjusted by the spread between the current market and coupon rate on the mortgage. Vandell and Thibodeau (1985) expanded upon this earlier specification by indexing sample property appreciation rates to those of the region and the census tract where the property was located; those authors further adjusted borrower equity by the percentage difference between the mortgage's current value and its par value, instead of simply calculating the spread between market and coupon rates.

In a more formal option-theoretic approach to mortgage defaults, Foster and Van Order (1984) used FHA data from the 1960s and 1970s to estimate changes over time in LTV ratios and, hence, the portion of loans with negative equity. Their analysis found current and lagged equity variables to be significant to the exercise of the default option. Foster and Van Order also utilized borrower and other loan characteristics to represent transactions costs associated with exercise of the default option; however, those controls added little to their analysis of aggregate default data.

Given borrower negative equity in the property, certain trigger events may adversely affect borrower ability to repay the loan on schedule, and in so doing, may significantly elevate the likelihood of default. Those trigger events might include the loss of employment or income, change in marital or health status, and the like. As might be expected, few mortgage data sets contain contemporaneous information on changes in borrower income; instead, most studies (e.g., Barth, Cordes, and Yezer 1979; Campbell and Dietrich 1983; Foster and Van Order 1984; Vandell and Thibodeau 1985) employ measures of payments-to-income and borrower income stability derived from the time of loan origination. Contrary to expectations of a model of mortgage default based on the ruthless exercise of the put option, results of these analyses suggest some importance to those nonequity indicators in the estimation of default probabilities.

As has been suggested, borrower and neighborhood characteristics may be further useful in evaluating allegations of racial discrimination and redlining in mortgage lending. Typical minority borrowers and neighborhoods may be characterized by higher levels of default risk than their nonminority counterparts (see, for example, Canner, Gabriel, and Woolley 1991). To the extent that estimated default risk—and hence loan underwriting guidelines—inadequately reflect a higher likelihood of default that might be characteristic of minority households or neighborhoods, those loans would be characterized by lower returns to the lender. Racial prejudice among lenders, however, may lead to discrimination against minority households or neighborhoods through the imposition of loan qualification standards that exceed those required to account for the higher levels of default risk. Alternatively, such prejudice may lead to loan standards for nonminority households or neighborhoods that are more lenient than those justified by lower nonminority default risks.

As in Peterson's (1981) discussion of uneconomic discrimination, biased lenders may include a negative discrimination coefficient for minorities or a positive discrimination coefficient for nonminorities

in their calculation of the expected present value of loans to minority and nonminority borrowers or neighborhoods. Under these circumstances, minority applicants or applicants from minority neighborhoods would then have to offset that discrimination coefficient through relatively higher levels of loan qualification. Loans to approved minority borrowers would then be likely to be characterized by lower default probabilities, relative to similar loans to nonminority borrowers. To the extent that racial discrimination is systematic among lenders, one would expect relatively lower levels of default and better loan performance among minority borrowers or neighborhoods.

As noted by Peterson (1981), however, a simple comparison of the average loan performance between two groups of borrowers can be misleading if the two groups do not exhibit similar distributions of expected returns. For example, if the proportion of nonminority borrowers who are highly qualified exceeds by a substantial margin the proportion of highly qualified minority borrowers, then default rates of nonminority borrowers, observed without controlling for other determinants of credit quality, would be lower than those associated with minority borrowers. This finding, however, would not necessarily reflect discrimination, but simply the differences in the average creditworthiness of the two groups of borrowers. To avoid this problem, it is necessary to account adequately for other important determinants of loan quality. In the analysis presented here, the data are fully exploited to control for such variations in applicant creditworthiness.

It should be noted that under certain conditions, racial discrimination in lending decisions may not be revealed in differential loan performance. This would be true if discrimination were random rather than affecting only those applicants who are marginally qualified for credit. Also, discrimination may not be revealed in differential loan performance if only some lenders in a local market engage in discrimination and if applicants who are denied home loans on the basis of their race or the location of the property they seek to purchase successfully obtain credit from lenders that do not discriminate. Finally, as discussed more fully later in the chapter, if the discrimination is solely "economic" (i.e., minority status is used as a proxy for risk-related characteristics that are either unobservable or costly to obtain) and if the higher standard of creditworthiness required of minority applicants accurately accounts for this difference, then no default differential between minorities and nonminorities should be observed.

Only a few recent studies (e.g., Barth, Cordes, and Yezer 1979; Van Order, Westin, and Zorn 1993) have expressly attempted to evaluate

the effects of individual or neighborhood race on default probabilities. Of those studies, only Van Order and colleagues have explicitly sought to test the Peterson (1981) theory. In all cases, however, shortcomings in available data constrain the interpretability of modeled results. Further, none of those studies is able to test hypotheses associated with both neighborhood redlining and individual-level racial discrimination. Barth et al. (1979) found default rates to be positively associated with black households; however, their various race and gender indicators may well reflect the effects of wealth and other variables omitted from the study. Van Order, Westin, and Zorn (1993) merged information on conventional loans purchased by the Federal Home Loan Mortgage Corporation (Freddie Mac) with decennial census files in estimating a proportional hazard model of mortgage default. Although the database contains information on ZIP code racial composition, the authors' analysis of discrimination effects was limited owing to a lack of critical information on a range of borrower characteristics, including credit history, assets, and, most important, race.

As previously suggested, research to date has failed to adequately specify and test the Peterson (1981) model of credit discrimination in the context of mortgage finance. Although recent studies of default risk apply improved analytical and empirical methods and better specify contemporaneous trigger events associated with default (see, for example, Giliberto and Houston 1989; Kau, Keenan, and Kim 1991; and Quigley and Van Order 1991), these analyses fail to expressly consider the role of racial discrimination and/or neighborhood redlining in mortgage lending. Conversely, the few studies that focus on racial discrimination are inadequately specified and suffer important data limitations.

In a departure from previous work, the current study tests hypotheses concerning both individual-level discrimination and neighborhood redlining in the context of a multivariate statistical model of mortgage defaults. In the process, the research applies both individual-level loan information from the FHA and census-tract-level characteristics from the 1980 decennial census; this information is particularly well suited to the investigation at hand, given the rich array of details concerning borrower attributes and property location. Estimated default probabilities associated with borrower and neighborhood characteristics may further provide new insights concerning the enhancement of existing FHA loan underwriting requirements.

The analysis presented here focuses on default as a measure of expected returns to mortgages. A more accurate measure of expected returns, though, might be expected losses, defined as the default prob-

ability multiplied by the expected dollar loss from a default. Although we expect these two measures to be highly correlated, the possibility exists that using a measure of expected losses could result in different conclusions. This would be a particular concern if default costs vary with loan size, which may be correlated with race (see, for example, Evans, Maris, and Weinstein 1984). The relationship between losses and both borrower and neighborhood characteristics will be examined by us in future research.

DATA AND MODEL SPECIFICATION

The principal data utilized in this study are drawn from records pertaining to FHA-insured, single-family mortgage loans originated over the 1986–89 period. Information about the status and characteristics of these loans is drawn from two files maintained by HUD: the F42 EDS Case History File and the F42 BIA Composite File. The former carries information on each FHA-insured loan from its origination through termination. This file is updated regularly and indicates the reason for each termination. The latter contains the loan and borrower characteristics information, and is updated only to append a census-tract identifier from the 1980 Census of Population and Housing.

As suggested earlier, borrower indicators of default risk pertain largely to financial, demographic, and employment information compiled at the time of loan application. Further, many FHA loan files have been geocoded and contain a census-tract indicator; accordingly, each file with such data was matched to neighborhood socioeconomic and housing market indicators for 1980. The census information facilitates evaluation of location-specific factors that may be associated with loan defaults. Further, FHA data on the race of the borrower, and census measures of neighborhood racial composition, enable assessment of any residual effects of discrimination or redlining on the performance of FHA-insured loans.

The FHA-insured data are relatively well suited to the analysis of default, given the inclusion in the program of large numbers of relatively high-risk borrowers. The use of formal underwriting criteria in the loan approval process implies that observed defaults reflect a population with ex ante default risk less than or equal to some critical value. Although both FHA and conventional mortgage applications are evaluated according to formal underwriting criteria, the FHA

guidelines are substantially less strict than those of conventional lenders, particularly regarding the level of equity the borrower must have at the time of loan origination and the acceptable levels of housing expense and total debt to income.

To conduct our analysis, a sample was drawn of FHA-insured loans originated during 1986–89. Detailed information on the characteristics as well as the performance of the portfolio of FHA-insured loans was provided by HUD. The main restriction on the sample is that detailed borrower and loan characteristics were recorded by HUD only for a random sample of loans originated in each year. In certain versions of the model, the sample was further restricted (in some cases substantially) owing to the lack of available information on the census-tract location of the property.

The FHA database distinguishes among the variety of instances in which mortgage terminations occur; in this analysis, we evaluate the likelihood of mortgage terminations resulting from borrower default (inclusive of those default outcomes resulting in lender foreclosure, as well as situations in which the borrower conveys title to the property to the lender in lieu of foreclosure).

Sample Characteristics

Definitions of the variables utilized in this study are provided in table 6.1. For the final sample employed, tables 6.2 and 6.3 present selected characteristics of FHA borrowers, the terms of their loans, and census-tract characteristics associated with the FHA loans. Tables 6.4 and 6.5 present cumulative default rates by characteristic for loans originated in each of the four years of the analysis (1986–89). These default rates reflect the proportion of loans originated in each yearly cohort that went into default between the year of origination and the end of the first quarter of 1993.

We discuss here only a few of the more salient results presented in these tables. Note, first, that the vast majority of FHA-insured loans entail very high LTV ratios (table 6.2). This is consistent with objectives of the program to facilitate home ownership among moderate-income borrowers with few assets available for down payment and closing costs. Over 80 percent of the loans in our sample had LTV ratios exceeding 95 percent. Similarly, the debt obligation ratios exhibited by loan applicants are high, averaging about 40 percent for the ratio of total debt payments to income and about 21 percent for the ratio of housing expense payments to income. These averages tend to mask the fact that many FHA borrowers have exceptionally high debt

Table 6.1 VARIABLE DEFINITIONS

RMISSING	1 if borrower race is unknown, 0 otherwise
BLACK	1 if black borrower, 0 otherwise
AMIND	1 if American Indian borrower, 0 otherwise
ASIAN	1 if Asian borrower, 0 otherwise
HISPANIC	1 if Hispanic borrower, 0 otherwise
LTV	Loan-to-value ratio
INVEST	1 if investment property, 0 otherwise
REFIN	1 if loan is a refinance, 0 otherwise
CONDO	1 if property is a condominium, 0 otherwise
DIRECT	1 if insurance approved under direct endorsement, 0 otherwise
URBAN	1 if property located in urban area, 0 otherwise
RURAL	1 if property located in rural area, 0 otherwise
COMP	1 if application indicates "compensating factors," 0 otherwise
FIRSTBUY	1 if borrower is a first-time homebuyer, 0 otherwise
NEW	1 if property is a new house, 0 otherwise
CBUNMARD	1 if borrower is unmarried coborrower, 0 otherwise
DEPNUM	number of dependents (excluding borrower and coborrower)
SELFEMP	1 if borrower is self employed, 0 otherwise
LQASS	Liquid assets available at closing
NOCBINC	1 if no coborrower or coborrower income is zero, 0 otherwise
PCBINC	percent of household income earned by coborrower
LQASS2	Liquid assets squared
AGE<25	1 if borrower is under 25 years of age, 0 otherwise
AGE25-35	1 if borrower is between 25 and 35 years of age, 0 otherwise
AGE35-45	1 if borrower is between 35 and 45 years of age, 0 otherwise
BUYDOWN	1 if mortgage interest rate has been "bought down" by seller, 0 otherwise
INCOME	Total annual effective family income
INCOME2	Income squared
SHRTMOR	1 if mortgage term is less than 30 years, 0 otherwise

ratios. For instance, in most years nearly 10 percent of FHA borrowers had total debt-to-income ratios exceeding 65 percent. Although the average annual incomes of FHA borrowers differ some among the four cohorts, they never exceed $39,000. First-time homebuyers comprise a large proportion of the sample in each year. In 1989, for instance, they accounted for about two-thirds of the FHA-insured loan originations. As indicated in table 6.2, minorities tend to be well represented in each of the yearly cohorts.

As shown in table 6.3, the majority of FHA borrowers reside in predominantly nonminority neighborhoods. About 10 percent of the borrowers reside in neighborhoods in which minorities constitute more than 50 percent of the population. In keeping with the goals of the FHA program, nearly half of the borrowers reside in census tracts

Table 6.1 VARIABLE DEFINITIONS (*continued*)

SINGLEM	1 if borrower is male and there is no coborrower, 0 otherwise
SINGLEF	1 if borrower is female and there is no coborrower, 0 otherwise
HVAL	Appraised value of the property at time of purchase
HVAL2	HVAL squared
POTHINC	Percent of borrower income that is from other (non-salary) sources.
HEI20-38	1 if housing expense to income ratio is between .20 and .38, 0 otherwise
HEI38-50	1 if housing expense to income ratio is between .38 and .50, 0 otherwise
HEI>50	1 if housing expense to income ratio is above .50, 0 otherwise
DTI20-40	1 if total debt-to-income ratio is between .2 and .41, 0 otherwise
DTI41-53	1 if total debt-to-income ratio is between .41 and .53, 0 otherwise
DTI53-65	1 if total debt-to-income ratio is between .53 and .65, 0 otherwise
DTI>65	1 if total debt-to-income ratio is above .65, 0 otherwise
CTBLACK	Black percentage of census tract population
CTAMIND	American Indian/Alaskan Native percentage of census tract population
CTASIAN	Asian percentage of census tract population
CTHISPANIC	Hispanic percentage of census tract population
CTMISS	Percentage of census tract population with race or ethnicity unknown
CTINCOME	Median family income of the census tract as a proportion of the median family income of the metropolitan area as a whole
CTHVAL	Median value of owner-occupied homes in the census tract
CTVACRAT	Percentage of one-to-four family housing units vacant in the census tract
CTMEDAGE	Median age of residential properties in the census tract
CTUNEMP	Unemployment rate of the census tract
CTRENTRATE	Proportion of housing units in the census tract that are rental

whose median family income is less than the median for the metropolitan area in which the census tract is located.

Simple tabulations of default probabilities (tables 6.4 and 6.5) show that default probabilities can differ significantly by characteristics of the loan, borrower, and location. For example, default rates appear to be higher for borrowers with high LTV ratios, smaller loan amounts, lower incomes and home values, and 30-year loans, compared to those with shorter terms to maturity. Among racial and ethnic groups, black borrowers exhibit the highest rates of loan defaults, whereas Asians exhibit the lowest rates of default. As shown in table 6.5, borrowers residing in predominantly minority neighborhoods exhibit higher default rates than those residing in predominantly nonminority neighborhoods. As also indicated, default rates tend to be lower for borrowers in higher-income neighborhoods.

Table 6.2 SELECTED CHARACTERISTICS OF FHA-INSURED LOANS BY YEAR OF LOAN ORIGINATION, 1986–1989 (PERCENTAGE DISTRIBUTION, OR AS OTHERWISE SPECIFIED)

Loan or Borrower Characteristic	Year of Loan Origination			
	1986 percent	1987 percent	1988 percent	1989 percent
All loans (number)				
Loan characteristics				
Loan-to-value ratio				
Less than 90%	10.3	11.3	12.6	14.0
90–95	9.7	10.8	13.4	13.0
96–99	8.6	15.7	26.7	21.9
100–104	49.3	47.3	39.2	46.2
105 or more	22.1	14.9	8.2	5.0
Total	100	100	100	100
Mean (%)	100	99	98	97
Total debt-to-income ratio				
Less than 19%	12.2	11.4	8.6	1.6
20–40	54.1	51.5	46.1	47.5
41–52	17.3	18.2	25.0	43.6
53–64	9.0	10.0	11.6	6.6
65 or more	7.5	8.9	8.6	0.5
Total	100	100	100	100
Mean (%)	37	39	41	41
Housing expense to income ratio				
Less than 19%	45.8	44.8	42.8	56.6
20–37	53.4	54.3	55.9	42.6
38–49	0.7	0.9	1.2	0.7
50 or more	0.0	0.1	0.2	0.0
Total	100	100	100	100
Mean (%)	21	21	22	19
Loan amount				
Mean ($)	58,455	60,614	60,300	64,459
Mortgage term				
Less than 30 year	11.8	8.2	5.7	4.8
30 year	88.2	91.8	94.3	95.2
Total	100	100	100	100
Borrower characteristics				
Race of borrower				
White	78.1	73.5	68.9	79.6
Black	6.4	11.3	18.3	8.1
Hispanic	5.2	7.4	6.7	8.4
Asian	1.4	1.8	1.8	2.0
American Indian	0.2	0.2	0.3	0.2
Unknown	8.7	5.8	4.0	1.7
Total	100	100	100	100

Table 6.2 SELECTED CHARACTERISTICS OF FHA-INSURED LOANS BY YEAR OF LOAN ORIGINATION, 1986–1989 (PERCENTAGE DISTRIBUTION, OR AS OTHERWISE SPECIFIED) (*continued*)

Loan or Borrower Characteristic	Year of Loan Origination			
	1986 percent	1987 percent	1988 percent	1989 percent
Family income				
Less than $30,000	32.1	34.8	36.4	31.2
$30,000–49,999	54.0	51.6	50.4	51.4
$50,000–74,999	11.8	11.5	10.9	14.3
$75,000 or more	2.1	2.1	2.3	3.2
Total	100	100	100	100
Mean ($)	37,293	36,765	36,456	38,732
Age of borrower				
Less than 25	17.5	17.7	20 0	18.7
26–34	53.6	51.2	51 0	50.5
35–44	19.3	20.0	18 9	20.2
45 or more	9.6	11.0	10 1	10.7
Total	100	100	100	100
Mean (age)	33	33	33	33
Marital status				
Single male	9.7	9.3	9.8	12.1
Single female	8.2	7.9	8.6	11.1
Married	80.0	80.1	78.0	63.1
Unmarried coborrowers	2.1	2.7	3.6	13.7
Total	100	100	100	100
Liquid assets				
Mean ($)	10,179	9,723	8,331	11,508
Home value				
Less than $40,000	17.0	15.0	16.3	13.1
$40,000–79,999	68.1	65.5	62.1	57.5
$80,000 or more	14.9	19.5	21.6	29.5
Total	100	100	100	100
Mean ($)	59,010	61,634	62,125	66,781
First-time homebuyer	47.9	51.5	61.9	67.7
Investor	4.8	4.3	1.9	2.0
Refinance	19.6	13.2	3.1	3.1
Condominium	0.2	1.7	4.8	6.2
Direct endorsement	85.0	91.3	96.1	94.7
Self-employed	NA	0.1	0.2	0.1

NA—not available.
Totals may not sum to 100 percent due to rounding.
Source: Department of Housing and Urban Development.

Table 6.3 SELECTED CHARACTERISTICS OF NEIGHBORHOODS WHERE PROPERTY SECURING FHA-INSURED LOAN IS LOCATED, BY YEAR OF LOAN ORIGINATION, 1986–1989 (PERCENTAGE DISTRIBUTION)

	Year of Loan Origination			
Census Tract Characteristics[1]	1986 percent	1987 percent	1988 percent	1989 percent
All loans (number)	828	29,384		
Racial composition of census tract[2]				
Less than 10%	43.5	52.2	55.7	58.0
10–24	31.8	24.9	25.1	24.1
25–49	14.6	12.7	11.1	10.4
50–79	4.2	5.5	4.4	4.0
80 or more	5.9	4.8	3.7	3.5
Total	100	100	100	100
Income of census tract[3]				
Less than 80%	13.7	15.5	14.1	13.7
80–99	30.6	31.2	31.4	30.8
100–120	29.7	34.2	35.0	34.2
120 or more	26.1	19.2	19.5	21.3
Total	100	100	100	100
Location				
Urban	10.9	22.6	24.1	23.0
Suburban	53.9	44.4	30.5	29.8
Rural	1.3	2.3	2.3	1.8
Unknown	33.9	30.7	43.1	45.4
Total	100	100	100	100

Totals may not sum to 100 percent due to rounding.

1. Characteristics of census tracts are based on the 1980 Census of Population and Housing.

2. Racial composition of census tract is the minority population of a census tract as a percentage of the total population of the census tract.

3. Median family income of census tract as a percentage of the median family income of the metropolitan statistical area where the census tract is located.

Source: Department of Housing and Urban Development and 1980 U.S. Census of Population and Housing.

The Statistical Model

The analysis employs logit regressions to estimate the contribution of the various loan, borrower, and locational characteristics to the likelihood of default. For each of the annual cohorts, we estimate

$$P = exp[bX]/(1 + exp[bX]), \qquad (6.1)$$

Table 6.4 CUMULATIVE DEFAULT RATE FOR FHA-INSURED LOANS BY CHARACTERISTIC AND BY YEAR OF LOAN ORIGINATION, 1986–1989[1] (PERCENT)

Loan or Borrower Characteristic	Year of Loan Origination			
	1986 percent	1987 percent	1988 percent	1989 percent
All loans	6.7	4.9	4.2	2.3
Loan characteristics				
Loan-to-value ratio				
Less than 90%	1.6	2.0	2.1	0.9
90–95	4.1	3.3	2.6	1.4
96–99	3.6	4.5	3.8	1.9
100–104	8.2	5.4	4.8	2.6
105 or more	8.2	6.9	8.3	6.8
Total debt-to-income ratio				
Less than 19%	7.9	4.8	4.2	1.8
20–40	6.3	4.8	4.4	2.3
41–52	6.5	4.6	3.7	2.3
53–64	7.3	5.1	4.1	2.6
65 or more	7.5	5.5	4.7	2.3
Housing expense-to-income ratio				
Less than 19%	7.2	4.9	4.1	2.1
20–37	6.3	4.9	4.3	2.5
38–49	3.0	3.9	2.4	2.4
50 or more	9.1	3.2	5.7	6.5
Loan amount				
Less than average	7.9	6.0	5.1	2.7
More than average	5.5	3.8	3.1	1.8
Mortgage term				
Less than 30 year	3.2	2.0	2.5	1.3
30 year	7.2	5.1	4.3	2.3
Borrower characteristics				
Race of borrower				
White	6.2	4.3	3.5	2.0
Black	13.3	9.0	6.2	4.7
Hispanic	6.1	5.1	5.2	2.8
Asian	5.0	3.2	2.7	1.2
American Indian	19.1	6.0	5.2	2.8
Unknown	6.7	4.4	4.8	2.5
Family income				
Less than $30,000	8.5	6.5	5.5	3.1
$30,000–49,999	5.8	4.2	3.7	2.0
$50,000–74,999	5.9	3.4	2.5	1.5
$75,000 or more	6.7	4.1	2.0	1.0

(continued)

Table 6.4 CUMULATIVE DEFAULT RATE FOR FHA-INSURED LOANS BY CHARACTERISTIC AND BY YEAR OF LOAN ORIGINATION, 1986–1989[1] (PERCENT) (*continued*)

Loan or Borrower Characteristic	Year of Loan Origination			
	1986 percent	1987 percent	1988 percent	1989 percent
Age of borrower				
Less than 25	7.7	5.9	4.3	2.6
26–34	6.2	4.5	4.0	2.1
35–44	7.3	5.3	4.7	2.5
45 or more	6.5	4.2	3.8	2.1
Marital status				
Single male	8.3	5.6	4.7	2.4
Single female	6.3	4.8	3.8	2.0
Married	6.0	4.8	4.2	2.3
Unmarried co-borrowers	6.0	4.0	3.5	2.3
Liquid assets				
Less than average	7.9	5.9	5.1	2.6
More than average	3.6	2.3	1.8	1.4
Home value				
Less than $39,000	9.6	7.9	6.3	3.8
$40,000–79,999	6.6	4.8	4.3	2.3
$80,000 or more	3.9	2.8	2.3	1.7
First-time homebuyer	6.9	5.3	4.4	2.5
Investor	8.4	3.6	1.8	0.7
Refinance	5.6	3.5	3.7	1.5
Condominium	2.9	3.6	2.1	1.8
Direct endorsement	6.3	4.7	4.0	2.1
Self-employed	NA	2.3	2.9	2.3

NA—not available.

1. Cumulative default rate is calculated by computing the number of loan defaults from the year of loan origination through the first quarter of 1993 as a percentage of total loans originated in a given year.

Source: Department of Housing and Urban Development.

where P represents the probability of default for a loan with characteristics X, and X is a vector of the attributes of the loan, including borrower and locational characteristics. The vector of estimated coefficients values, b, indicates the effect of each characteristic on the likelihood of default.

We consider next the expected effects of each of the more important explanatory variables. Loan collateralization at the time of origination represents a critical component of the risk evaluation and underwrit-

Table 6.5 CUMULATIVE DEFAULT RATE FOR FHA-INSURED LOANS BY VARIOUS NEIGHBORHOOD GROUPS AND BY YEAR OF LOAN ORIGINATION, 1986–1989[1] (PERCENT)

	Year of Loan Origination			
Census tract Characteristics[2]	1986 percent	1987 percent	1988 percent	1989 percent
All loans	5.3	5.2	4.3	2.4
Racial composition of census tract[3]				
Less than 10%	3.3	4.2	3.5	1.9
10–24	5.7	5.6	4.5	2.7
25–49	3.3	5.9	5.3	3.0
50–79	8.6	6.3	6.6	3.6
80 or more	8.2	11.5	9.5	4.5
Income of census tract[4]				
Less than 80%	5.3	8.3	6.5	3.8
80–99	7.9	5.6	4.8	2.6
100–120	2.4	4.3	3.7	2.1
120 or more	5.6	3.8	3.1	1.7
Location				
Urban	4.4	6.1	4.5	2.4
Suburban	6.0	4.1	3.3	2.0
Rural	0.0	4.6	3.3	2.3
Unknown	6.2	5.2	4.7	2.5

1. Cumulative default rate is calculated by computing the number of loan defaults from the year of loan origination through the first quarter of 1993 as a percentage of total loans originated in a given year.
2. Characteristics of census tracts are based on the 1980 Census of Population and Housing.
3. Racial composition of census tract is the minority population of a census tract as a percentage of the total population of the census tract.
4. Income of census tract is the median family income of the census tract as a percentage of the median family income of the metropolitan statistical area where the census tract is located.
Source: Department of Housing and Urban Development and 1980 U.S. Census of Population and Housing.

ing process used by creditors; higher LTV ratios are commonly believed to be associated with elevated risks of mortgage default, since even a small adverse movement in property values may put the borrower in a negative equity position. Thus, we expect loans with higher initial LTV ratios to exhibit higher rates of default.

The borrower's anticipated ability to service a loan as scheduled is another important component of risk evaluation. In this vein, creditors

assess whether a proposed loan might create an excessive payment burden for the consumer and whether other resources are available to meet payments if unforeseen interruptions in borrower income should arise. Debt obligation ratios are specified in the following two ways: the ratio of housing expense to income (HEI), and the ratio of total debt payment to income (DTI). The former comprises the monthly total mortgage payment (including property taxes and insurance) relative to total monthly effective family income as allowable by the FHA, whereas the latter adds to the numerator the sum of other monthly installment debt payments. Lenders typically devote much attention to the levels of these ratios in the assessment of mortgage credit risk; FHA guidelines regarding insurance endorsements over the period of analysis indicate that an important threshold for the former ratio occurs at 38 percent, whereas the threshold for the latter ratio occurs at 53 percent. We also allow for the possibility of nonlinearities in estimating the relationship between these ratios and the likelihood of default.

The study furthermore tests various other loan characteristics hypothesized to bear importantly on default risk, including loan amount, type, purpose, and term. For example, shorter-term loans—which amortize and build equity more quickly—are hypothesized to carry lower default risk. Since the FHA offers loans with differing terms to maturity, a variable is introduced to indicate a loan that has a maturity of less than 30 years (SHRTMOR). The default literature provides some evidence that refinance loans originated for the purpose of equity takeout have higher default probabilities than do other loans. Although our data fail to distinguish those refinance loans funded for the purpose of equity takeout, the analysis does test for any significant differences in default probability associated with refinance loans (REFIN). Loans taken out by investors (INVEST) may also entail additional risk, since such individuals are likely to exercise the default option more ruthlessly, should equity in the property decline substantially. The distinction between newly constructed and existing properties is also introduced (NEW) to account for the fact that newer units may provide better loan collateral, since they are less likely to require unexpected maintenance outlays by the borrower. In addition, the home value (HVAL) is included as an independent explanatory variable to account for the possibility that loans on higher-valued homes perform differently than loans on lower-valued properties.

In recent years, the vast majority of FHA-insured loans have been processed under the Direct Endorsement program. This program,

which began in 1983, allows certified lenders to underwrite FHA loans directly without seeking prior FHA approval. In so doing, the program seeks to avoid the lengthy delays often encountered with HUD processing of loan applications. Previous research suggests that loans directly endorsed consistently experience default rates that are lower than those observed for loans processed by HUD (ICF 1989). Consequently, we include in our analysis a dummy variable indicating whether the loan was directly endorsed (DIRECT).

The empirical analysis further includes a set of borrower characteristics that pertain to the mortgage underwriting process and are hypothesized to affect homeowner ability to repay the loan as scheduled. These characteristics include a vector of borrower sociodemographic characteristics, including borrower age, gender, race/ethnicity, marital status, number of dependents, first-time buyer status, and the like. Also tested are borrower financial characteristics, including total assets, income, income by source, and employment status.

Among borrower sociodemographic characteristics, the age of the borrower (AGE) is captured by categorical variables distinguishing among young, middle-aged, and older borrowers. The analysis also includes dummy variables indicating first-time buyers (FIRSTBUY), single male borrowers (SINGLEM), single female borrowers (SINGLEF), unmarried coborrowers (CBUNMARD), and married borrowers. The number of dependents (children under 18 years of age) is measured by a continuous variable (DEPNUM). Default probabilities are hypothesized to be higher among first-time buyers, since such households are more likely to have little in the way of credit or employment histories; further, those borrowers likely have limited assets with which to maintain loan payments in the case of income disruption. Similarly, households with larger numbers of dependents are expected to have higher default rates, since such borrowers have greater claims on their residual incomes and may be more subject to unanticipated expenditures.

Household balance sheet measures that proxy borrower ability to repay the loan as scheduled include the levels of borrower liquid assets, household income, income by source, coborrower income, borrower type, and self-employment status. Borrower liquid assets (LQASS) comprise funds available to complete the housing transaction at the time of loan settlement; all things equal, higher levels of liquid assets imply reduced likelihood of default as might occur in the context of such "trigger events" as disruptions in income. Borrower income (INCOME) includes all FHA-allowed qualifying income (including base employment income and income from other sources

earned by the borrower and coborrower, if any). Higher levels of income suggest concomitantly elevated ability to repay the loan as scheduled, accordingly reducing the probability of default. All things equal, however, higher levels of nonsalary to total borrower income (POTHINC) are hypothesized to elevate the likelihood of default, given the relatively higher levels of volatility surrounding nonsalary income. Also, increased income volatility is associated with self-employed borrowers (SELFEMP), ceteris paribus.

Studies of discrimination focusing on the loan application process have found that credit history is an important determinant of the likelihood of approval of an application (Munnell et al. 1992). Although all borrowers must have acceptable credit history to be granted a mortgage, differences in credit history profiles may be related to the likelihood of default on the part of those granted credit. Although the available FHA data do not provide detailed information on the credit history of each borrower, some information is available on those borrowers deemed to be marginally qualified at the time of application. Specifically, the data contain a variable indicating compensating factors that enabled the loan to be approved for those borrowers that might not otherwise have received credit. Among these factors are indications that the borrower had an excellent credit history, good performance on a previous mortgage loan, and substantial savings. We address the issue of credit history by examining the performance of loans to borrowers assigned a compensation code. More generally, an indication of whether the borrower required a compensating factor (COMP) to receive approval is accounted for in all estimations.

To account for differences in default likelihoods that may be associated with the general location of the property, dummy variables are included that indicate location in the urban part of a metropolitan area (URBAN) and in rural areas (RURAL), with suburban locations representing the omitted category. To account for regional differences in economic conditions, as well as for the potential effects of differing state laws governing foreclosure practices, a dummy variable for each state in which FHA loans were extended is included in all estimations.

In working with the data, we found that census-tract designations were missing for a substantial proportion of all loans and, in particular, for virtually all loans originated in 1986. Because the inclusion of these variables results in a substantial reduction in the size of the sample, estimations without census-tract characteristics are presented in table 6.6 with preliminary estimations that include a number of census tract characteristics following in table 6.7. At this writing,

Table 6.6 LOGIT ESTIMATIONS OF THE RELATIONSHIP BETWEEN THE CUMULATIVE PROBABILITY OF LOAN DEFAULT AND ITS DETERMINANTS

	1986 Loans	1987 Loans	1988 Loans	1989 Loans
INTERCPT	−7.7385***	−5.1035***	−5.9584***	−7.9811***
Loan characteristics				
LTV	6.8356***	3.1341***	3.5185***	6.2932***
HEI20-38	0.0527	0.2564***	0.1709***	0.1873***
HEI38-50	−0.0048	0.6250**	−0.0900	0.2261
HEI>50	1.5981	0.1040	0.2511	1.5840**
DTI20-41	−0.2207**	−0.1086*	−0.0445	0.2041
DTI41-53	−0.1617	−0.1173*	−0.1097	0.2099
DTI53-65	−0.0736	−0.0602	−0.0061	0.3954*
DTI>65	0.0181	0.0573	0.01136	0.2156
REFIN	−0.7786***	−0.4855***	0.2590*	0.3265*
CONDO	−0.5787	0.1399	−0.2102*	0.2241*
BUYDOWN			−0.3215*	0.0884
INVEST	0.8719***	0.3368**	−0.0776	−0.3169
HVAL	−4.9E-5***	−3.6E-5***	−7.231E-6	−2.2E-5***
HVAL2	362.0E-12*	206.0E-12***	36.0E-13	141.0E-12***
DIRECT	−0.1906**	−0.2706***	−0.4515***	−0.6253***
SHRTMOR	−0.7672***	−0.9797***	−0.4822***	−0.4685***
URBAN	0.0534	0.1661***	0.1936***	−0.0407
RURAL	0.1173	0.1778*	0.0863	0.2012*
Borrower characteristics				
COMP		−0.0882	−0.0178	−0.0149
FIRSTBUY	−0.0609	0.1045**	0.2282***	0.1400**
NEW	0.3154	−0.0131	−0.0525	−0.2924***
CBUNMARD	−0.0705	0.0267	−0.0136	0.0116
SINGLEM	0.3016**	0.2136***	0.1759**	0.0662
SINGLEF	−0.2080*	−0.1905**	−0.2552***	−0.3365***
DEPNUM	0.1434***	0.1682***	0.1385***	0.1814***
SELFEMP		−0.6909	−0.5208	−0.1729
LQASS	−0.0395***	−0.0507***	−0.0611***	−0.0266***
LQASS2	0.00023***	0.0003***	0.00041***	0.00015***
NOCBINC	−0.1946*	−0.0003	−0.0690	−0.2129**
PCBINC	−0.00515*	−0.00128	−0.00263*	−0.00547***
AGE<25	−0.0187	0.0915	−0.1178*	−0.0492
AGE25-35	−0.1795*	−0.1766**	−0.1341*	−0.2346***
AGE35-45	0.01106	0.0424	0.0806	−0.0353
INCOME	−0.00234	−0.00584	−0.0132***	−0.0205***
INCOME2	0.00002	0.00008***	0.00007**	0.0001***
POTHINC	0.2477	0.7585***	0.5554***	0.5322***
BLACK	0.8126***	0.6753***	0.4737***	0.6012***
AMIND	0.9070**	0.3807	0.2399	0.1625
ASIAN	0.0178	−0.0925	−0.0814	−0.4405*
HISPANIC	−0.1603	0.00159	0.1192*	−0.0549
RMISSING	0.2335*	0.1181	0.3134***	0.1526
No. of Obs.	27,671	80,042	101,380	148,801

Note: The symbols *, **, and *** denote statistical significance at the 90, 99, and 99.9 percent levels, respectively.

Table 6.7 LOGIT ESTIMATIONS OF THE RELATIONSHIP BETWEEN THE CUMULATIVE PROBABILITY OF LOAN DEFAULT AND ITS DETERMINANTS

	1987 Loans	1988 Loans	1989 Loans
INTERCEPT	−4.9410***	−4.8248***	−6.8573*
Loan characteristics			
LTV	3.4109***	3.5391***	6.3785***
HEI20-38	0.2561**	0.1377*	0.1978***
HEI38-50	0.6260*	−0.0598	0.2165
HEI>50	−0.2972	0.1597	1.7563**
DTI20-41	−0.0932	−0.0833	0.1592
DTI41-53	−0.1970	−0.1829*	0.1822
DTI53-65	−0.1632	−0.0695	0.3346*
DTI>65	0.1828	0.1133	0.1994
REFIN	0.4161**	0.2921*	0.4333**
CONDO	0.7202***	0.2650*	0.4873***
BUYDOWN		0.1722	0.0269
INVEST	−0.0646	−0.0329	−0.3329
HVAL	−8.973E-6	7.70E-6	−0.000018***
HVAL2	92.0E-12*	−4.75E-11	123E-12***
DIRECT	−0.2169	−0.4526***	−0.6907***
SHRTMOR	−0.8434***	−0.4356***	−0.2710*
URBAN	0.2283**	0.1224**	−0.0227
RURAL	0.1455	−0.0586	0.0535
Borrower characteristics			
COMP	−0.0385	−0.1254	−0.0911
FIRSTBUY	0.0738	0.1938***	0.1058*
NEW	−0.0524	−0.1289*	−0.2429***
CBUNMARD	−0.2009	−0.0722	−0.0087
SINGLEM	−0.0494	0.1282*	0.0823
SINGLEF	−0.3207**	−0.3000***	−0.3552***
DEPNUM	0.1910***	0.1338***	0.1733***
SELFEMP	−0.5553	−0.2467	0.0718
LQASS	−0.0625***	−0.0593***	−0.0224***

(continued)

census-tract measures are drawn from the 1980 decennial census and include the racial composition of the neighborhood, as measured by the proportion of the population that was black (CTBLACK), American Indian or Alaskan natives (CTAMIND), Asian (CTASIAN), Hispanic (CTHISPANIC), or other (CTMISS). Other census-tract characteristics controlled for are the neighborhood median family income level as a proportion of the median family income for the metropolitan area as a whole (CTINCOME), the median value of owner-occupied housing units (CTHVAL), the proportion of housing units that were vacant

Table 6.7 LOGIT ESTIMATIONS OF THE RELATIONSHIP BETWEEN THE CUMULATIVE PROBABILITY OF LOAN DEFAULT AND ITS DETERMINANTS (*continued*)

	1987 Loans	1988 Loans	1989 Loans
LQASS2	0.00054***	0.00039***	0.00012***
NOCBINC	0.1183	−0.0452	−0.2401**
PCBINC	0.00014	−0.00235	−0.0071***
AGE<25	0.2233*	−0.0626	−0.0618
AGE25-35	−0.0779	−0.1025	−0.1975**
AGE35-45	0.0614	0.1102	−0.0702
INCOME	−0.00178	−0.0172***	−0.0171***
INCOME2	0.00005	0.0001***	0.00008**
POTHINC	0.4826*	0.5032***	0.5713***
BLACK	0.3696***	0.3415***	0.6398***
AMIND	0.3528	−0.1432	−0.0067
ASIAN	0.1047	−0.0053	−0.3023
HISPANIC	0.0090	0.1372*	0.0741
RMISSING	0.0904	0.2551**	0.2050
Location characteristics			
CTBLACK	0.3001*	0.4891***	−0.1468
CTAMIND	−8.0237	5.3862	−0.1171
CTASIAN	−14.4575**	−6.3791	−7.8146*
CTHISPANIC	−0.6411*	−0.6935***	−0.1903
CTMISS	6.2212	−0.0162	2.3977
CTINCOME	−0.0046*	−0.0025	−0.0060***
CTHVAL	−0.00002***	−0.00002***	−8.15E-6***
CTVACRAT	−0.03490	0.8888*	0.8422*
CTMEDAGE	−0.00556	−0.0053*	0.0003
CTUNEMP	0.9532	−0.5030	−1.4853*
CTRENTRATE	0.1564	−0.1665	−0.3911*
No. of Obs.	29,363	80,135	112,371

Note: The symbols *, **, and *** denote statistical significance at the 90, 99, and 99.9 percent levels, respectively.

(CTVACRAT), the median age of the housing units (CTMEDAGE), the area unemployment rate (CTUNEMP), and the proportion of housing in the neighborhood accounted for by rental units (CTRENTRATE).

ESTIMATION RESULTS

Table 6.6 presents for each of four different loan cohorts the results of logit estimations of the relationship between the probability of default

(for the period between the time of origination and the end of the first quarter of 1993) and the determinants of that probability, absent census-tract variables. Columns one through four present results obtained for loans originated in 1986, 1987, 1988, and 1989, respectively. Since the dependent variable may be thought of as the probability of default, a positive (negative) coefficient associated with an explanatory variable implies that the characteristic is associated with an increase (decrease) in the likelihood of default. All four estimations also include as explanatory variables a dummy variable for each state in which loans were made. These are not shown for reasons of space.

Among variables acting as proxies for loan characteristics, the LTV ratio is positive and highly significant in all four annual cohorts. Results indicate, as predicted, that loans with higher initial LTV ratios are more likely to end in default (see table 6.6). This implies, not surprisingly, that requiring borrowers to establish more equity in their properties at the time of loan origination would result in fewer defaults.

We further consider the role of the two obligation ratios (the ratio of housing expenses to income and the ratio of total debt payments to income) in determining the performance of the loan. To investigate the possibility of nonlinearities in the relationship between these ratios and the likelihood of default, each ratio is represented by a series of three dummy variables indicating that the loan falls within specific ranges of the possible values of these ratios. For the ratio of housing expenses to income, HEI20-38 indicates that the value of this ratio falls between 0.2 and 0.38; HEI38-50 indicates that the value of the ratio falls between 0.38 and 0.50; while HEI $>$ 50 indicates a value that exceeds 0.50. Values of this ratio less than 0.2 constitute the omitted category. The variables DTI20-41, DTI41-53, DTI53-65, and DTI $>$ 65 are defined in a similar manner for the ratio of total debt payments to income. Note that these dummy variable categories were structured to reflect the value of 0.38 for the ratio of housing expenses to income and the value of 0.53 for the ratio of total debt payments to income mentioned in FHA underwriting guidelines.

The coefficients of these obligation ratio dummy variables tell a plausible story only in some cases. In general, borrowers with higher ratios of housing expenses to income tend to exhibit higher likelihoods of default. The coefficients of the dummy variables indicating ranges of the ratio of total debt payments to income are not easily interpretable in terms of an overall trend. Since the total obligation ratio includes housing expenses in the numerator, collinearity between these two ratios is a distinct possibility.

The positive and significant coefficients of INVEST in the 1986 and 1987 estimations imply that for originations in these two years, properties purchased as an investment exhibited higher default probabilities, all else equal, than did owner-occupied properties. This relationship, however, is not observed in the 1988 and 1989 estimations.

The relationship between the likelihood of default and a dummy variable indicating that the loan represents a refinance (REFIN) of an existing loan on the same property is also mixed. The negative and significant coefficients for the 1986 and 1987 cohorts indicate that such loans are less likely to result in default, but the significant positive coefficients in the 1988 and 1989 cohorts indicate that such loans were more risky in these later years. A possible reason is that refinancing loans extended in 1986 and 1987 were frequently undertaken to take advantage of the decline in long-term interest rates, whereas loans in 1988 and 1989 may have been undertaken more frequently to extract equity from the property.

A dummy variable indicating that the property is a condominium (CONDO) also fails to show a consistent relationship with default likelihoods over the four cohorts. Note, as well, that a variable indicating that the loan was "bought down" (BUYDOWN) exhibits no consistent relationship with the likelihood of default. In contrast, the coefficients of the dummy variable indicating that the loan was processed through direct endorsement (DIRECT) do indicate a strong and highly significant relationship with default likelihoods. Confirming previous research, the negative coefficients of this variable imply that such loans entail less default risk than loans processed directly through HUD.

The variable SHRTMOR is a dummy variable indicating that the term of the mortgage is less than the traditional 30 years. As predicted, the coefficients of this variable are negative and significant in all four cohorts, implying that, perhaps because of the faster rate at which equity is built, such mortgages entail a lower probability of default than do 30-year mortgages, all else equal.

The value of the property serving as collateral for the loan is also introduced in the analysis through the use of two variables: HVAL indicates the value of the property, whereas HVAL2 is simply the square of this variable. The negative and generally significant coefficients of HVAL and the positive and generally significant coefficients of HVAL2 imply that default likelihoods generally decline with the value of the house; however, this relationship becomes less pronounced for the higher valued houses.

With loans for properties in suburban areas constituting the omitted category, the coefficients of URBAN indicate that, all else equal, loans originated in 1987 and 1988 for properties located in center cities were significantly more risky than loans made for suburban properties. No such relationship is observed, however, for the 1986 and 1989 cohorts. The coefficients of RURAL also suggest that rural loans entailed higher default likelihoods than did similar suburban loans in the 1987 and 1989 cohorts, but this does not seem to be the case for the 1986 and 1988 cohorts.

Among borrower characteristics, the variable COMP is a dummy variable indicating that certain compensating factors (such as an excellent credit history, a long history of continuous employment, or substantial savings) were employed in considering whether to approve the loan. This variable was missing in the 1986 cohort and, as indicated, is not statistically associated with the likelihood of default in the other three cohorts.

Additional regressions were also run using only marginally qualified borrowers; that is, only those borrowers that required compensating factors (as indicated by the compensation codes carried on the FHA data files) for credit approval. These runs revealed that a variable indicating excellent credit history is associated with reduced default rates. Also, the inclusion of this credit-history variable did not alter in any material way the relationship found between minority status and the likelihood of default.

The coefficients of FIRSTBUY indicate first-time home buyers were more likely to default, all else equal, than were other borrowers in the 1987 through 1989 cohorts, but no statistically significant relationship was observed for the 1986 cohort. The coefficients of NEW suggest that loans for newly constructed homes were less likely to default than loans for other homes in the 1989 cohort, but no statistically significant relationship was observed for the earlier three cohorts.

The borrower's marital status is indicated by three dummy variables: CBUNMARD indicates the presence of an unmarried coborrower, whereas SINGLEM and SINGLEF indicate that the borrower is a single male and female, respectively. Married borrowers represent the omitted category. The coefficients of CBUNMARD suggest that unmarried coborrowers are not statistically different from married borrowers in terms of default likelihoods. Single males appear to be more likely to default than married borrowers, while single females appear to be significantly less likely to default in all four cohorts. Next, note that in all four cohorts, default likelihoods unambiguously increase with the number of dependents (other than the spouse) in the borrower's

household (DEPNUM). This may result because of the added claims on income associated with higher numbers of dependents in the household. The borrower's status as a self-employed person (SELFEMP), however, does not appear to be significantly related to default likelihoods in the three cohorts for which this information is available.

To account for possible nonlinearities in the relationship between the borrower's liquid assets and the likelihood of default, a variable indicating the borrower's liquid assets (LQASS) and the square of the variable (LQASS2) were both employed. The significant negative coefficient of LQASS and the significant positive coefficient of LQASS2 in each cohort indicate, not surprisingly, that the likelihood of default declines with an increase in the borrower's liquid assets, but that this effect tends to become less pronounced as the amount of the borrower's liquid assets increases.

The variable NOCBINC indicates that there is either no coborrower or that no coborrower income is available for payments on the loan, whereas PCBINC indicates the percentage of the combined income that comes from a coborrower. Whereas the coefficients of NOCBINC are not consistent across cohorts, the coefficients of PCBINC are negative in all cohorts and are statistically significant in all cohorts but 1987. This suggests, in general, that larger percentages of coborrower income entail lower default likelihoods. Diversification benefits associated with the existence of two separate incomes may be a possible explanation.

To capture the relationship between age of the borrower and default likelihoods, dummy variables were defined for three different age ranges: less than 25 years (AGE $<$ 25); between 25 and 35 years (AGE 25–35); and between 35 and 45 years (AGE 35–45), with ages higher than 45 representing the omitted category. Coefficients of these dummy variables suggest that borrowers between the ages of 25 and 35 exhibit lower likelihoods of default, all else equal, than do other borrowers. This finding is contrary to expectations, given the relative lack of credit and employment histories—and hence the higher a priori risk—attached to younger borrowers.

As with liquid assets, we allow for nonlinearities in the relationship between borrower's qualifying income and the performance of the loan. Thus, we introduced in each estimation a variable indicating the borrower's income (INCOME) and a variable indicating the square of that variable (INCOME2). Although results are not identical across cohorts, the negative coefficients of INCOME, together with the typically positive and highly significant coefficients of INCOME2 imply, not surprisingly, that the likelihood of default declines as the income

of the borrower rises. However, this relationship becomes less pronounced as income rises.

The variable POTHINC indicates the amount of nonsalary income as a percentage of the total income of the borrower. The coefficients of this variable are positive in all four cohorts and are highly significant in three of them, implying, as hypothesized, that default likelihoods rise with the importance of nonsalary income, all else equal.

Having accounted for an expansive set of borrower and loan characteristics, the remaining individual level variables relate to the borrowers' race. Dummy variables indicating that the borrower is African American (BLACK), American Indian or Alaskan Native (AMIND), Asian (ASIAN), or Hispanic (HISPANIC) are included, with whites representing the omitted category. Because, for a number of loans, information on race was not coded, we also included a dummy variable indicating that the borrower's race is unknown (RMISSING). The positive and highly significant coefficients of BLACK for each of the four cohorts imply that, after controlling for the influence of the other variables in the analysis, black borrowers exhibit a higher likelihood of default than do white borrowers. Further, the inclusion of the other variables in the analysis, as described earlier, has little effect on the differential default rates of whites and blacks. As shown in table 6.4, black borrowers in the 1986 sample have a cumulative default rate of 13.3 percent, over 7 percentage points higher than the default rate for white borrowers in the 1986 sample. The predicted effect of race in the logit model for 1986 is only slightly less, with blacks predicted to have default rates about 6.5 percentage points above that for whites, even after controlling for LTV ratios and other loan and borrower characteristics. Other years show similar results, although cumulative default rates are somewhat lower. Interpretations of these results as they relate to hypotheses of discrimination in mortgage lending are discussed in the subsection following.

The coefficient of the dummy variable indicating that the borrower is an American Indian or Alaskan Native is positive for all four cohorts but is statistically significant only in the case of the 1986 cohort. The coefficient of the dummy variable indicating that the borrower is an Asian American is statistically significant only in the case of the 1989 cohort, with a sign indicating a lower likelihood of default relative to a white borrower, all else equal. The coefficients of the dummy variable indicating a Hispanic borrower imply that Hispanic borrowers are statistically indistinguishable from white borrowers in terms of their likelihood of defaulting on mortgage obligations. The 1988

cohort, however, which exhibits a weakly significant positive coefficient, is an exception. Finally, the coefficients of the dummy variable indicating that the borrower cannot be identified by race are positive for all four cohorts and are statistically significant in the case of the 1986 and 1988 cohorts.

As noted earlier, FHA loans may be underwritten either by HUD or by private-sector lenders under the direct endorsement program. Because these two alternatives involve different types of decision makers in determining who qualifies for a loan, we further investigated the relationship between default likelihoods and race by conducting separate analyses of the performance of loans processed by HUD, as distinct from those processed under the direct endorsement program. This analysis revealed that the signs and statistical significance of the coefficient of BLACK are similar, regardless of whether HUD or a direct endorser processed the loan (results not shown). Thus, the higher likelihoods of default observed for black borrowers apparently are robust to whether the underwriter is a government employee or a private-sector agent.

As a further check on the robustness of the results, we evaluated the impact of urban location on racial default patterns. Specifically, separate models were estimated for borrowers in urban, suburban, and rural locations. The results indicated that default patterns for urban and suburban borrowers are similar. In particular, black borrowers exhibit significantly higher default rates in both urban and suburban locations in each year. The results for rural borrowers, where we had far fewer observations, were less clear.

Although these findings regarding the coefficients of BLACK are not consistent with the prediction implied by models of uneconomic (prejudicial) discrimination as previously outlined, it should be noted that potentially important explanatory variables have yet to be accounted for in the analysis. Important among these are variables describing the rate of housing appreciation in the area in which the property is located, income volatility, and better indications of the borrower's past credit history. Without including improved measures of these effects, we cannot reach definitive conclusions about the implications of this research for the issue of discrimination. Further research will include additional information about loans and borrowers in order to provide a clearer indication of the effect of race and neighborhood location on default.

Finally, as noted earlier, dummy variables indicating the state in which the loan is made were included in all estimations, but not

reported. These variables seem to reflect the tendency of states with weaker economies (Texas during the oil bust, for example) to exhibit higher rates of loan default. As mentioned previously, they also may capture important differences in state laws and regulations applying to foreclosure requirements.

Table 6.7 presents the results of logit regressions that differ from those presented in table 6.6, in that 11 variables describing the demographic and economic characteristics of the census tract in which each property is located are added to the list of explanatory variables. These regressions are presented separately, in part because of the substantial number of observations that are lost as a result of including census-tract characteristics.

It is important to note that inclusion of these additional variables (shown at the bottom of table 6.7) for the most part does not appear to change the coefficients of the other explanatory variables in any material way. The most notable exception concerns the coefficients of CONDO, which now suggest a clearer tendency for loans on such properties to exhibit greater likelihoods of default. Also, inclusion of these variables reveals a more consistent tendency for loans used to refinance existing mortgages to perform more poorly.

As for the coefficients of the individual census-tract variables, only a few consistent patterns are found. Focusing first on neighborhood racial composition, we find some evidence of a positive relationship between the proportion of the neighborhood population that is black and the likelihood of default in the 1987 and 1988 cohorts. However, the coefficient of CTBLACK is negative and statistically insignificant in the 1989 cohort. A more consistent pattern emerges in the case of Asians and Hispanics, since the coefficients of CTASIAN and CTHISPANIC are negative in all three cohorts and significant for two of them.

As indicated by the coefficients of CTINCOME, the relative income of the census tract in which the property is located exhibits a highly significant inverse relationship with the likelihood of default, implying that loans on properties located in higher-income census tracts of a metropolitan area are less likely to default. Among the remaining census-tract characteristics, only the median value of owner-occupied properties (CTHVAL) yields consistent and significant results in all years. In particular, the results suggest that properties in neighborhoods with higher median home values perform better over time. This may be due to greater appreciation of properties insured by FHA loans in areas characterized by higher-priced homes. We hope to test this hypothesis in detail when 1990 census tract information is merged into our data files.

Interpretation of Results

This section considers the interpretability of results obtained thus far for the issue of discrimination in mortgage lending. Although some would maintain that evaluation of the relationship between minority status and loan performance can provide a clear indication of the presence of discrimination, the linkage can be fairly complex. To better appreciate the complexities associated with the interpretation of estimation results, table 6.8 presents six possible interpretations of the findings of a mortgage default study.

As table 6.8 indicates, interpreting the findings of a default study such as this one depends on the nature of any existent discrimination as well as the study's ability to control adequately for borrower and locational risk-related characteristics. The taxonomy described in table 6.8 considers, first, the case in which only uneconomic discrimination (or prejudicial discrimination) exists and in which the default study succeeds in accounting for all risk-related characteristics that correlate with minority status. Assuming that minority applicants are subjected to underwriting standards that exceed any objective assessment of default risk, one would expect a loan performance study to find that minority borrowers are less likely to default, controlling for other characteristics. Since we do not find this result in our analysis of FHA loan performance to date, this combination of circumstances should be excluded as a possibility.

The second case described in table 6.8 is consistent with our study finding that blacks are more likely to default, controlling for other risk-related characteristics. In this case, it is assumed that uneconomic discrimination exists, but also that our default study omits variables that correlate positively with both minority status and default. As an example, suppose the default study inadequately accounts for borrower credit history and that, on average, the credit histories of black borrowers are more problematic than those of white borrowers. If this omission more than offsets any reductions in minority default rates owing to discrimination, then minorities would be more likely to default, controlling for those characteristics on which data are available. This explanation may be particularly relevant at this stage of our analysis, in that a number of potentially important variables have yet to be adequately accounted for. Specifically, in future analyses, we will seek to improve the accounting for borrower credit history, borrower income stability, and neighborhood housing price appreciation.

Table 6.8 IMPLIED RESULTS IN MORTGAGE-DEFAULT STUDIES, UNDER VARIOUS SCENARIOS

The Implied Findings for a Default Study Depend on Nature of the Discrimination and the Success of the Study in Accounting for Other Characteristics	
Condition	Implied Default-Study Finding
"Uneconomic discrimination":	
1. "Uneconomic discrimination" (or prejudicial discrimination) exists such that minority applicants are subjected to an underwriting standard in excess of any objective assessment of default risk. The default study accounts for all relevant risk-related characteristics that correlate with minority status.	Minority borrowers are *less* likely to default, controlling for other characteristics.
2. "Uneconomic discrimination" exists, but the default study omits at least one variable that is positively correlated with minority status and default. This omission is important enough to more than compensate for the discrimination-induced lower minority default rates that would otherwise be found. (Less important omissions would not alter case 1.)	Minority borrowers are *more* likely to default, controlling for other characteristics.
No discrimination:	
3. Discrimination does not exist and the default study accounts for all relevant risk-related characteristics.	Minority borrowers exhibit the *same* likelihood of default as do nonminority borrowers, controlling for other characteristics.
4. Discrimination does not exist, but the default study omits at least one variable that is positively correlated with minority status and default.	Minority borrowers are *more* likely to default, controlling for other characteristics.
"Economic discrimination":	
5. "Economic discrimination" exists. This means that the lender uses minority status as a proxy for unobservable (or costly to obtain) characteristics indicating higher default risk. The higher standard required of minorities, however, is not enough to completely account for their higher default likelihoods attributable to these unobservable characteristics.	Minority borrowers are *more* likely to default, controlling for other characteristics.
6. "Economic discrimination" exists. The lender uses minority status as a proxy for unobservable characteristics indicating higher default risk. The higher standard required of minorities accurately accounts for these unobservable characteristics.	Minority borrowers exhibit the *same* likelihood of default as do nonminority characteristics.

The next two cases in table 6.8 pertain to the situation in which discrimination (either uneconomic or economic) does not in fact exist. In the third case, the default study is further presumed to account for all relevant risk-related characteristics that correlate with race. Under these circumstances, a default study should find no significant difference in the default likelihoods of the different racial groups, controlling for other characteristics. Although this case may possibly be relevant to our findings regarding other minorities, it is clearly not applicable in the case of blacks, since blacks are observed to have higher default likelihoods, controlling for other factors. The fourth case similarly assumes no discrimination, but further presumes that the default study omits variables that are positively correlated with both minority status and default. Under these circumstances, a default study should find that minorities are more likely than nonminorities to default, controlling for other factors. This case is similarly consistent with our findings regarding the differences in default likelihoods among white and black FHA borrowers.

The final two cases presented in table 6.8 pertain to the situation in which economic (but not uneconomic) discrimination is present. In the case of economic discrimination, the lender uses minority status as a proxy for unobservable (or costly to obtain) characteristics that correlate positively with both minority status and default risk. In the fifth case, the higher qualification standard required of minorities (because of their higher level of credit risk, controlling for observable factors) is inadequate to completely account for their higher default likelihoods attributable to unobservable characteristics. Under these circumstances, a default study would find that minority borrowers are more likely to default than are nonminorities, controlling for other characteristics. Finally, the sixth case is equivalent to the fifth case, except that the higher standard required of minorities by lenders now completely accounts for the unobservable risk characteristics associated with minority loan performance. In this case, a default study would find no significant differences in default likelihoods after controlling for other relevant factors.

As this list of possible scenarios suggests, results obtained thus far as they apply to black borrowers are consistent with several different possibilities. Specifically, cases two, four, and five in table 6.8 are all potential explanations for our results as they apply to black borrowers. Since these cases are consistent with the alternatives of no discrimination, uneconomic discrimination, or economic discrimination, results obtained thus far do not allow us to draw definitive conclusions regarding the issue of mortgage lending discrimination as it applies

to blacks. It is interesting to note, however, that whatever the explanation for the statistical results reported to date, the same pattern seems to hold, regardless of whether the underwriting is done by HUD or the private sector. We hope that future research incorporating more information on potentially important factors related to loan performance will allow us to draw more definitive conclusions regarding discrimination in mortgage lending.

SUMMARY

Some observers have recently argued that alleged discrimination in mortgage lending may be revealed in the performance of loans extended to different racial or ethnic groups. Specifically, it is hypothesized that systematic racial discrimination owing to lender bias may result in lenders holding minority applicants or applicants from minority neighborhoods to loan qualification standards that far exceed those required by objective assessments of default risk. This implies that discriminatory behavior would likely result in higher returns to home loans as evidenced by lower default rates or smaller dollar losses among minority borrowers or neighborhoods than that observed for nonminority borrowers or neighborhoods.

This study evaluates the default risk characteristics and the performance of FHA-insured, single-family residential mortgages. In the context of a multivariate statistical model, the study examines the relationship between a wide variety of loan and borrower characteristics and the default experience of FHA loans. In so doing, it assesses any residual effects of borrower race or neighborhood racial composition on the likelihood of loan default. The analysis is undertaken using formerly unavailable individual loan records from HUD that cover loans originated from 1986 through 1989.

The empirical analysis identifies a number of factors that significantly affect the probability of a loan default. Among the different characteristics of loans examined, higher LTV ratios and longer terms to maturity are associated with higher default rates. Further, loans processed under the Direct Endorsement program appear to be less likely to default than loans processed by HUD. Among the different borrower characteristics, higher amounts of liquid assets, higher house values, fewer dependents, single female borrowers, and borrowers between the ages of 25 and 35 all are associated with lower default probabilities.

In terms of the race or ethnic background of the borrower, preliminary results indicate a higher likelihood of default on the part of black households (compared to white households), whereas the likelihood of default for Hispanic, Asian, and American Indian households does not appear to differ significantly from that of white households. With regard to the neighborhood characteristics included in our analysis to date, we find that loans on properties located in the higher-income census tracts of a metropolitan area and loans in tracts with higher median home values are less likely to default. At this stage of our analysis, we find that the proportion of census-tract populations accounted for by blacks is not strongly and consistently related to the likelihood of loan default, whereas higher population proportions accounted for by Hispanics and Asians appear to be associated with lower likelihoods of default.

As described in table 6.8, the interpretation of findings with respect to the relationship between race and default probabilities as they pertain to discrimination is not straightforward. The results obtained here may or may not reflect discrimination in the mortgage lending process. To further enhance the assessment of discrimination in mortgage lending, our future research will focus on issues related to possible omitted variables and will analyze the actual loss experiences and expected returns to lenders in the FHA loan market.

Note

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