Mortgage Default Rates and Borrower Race

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Abstract. **We estimate a mortgage default model with national data on conventional mortgages that were current from 1986 to 1992. Our analysis confirms the results of previous analyses of Federal Housing Authority mortgages: Black households have higher marginal default rates, controlling for differences in borrower and property characteristics. Further, we do not find that Black borrowers have significantly more home equity. These results do not provide evidence of racial discrimination in mortgage lending and suggest that differences in default costs or transaction costs may explain differences in default rates.**

Introduction

This article presents evidence that Black borrowers have higher default rates on conventional residential mortgages than other borrowers. Our results do not support racial discrimination in mortgage lending, consistent with analyzes of Federal Housing Authority (FHA) mortgages. Our confirmation of previous findings is important because of the prominence of the discrimination issue in public policy initiatives and the questions surrounding previous studies of racial differences in mortgage default rates. For decades public policy goals have included increasing minority access to owner occupied housing by eliminating racial discrimination in mortgage lending. Congress passed several laws aimed at eliminating discrimination (*e.g.*, Fair Housing Act (1968); Equal Credit Opportunity Act (1974); Community Reinvestment Act (1977, amended 1989); Home Mortgage Disclosure Act (1975)). Various federal agencies monitor lenders for compliance with lending laws and provide information to the Department of Justice for prosecution. Evanoff and Segal (1997) provide a detailed discussion of policy initiatives.

Recent studies provide not only conflicting evidence of the existence of racial discrimination but also fundamental disagreements on what constitutes evidence of discrimination. Munnel, Browne, McEneaney and Tootell (MBMT) (1996) analyze mortgage application data collected for a study by the Federal Reserve Bank in Boston. They find lower mortgage loan approval rates for minority borrowers and conclude that racial discrimination exists. Horne (1997) analyzes a subset of the Boston Fed data and concludes that there is no difference in approval rates among racial groups. Critics of the MBMT approach argue that the lower minority borrower loan approval rates may be the result of higher credit risks and that evidence of

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discrimination[1] is manifest in differences in mortgage default rates[2] and mortgage loan profitability. Using data on FHA mortgages, Berkovec, Canner, Gabriel and Hannan (BCGH) (1994a, b) estimate a default probability model that accounts for characteristics of the property, the neighborhood and the borrowers, including race. Their analysis indicates that minority borrower default rates are higher and minority borrower loans are less profitable, results not suggestive of racial discrimination in the FHA mortgage market.

Both the interpretation and the reliability of the BCGH studies are questioned. Brueckner (1995) and Ferguson and Peters (1995) demonstrate that taken together lower minority borrower default rates and lower minority borrower approval rates indicate discrimination, but that higher minority borrower default rates cannot be interpreted as evidence of the absence of discrimination. Higher minority default rates may result from lower default costs, regardless of whether lenders discriminate or not. Questions about the reliability of the BCGH default rate estimates stem from three sources of bias: (1) omitted variables due to the absence of variables identified in theoretical default models; (2) simultaneous equations due to the correlation between equity and (unmeasurable) components of default costs; and (3) measurement errors due to the use of variables measured at the time of loan origination instead of at the time of default.[3]

Our study extends knowledge on default rates in two important ways. First, we analyze conventional mortgage defaults. Some researchers[4] assume that discrimination in the conventional mortgage markets forces minority borrowers into the government mortgage market although conventional mortgage default rates by racial groups have not been analyzed.[5] Second, we estimate a default rate model with procedures and data to correct the above biases. The model derives from theories of the optimal exercise of the default option to lessen omitted variable bias. In addition, this model is estimated with an instrument for equity to correct simultaneity bias and with data values contemporaneous to the default decision, not loan origination, to lessen measurement error bias.

Our default probability model indicates that the marginal default rate for Black households[6] is significantly higher and the difference in default rates is not reduced when controlling for equity, borrower age, borrower education and the number of dependents. Further analysis of house equity does not suggest mortgages issued to minority borrowers are more profitable. These results do not provide evidence of racial discrimination in the conventional mortgage market.

The Empirical Model

Default occurs when a borrower maximizes wealth by choosing the option to cease mortgage payments and ultimately relinquish the property to the lender. Defaults result from decisions by both lenders and borrowers. Lenders approve mortgage applications based on a credit index, an estimate of borrower default costs. If a borrower becomes delinquent in payments, lenders choose to either foreclose on the property or restructure a loan according to the likelihood that a new mortgage contract would be

profitable. Borrowers experience unpredictable changes in personal and financial conditions that may dictate relinquishing the property to the lender if its value is less than the mortgage value. The mortgage value is equity, house value less mortgage balance, and the value of prepayment and default options[7] (*OV*) imbedded in the mortgage contract. Negative mortgage values motivate financial defaults; changes in personal, financial or occupational circumstances that impel households to relocate motivate nonfinancial defaults. With no costs to default, negative mortgage value would prompt default. However, default imposes personal costs on borrowers that include limits on occupational and credit opportunities, social stigma and damage to reputation (see Kau, Keenan and Kim, 1993; and Vandell and Thibodeau, 1985). If these costs exceed the absolute value of negative equity, the borrower will not default. We denote these personal costs as default costs (*DC*). Default also depends on transaction costs (*TC*) such as payments related to selling the property and relocation, discounts of the selling price from (expected) house value due to market conditions or property liquidation time constraints and the negative cost of free rent during the foreclosure process (Gilberto and Houston, 1989). The borrower must subtract these costs from equity in order to decide if selling the property and moving is preferable to relinquishing the deed to the lender. Default will occur if:

$$DC + EQUITY + OV - TC < 0. \tag{1}$$

Although lenders cannot determine borrower default costs because they are partly subjective and thus vary for individuals who may have similar financial and personal circumstances, lenders reduce default risk by approving mortgages only to borrowers judged to have sufficiently high default costs as measure by a credit index (*CI*):

$$DC = CI + \zeta, \tag{2}$$

where ζ is a disturbance term that represents unobservable borrower information. The *CI* is:

$$CI = bX^* + cB. \tag{3}$$

where X^* is a vector of property and borrower characteristics and *B* is a binary variable equal to one for minority borrowers. The parameter c measures differential default costs appraisals due to race related factors.[8]

Lenders approve mortgages only when estimated default costs exceed their limit, *Q*. Lenders may discriminate by setting a higher cost limit for minority borrowers, represented by the parameter d^*. Loan approval requires:

$$CI = bX^* + cB > Q + d^*B. \tag{4}$$

Minority borrowers will have lower loan approval rates if either lenders discriminate ($d^* > 0$) or judge minorities to have lower default costs ($c < 0$). Lenders discriminate by requiring minority borrowers have higher (expected) default costs, measured by bX^*. This discrimination results in lower expected default probabilities and higher

expected loan profitability. If lenders judge the average credit index to be lower for minority borrowers ($c < 0$), both discriminating and nondiscriminating lenders ($d = 0$) require minority borrowers have higher (expected) default costs. However, in this case ($c < 0$), the loans to minority borrowers will not be more profitable because predicted total default costs will equal Q for all borrowers. This reasoning leads some (see Becker, 1993; and Ferguson and Peters, 1995) to conclude that evidence of racial discrimination derives from the analysis of loan profitability.

Equation (4) allows illustration of the econometric issues related to the analysis of discrimination with default equation estimates. Because we do not have data on applicants who scored below $Q + d^*B$, sample selection bias is possible. However, a recent simulation (Ross, 1996) suggests bias from this source is not problematic. Also, if our model contained all the information used in constructing the credit index, X^*, we would estimate no significance difference in the race binary variable coefficient due to discrimination. Black borrowers have larger values of X^* but the effect on default probability is measured by the parameter b for all borrowers. If we do not have the complete set of variables in X^*, then the model estimates may inappropriately indicate discrimination. Let X^* include variables in our model, X, and variables unobservable by researchers (but not the lender), X_u: $X^* = X + X_u$. Then the credit index for approved loans can be written:

$$CI = b_u X_u + b'X + (c + d)B, \tag{5}$$

where $d = b_u(X_u$ for Black borrowers $- X_u$ for other borrowers). Since discrimination requires Black borrowers to have higher credit index values for loan approval, $d > 0$.[9]

The decision to default depends on borrowers' appraisals of the transaction costs incurred when vacating the property. For planned changes in residence, say due to a new employment opportunity or purchase of a larger house, these costs are likely relatively low and the borrower sells the property and repays the mortgage balance. These transaction costs are likely higher for unplanned relocation resulting from ''trigger events,'' such as unexpected changes in financial and personal circumstances, including job termination, layoffs and divorce. When a trigger event occurs, the borrower may abandon the property to the lender. We represent these transaction costs[10] as:

$$TC = zX + tB + \gamma, \tag{6}$$

where γ measures unobservable costs. Recall that the vector X contains borrower characteristics that may affect transaction costs and trigger events, such as income, number of dependents, education level and age. The parameter t measures differences in these costs for minority borrowers.

Substitution of Equations 3–7 into Equation 1 yields the following expression for the probability that a mortgage will default (D):

$$D = \text{prob}((b - x)X + (c + d - t)B + \zeta - \gamma + EQUITY + OV < 0). \quad (7)$$

The default decision is represented as a linear model:

$$y^*_{t,j} = \beta X_{t,j} + \beta_b B_j + \varepsilon_{t,j} \quad (8)$$

where $\beta_b = c + d - t$. The individual defaults at time t if $y^*_{t,j}$ is less than a critical value, c. We observe the binary variable y defined by:

$$\begin{aligned} y_{t,j} &= 0 \quad \text{if } y^*_{t,j} > c. \\ y_{t,j} &= 1 \quad \text{if } y^*_{t,j} < c. \end{aligned} \quad (9)$$

Equations (8) and (9) indicate:

$$\text{Prob}(y_{t,j} = 1) = \text{prob}(\beta X_{t,j} + \beta_b B_j + \varepsilon_{t,j} < c). \quad (10)$$

We estimate the parameters β and β_b with a probit model.[11] The regressors, $X_{t,j}$, include a constant term and the following variables:

$BLACK_j$ = 1 if the jth borrower is Black; = 0 otherwise;
$INCOME_{t,j}$ = Income of borrower j and time t;
AGE_j = Age of the borrower at loan origination;
$DEPENDENTS_j$ = Number of dependents at loan origination;
$EDUCATION_j$ = Years of schooling at time of loan origination;
$EQUITY_{t,j}$ = House value − mortgage market value;
$VARPRICE_{t,j}$ = Standard deviation of house price changes; and
$STATE_j$ = 1 if the property is in Florida, Texas or Oklahoma; = 0 otherwise.

BLACK identifies default rate probability differences stemming from discrimination or costs differentials. If Black borrowers do not have different average transaction costs or default costs ($c = t = 0$), racial discrimination ($d > 0$) reduces the probability of default, $\beta_b < 0$, because discrimination requires higher credit index for loan approval. If Black borrowers have lower default costs ($c < 0$) or higher transaction costs associated with trigger events ($t > 0$), Black borrower default rates could be higher, even with racial or economic discrimination, holding constant other factors expected to influence default rates.

Models of default predict that *EQUITY* is inversely related to default probability; higher equity makes default less likely. Brueckner (1994a) illustrates that equity may be endogenous in default probability models. Borrowers with higher default costs will choose lower loan-to-value loans and have higher levels of equity. Because default costs are subjective, variables included in the model to measured default costs will do so with error, thus equity and the regression disturbance term are correlated. Yezer, Phillips and Trost (1994) demonstrate that this simultaneity problem is likely to bias the coefficient on the race variable upwards, masking the effects of discrimination of

default probability. To correct for this bias, the default probit model is estimated with an instrumental variable for *EQUITY*.

The variability of house prices is directly related to the value of the default option imbedded in the mortgage contract. Because increases in *VARPRICE* raise the value of the mortgage, borrowers are less likely to default. *STATE* is included to measure locations (Florida, Texas and Oklahoma) which likely experienced real estate price declines and higher selling costs due to market weakness.

Individual characteristics measure differences in borrower default and transaction costs. Because default costs include restrictions on employment and credit opportunities, borrowers with more human capital, measured by *INCOME*, *EDUCATION* and *AGE*, have higher default costs and thus lower default probabilities. More *DEPENDENT*S increase claims on income and increases the likelihood a trigger event will force relocation and default.[12]

The Data

The data is primarily constructed from the conventional mortgage origination records and the conventional mortgage servicing records of a large New Jersey-based Savings and Loan that originated loans nationally.[13] The origination data includes characteristics of the borrower and the property, the purchase price, the metropolitan location of the property and characteristics of the mortgage. The loan servicing data includes the mortgage termination information and the monthly payment history. The sample includes conventional FRMs that originated from 1985 to 1988 and terminated or were censored between 1986 and June 1992.[14] Censored loans include loans current at the end of the sample period and loans that were dropped from servicing records prior to termination primarily due to the sale of the servicing contracts. The default date records when payments were stopped, not when loans were foreclosed.[15] For the analysis, annual observations of the loan status are used and equity and the variability of house appreciation rates are calculated each year.[16]

Values of the variables *AGE*, *DEPENDENTS*, *EDUCATION* and *BLACK* are as reported on the loan application. Equity[17] is:

$$EQUITY_{t,j} = HOUSE\ VALUE_{t,j} - MORTGAGE\ BALANCE_{t,j}. \tag{10}$$

The property is assumed to appreciate at the metropolitan average rate:

$$HOUSE\ VALUE_{t,j} = Purchase\ Price_j^{*}\ MHP_{t,i}/MHP_{0,i}, \tag{11}$$

Where $MHP_{t,i}$ is the value of the house price index for the ith Metropolitan Statistical Area (MSA) during year t, and $MHP_{0,i}$ is the value of the index at the time the loan was originated.[18] The instrumental variable for *EQUITY* is calculated with the predicted mortgage balance, which is calculated as the predicted initial loan amount adjusted each time period for payments to principal made prior to time t.[19] *VARPRICE*

is the standard deviation of a five-year moving average of the MSA house price appreciation rate and measures the value of the default option.

The sample means, reported in Exhibit 1, illustrate Black borrowers have substantially higher default rates (.065 vs. .009). The data suggest several reasons for these higher default rates that are unrelated to race. Blacks borrowers have about one-third less *EQUITY* and 30% of Black household have negative *EQUITY*, while only 16% of other households have negative *EQUITY*. Also, Black households in this sample are more likely to live in the three Southern states (Texas, Oklahoma and Florida), which experienced lower house price appreciation and higher default rates during the sample period. Also, Black borrowers may have lower default costs, as evidenced by 40% less *INCOME*.

Default Model Estimates

Exhibit 2 reports estimates of two discrete time models. The first model contains a single explanatory variable, *BLACK*. The model indicates Black borrowers have statistically significant higher default rates. The second model includes the measures

Exhibit 1
Means and Standard Deviations

Variable	Complete	Non-black	Black
Default Rate	0.011	0.009	0.065
	0.106	0.093	0.248
EQUITY ($1000s)	27.2	28.0	11.4
	40.5	41.1	20.2
Proportion with negative equity	0.165	0.159	0.30
Mortgage balance ($)	80,406	81,643	54,823
	6,508	46,826	29,548
House value	107,680	109,682	66,264
	76,626	76,196	46,476
VARPRICE	0.1	0.1	0.0
	0.1	0.1	0.0
STATE	0.47	0.46	0.84
	0.50	0.50	0.37
AGE	35.3	35.3	36.2
	10.3	10.3	10.9
EDUCATION	15.4	15.4	14.9
	2.3	2.3	2.5
DEPENDENTS	1.0	1.0	0.9
	1.2	1.2	1.2
INCOME ($1000s)	46.9	47.7	29.8
	32.3	32.7	14.9
Observations	1,670	1,593	77

Exhibit 2
Estimates

	Default Probability Model		
Variable	One	Two	Equity Model
BLACK	0.85	0.94*	−2,087.2
	(3.75)	(3.76)	(−0.5)
AGE		−0.1*	365.15*
		(−2.9)	(4.1)
EDUCATION		−0.01	2,620.1*
		(−0.2)	(6.5)
DEPENDENTS		0.20*	1,265.6
		(2.2)	(1.7)
INCOME		−0.002	128.94*
		(−0.3)	(4.3)
EQUITY		−0.3*	
		(−2.3)	
VARPRICE		1.2	
		(0.5)	
STATE		0.6	−28,519*
		(1.3)	28,519*
CONSTANT	−2.48*	0.7	(−15.50)
	(31.2)	(1.0)	−19,627*
Chi-Squared	11.2*	45.6*	(−2.75)
R^2			.2

Note: *t*-Statistics are in parenthesis.
*Statistically significant at the 1% level.

of the default option and borrower characteristics that may affect default and transaction costs. The estimates indicate that lower levels of *EQUITY* increase default probability. Properties located in the three states have higher default rates, although not significantly higher. Younger borrowers and borrowers with more dependents have higher default probabilities. Also, Black borrowers are estimated to have higher default probabilities. The magnitude of the coefficient suggests the additional variables do not reduce substantially the magnitude of the racial differential in default probability.[20] The result that Black borrower default rates are higher is not itself evidence of the absence of racial discrimination because lower default costs or higher transaction costs can offset the effect of discrimination on default rates. To investigate the reason for differential default rates among borrowers, we regress *EQUITY*[21] on *BLACK* and other borrower characteristics. We expect to find a positive effect of *BLACK* on *EQUITY* if there is discrimination by the lender; recall discrimination results in both lower defalt rates and higher loan profitability, hence higher *EQUITY* for Black borrowers.[22] We expect to find a negative effect of *BLACK* on *EQUITY* if Black borrowers have lower default costs.

The estimate of the *EQUITY* model is reported in Exhibit 2. Older, more highly educated and higher income borrowers have higher equity levels. These results combined with the estimated lower default rates are consistent with either lender discrimination or higher default costs for these groups, but are clearly due to higher default costs. *BLACK* borrowers are estimated to have lower levels of *EQUITY* although the difference is not statistically significant. These results combined with the higher default probabilities are not suggestive of discrimination and may derive from lower default costs or higher levels of transaction costs associated with trigger events that require unanticipated and, perhaps, unwanted changes in residential location. We recognize that our measure of *EQUITY* is weak because it is calculated with metropolitan area house price appreciation rates and this weakness reduces the power of our analysis. However, the analysis is useful because it provides information on discrimination previously lacking in the literature and direction for further research.

Conclusion

Our analysis of conventional mortgage data confirms the results of previous analyses of FHA mortgages: Black households have higher marginal default rates. Further we find no evidence of higher profitability on loans to Black borrowers but find evidence of lower equity for Black borrowers. These results are not consistent with racial discrimination in mortgage lending. We conclude further research on costs associated with default and with trigger events is needed to understand why minority borrowers have higher default rates.

Endnotes

[1] Discrimination refers to ''uneconomical discrimination'': discrimination that causes expected profitability of loans made to one group to exceed that of loans made to other groups. This usage does not include economic discrimination, which lenders use to distinguish between good and bad risks. See Peterson (1981) and Becker (1993).

[2] We use default to indicate the property is claimed by the lender, not the technical definition that a mortgage is delinquent in payments.

[3] These econometric critiques are made by several researchers. For examples, see Brueckner (1994a, b), Cappozza (1994), Ross (1994, 1998) and Yezer, Phillips and Trost (1994) and other articles in the special issues of *Cityscape* (February, 1994) and the *Journal of Real Estate Finance and Economics* (November, 1994) devoted to discrimination in real estate finance.

[4] See BCGH (1994a, b) and Brueckner (1994a).

[5] Several studies of default rates on conventional mortgages have been published but these do not include the borrower race in the model (see Phillips, Rosenblatt and VanderHoff, 1995).

[6] We analyze Black default because preliminary analysis indicated that other minority borrowers had a small percentage of loans and did not default at a rate statistically different from White borrowers. Also, the literature has predominately focused on Black default rates. See the articles in *Cityscape* (February, 1994) and the *Journal of Real Estate Finance and Economics* (November, 1994).

[7] The value of options depends on interest rates, the variability of house prices and interest rates (see Kau, Keenan and Kim, 1993).

[8] For example, racial discrimination in employment markets could lessen default costs associated with restrictions on employment opportunities.

[9] When the omitted variables are correlated with race, the coefficient on the race variable will be biased towards zero, indicating no racial difference in default rates.

[10] The rent free occupancy of the house during the foreclosure proceeding is included as a negative transaction cost.

[11] The standard errors are biased in the linear model due to heteroskedasticity and predicted value of the default probability may lie outside the (0,1) interval problems (see Greene, 1993).

[12] BCGH (1994a, b) discuss the effect of dependents on default probability.

[13] The origination data is more fully described in Phillips and VanderHoff (1994) and the payments data is more fully described in Phillips, Rosenblatt and VanderHoff (1995). A relatively small number of loans, about 1100, were in both data sets and include data on borrower characteristics. These data include loans from twenty states.

[14] The data set also included information on adjustable rate mortgages (ARMs) but these loan are not included in the analysis. The FRM and ARM default models are significantly different and the ARM model did not identify borrower race as a factor affecting default probability. This result may stem form the low number of minority borrowers who choose the ARM.

[15] Loans are classified as a default if payments and loan balances are not paid. A loan in which payments were continued after a period of nonpayment would not be classified as a default.

[16] This use of annual observations to analyze the probability of default is an application of discrete time methods, as discussed by Allison (1982).

[17] Because *EQUITY* is measured when payments were stopped not when the deed to the property was transferred, its estimated coefficient provides insights into the reasons for initiating the process that leads to default not the conditions that exist at loan origination or the end of the foreclosure process.

[18] This index created by Haurin, Hendershott and Kim (1991) combines house price data from the American Chamber of Commerce, Coldwell Banker and the National Association of Realtors.

[19] We estimate LTV as a function of borrower characteristics. This estimate and house price provide an estimate of initial loan amount.

[20] The probit model estimates do not indicate the magnitude of the effect of a variable on the probability. Analysis of the linear model indicates that the additional variables reduce the estimated effect of *BLACK* on default probability by 12%.

[21] We use actual values of *EQUITY*, not the predicted value used in the default model.

[22] We recognize that loan profitability depends not only on equity but on the recovery rate on the equity and on collection costs. However, our data does not include measures of the factors required to make a more exact measure of profitability.

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