Defaults, Denials, and Discrimination in Mortgage Lending

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The results of the study of discrimination in mortgage lending by Munnell, Browne, McEneaney, and Tootell (1992) have been questioned by some in both the popular press and academia. Both non-economists (Brimelow and Spencer 1993), and economists (Becker 1993), have registered similar complaints about the study's methodology. These authors assert that a cursory examination of default rates for minorities and whites would explain the disparate treatment minorities received in obtaining mortgage loans. Specifically, they claim Munnell, Browne, McEneaney, and Tootell (MBMT) failed to control adequately for the expected profitability of each loan. This article will demonstrate that their criticisms are invalid: not only are studies of denials a valid approach to testing for discrimination but, in fact, examinations of defaults cannot, in general, reveal much about the issue.

All empirical examinations of loan denials attempt to model the mortgage lending decision. Whether an application is accepted or denied depends on its expected profitability. Thus, tests for discrimination in studies of denials compare the treatment of equally profitable minority and white applications. Only when rejected minority applications have the same expected profitability as accepted white applications is there clear evidence of discrimination.[1]

Empirically measuring expected profitability can be extremely complicated, however. If the researcher fails to model this expected profitability correctly, and a variable important in the calculation of credit-worthiness and correlated with race is omitted from the statistical analysis, then a false-positive finding of discrimination can occur. For example, if minorities tend to have higher loan-to-value ratios than whites, and this variable is not included in the estimation of the probability of being denied a loan, then the effect of higher loan-to-value ratios will be incorrectly ascribed to race; the coefficient on race in this estimation will be overstated. Since it is difficult to collect all the variables relevant to the lending decision, these critics argue that any

study examining denials is suspect because of possible omitted variable bias. In fact, some observers view a finding of a significant coefficient for race in these studies as proof that an important variable has been omitted, rather than as evidence for discrimination.

Not only are studies of denials a valid approach to testing for discrimination but, in fact, examinations of defaults cannot, in general, reveal much about the issue.

The above-mentioned authors have recently proffered studying default rates as a way to avoid the problems with omitted variable bias. The inability to include every relevant variable in a study of mortgage lending, the argument goes, compels researchers to sidestep an exploration of the determinants of mortgage lending decisions and instead examine the direct effects of discrimination: are the by-products of discrimination visible in the data? If minorities are being treated unfairly, then lenders are not profit-maximizing; less profitable loans to white borrowers are being selected over more profitable applications from minorities. As a result, the argument goes, applications from whites with higher default probabilities are being accepted over minority applications with less chance of a default; thus, minority default rates will be lower than white rates.

This argument implicitly assumes that default studies do not suffer from the same problem with omitted variables as studies of denials. The assumption is that any variables missed by the researcher but utilized by the profit-maximizing lender will ensure that profitability is the same for the two groups when no discrimination is occurring. If, on the other hand, minorities are being discriminated against, then their loans will be more profitable since their default rate will be lower; lower default rates would then constitute evidence to support the conclusion of discrimination.[2]

Several additional assumptions must hold for this line of reasoning to be valid. First, the above argument assumes that discrimination in the mortgage market takes the form of forcing minority applicants to jump higher hurdles; minorities are, for example, forced to produce a larger down payment or lower obligation ratio than similarly situated whites. Discrimination can, however, take other forms. If, for example, redlining of minority neighborhoods were occurring, and minority and white profitability were identical, more profitable minority loans in minority areas would be turned down in favor of less profitable white and minority loans in white areas. The default rates of the accepted white and minority applicants would be identical, but minorities with profitable loans in minority areas would still be discriminated against. An examination of denials would uncover this discrimination, where an analysis of defaults would not.[3]

Yet the argument for examining defaults makes a much more restrictive assumption than the exact form discrimination takes; it also assumes that the distributions of accepted applicants' creditworthiness, or profitability, are identical for minorities and whites. If these two distributions are not the same, then comparing average white and minority default rates reveals nothing about the existence of discrimination. Just as comparisons of the average wage from two different groups reveal nothing about discrimination in the labor market because the education, job training, and other forms of human capital of each group are unknown, the different distributions of creditworthiness among minorities and whites would make it impossible to say anything about discrimination by examining average default rates.

As a result, any analysis of defaults must account for all the variables that affect the profitability of the loan. Default studies suffer from the same omitted variable problems as examinations of denials. If, for example, the rates of default differ between minori-

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[1] Note that legal discrimination may be different from economic discrimination. The law can state that certain data, like race, cannot be used in the lending decision whether it is independently correlated with profitability or not.

[2] Other elements of the loan are important to the expected profitability of the loan besides the probability of default. The probability that the loan will be paid back early and the costs of a default may vary between loans and affect the expected profitability of the loan.

[3] A study of denials would show that minorities were being treated differently from whites. If the racial composition of the neighborhood where the property is located is included in the examination of denials, evidence would be found for redlining. Looking only at default data would show no evidence for discrimination unless tract variables were included in the analysis, but in that case one is no longer examining average default rates.

ties and whites but the loan-to-value ratio of each applicant is not accounted for in the analysis, the different default rates may simply be due to the fact that minorities tend to have higher, though acceptable, loan-to-value ratios than whites.

The problem with examining average default rates is fairly well known in the literature. What is more problematic to default analysis, however, is the fact that holding the creditworthiness of each defaulted application constant is not sufficient to perform a test for discrimination. This article will show that even when all relevant variables are included in the analysis, the examination of defaults reveals very little about whether discrimination is occurring. Since studies of defaults leave out the observations that are most important to the examination of discrimination, denied applications, they cannot compare the profitability of rejected minority applications to accepted white applications. Only by including these observations, as is done in studies of denials, can definitive evidence about discrimination be found.

The next section provides a model for lender behavior that allows empirical tests for discrimination. The following section discusses the difficulties with discerning discrimination using an analysis of defaults. The third section presents some empirical evidence relevant to the issue, and a conclusion follows.

I. The Model

Lenders maximize profits by choosing whether to lend capital equal to the desired mortgage or invest that capital at the going market interest rate, r_s. Assume that the interest rate lenders charge each borrower is the same; the lender faces a take-it-or-leave-it offer from the borrower at the market mortgage rate. This assumption is innocuous; lenders are unlikely to alter the interest rate between applicants of varying default probabilities since they fear that charging different borrowers different rates could be construed as evidence of discrimination.[4]

Lenders make the mortgages that maximize profits,

$$\text{Max}_M \; M(1 - P_d)r_M + MP_d(\alpha - 1) - Mr_s, \quad (1)$$

where M is the mortgage amount, P_d is the probability that the loan will default, r_M is the market interest rate for mortgages, and $\alpha - 1$ is the percentage of the mortgage that is lost if the borrower defaults.[5] Note

that the probability of default depends on the applicant's credit and employment histories, the expense-to-income ratio, the loan-to-value ratio, and a host of other variables assumed to be exogenous to the lender in this simplified model.

The expected return to the lender equals a weighted average of the mortgage rate and the losses from a default. If the lender is risk neutral, profit maximization ensures that the lender makes the loan if

$$r_M(1 - P_d) + P_d(\alpha - 1) > r_s, \quad (2)$$

the expected return from the loan is greater than the return from the safe asset. The probability of default is a vital determinant of the mortgage's expected return, and since the mortgage rate for each borrower is identical, the probability of default for each applicant determines the relative profitability of each loan.[6] A rearrangement of equation (2) illustrates that profit maximization compels the lender to grant every loan where the probability of default is below some threshold level,

$$P_d < P_d^T = \frac{r_M - r_s}{r_M + (1 - \alpha)}. \quad (3)$$

As a result, to examine the expected profitability of each loan, it is sufficient to model the expected probability of default; by doing so, lenders maximize risk-adjusted expected profits by granting all mortgages whose expected rate of return is greater than the return on a safe asset.

The profit-maximizing rule that results from this simple model is very close to reality. Theoretically,

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[4] In fact, King (1980) found no evidence that interest rates varied between racial groups. As will be shown later, this finding suggests that interest rates do not vary over applications with different default probabilities. Lenders can alter the "price" of the loan in other ways, however; decreasing the loan-to-value ratio of a loan is one common way the price of the loan is altered.

[5] α is the percent of the mortgage that is recovered. $\alpha - 1$ includes the costs to the lender of recovering the property. Actually the profit maximization decision is much more complicated than that represented in equation (1). In reality it is a multi-period decision that depends, for example, on expectations of future rates, probabilities of early buy-backs, and any fixed costs. The model above is selected because it is most advantageous to the use of information on loan defaults. The strongest possible case for defaults is modeled in order to examine its usefulness at its best.

[6] The other variables that affect profitability, like the probability of an early buy-back, can be captured in the empirical model by including the variables that determine an early buy-back. This paradigm abstracts from these additional determinants in order to place default studies in their best light.

the interest rate charged on each loan could differ but, as mentioned before, there is little evidence that interest rates vary between applicants, and particularly over race. Furthermore, any individual pricing can be accomplished by altering the loan-to-value or income ratios and thus changing the probability of default. As a result, the probability of default is sufficient to capture the profitability of the loan.

This model is designed to make default analysis as relevant as possible for detecting discrimination. If other variables besides the default probability were relevant to the profitability of the loan, and default probabilities were not sufficient statistics for loan profitability, then researchers could not look at default rates alone.

II. Defaults versus Denials

Since the expected profitability of each loan depends on its default probability, empirical comparisons of default probabilities might be valid. Examining average default rates, however, reveals nothing about the existence of discrimination. Even if no discrimination exists, and the threshold level of creditworthiness is the same for both minorities and whites, the average default rates for the two groups will be identical if, and only if, the two groups also have identical distributions of accepted applications over the expected creditworthiness spectrum. Furthermore, knowing the expected default probability of each accepted loan is only a necessary, not sufficient, condition to test for discrimination.[7] The next two subsections illustrate the last two statements in detail.

Case Where Distribution of Creditworthiness Not Considered

Contrary to the recent criticism in the popular press of the methodology used in MBMT (1992), if the two specified groups of borrowers do not have the same distributions of creditworthiness, then average default rates reveal nothing about the existence of discrimination. Figure 1 illustrates this point. In Figure 1, accepted minority loans are assumed to cluster toward the threshold of the acceptable range of creditworthiness, while applications by whites are more evenly distributed over the acceptable spectrum. A loan is granted to every applicant, minority or white, whose level of creditworthiness or expected probability of default is to the right of the threshold

Figure 1

### A Case Where Minority Applicants Cluster toward Threshold of Profitability
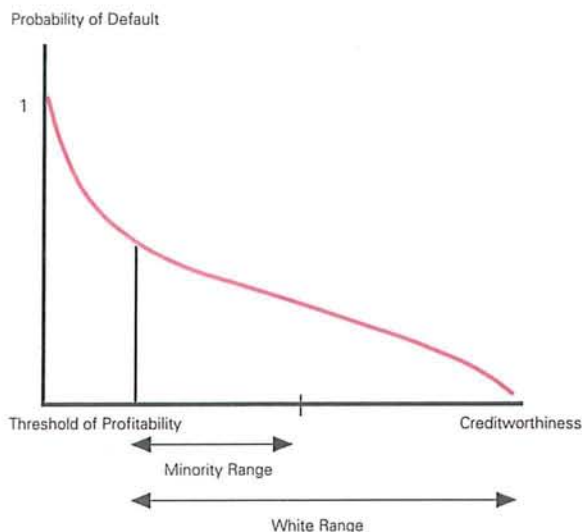
level of default probability. Even though each group is treated similarly, the average minority default rate will be higher than the average rate for whites.

Whites, however, are not being discriminated against, since their threshold for acceptance is the same as that for minorities. Because the economic fundamentals of minority acceptances such as their loan-to-value ratios, obligation ratios, and the like tend to skew toward the threshold relative to those of whites, the average default rate for minorities will be higher than the average rate for whites. As a result, average default rates say nothing about discrimination. Any examination of defaults must control for the different creditworthiness of each applicant in order to examine the importance of race as a factor in determining defaults.

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[7] It is important to point out that studies of loan denials examine ex ante default probabilities, which lenders actually use, not the ex post or actual default rates examined in work on defaults. To argue that ex post defaults equal ex ante probabilities requires a very long time series on ex post defaults. This paper, however, does not concern itself with that specific problem in default analysis. Instead, it considers the difficulties with examining ex post default rates even if they are accurate instruments for ex ante default probabilities.

Figure 2

A Case of Discrimination

Figure 3
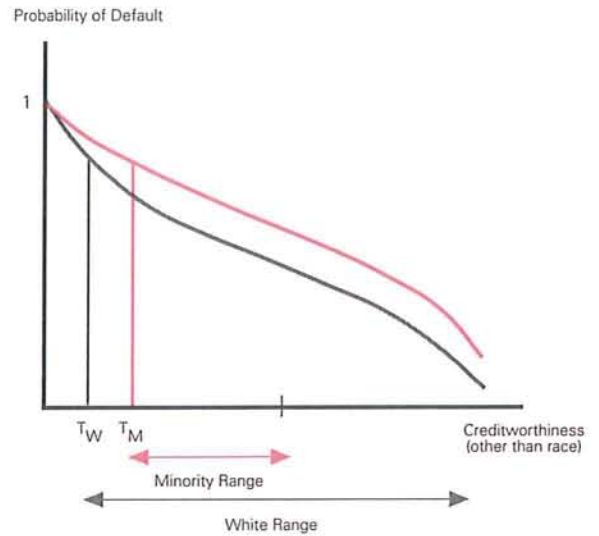
A Case with Omitted Variable
Correlated with Race
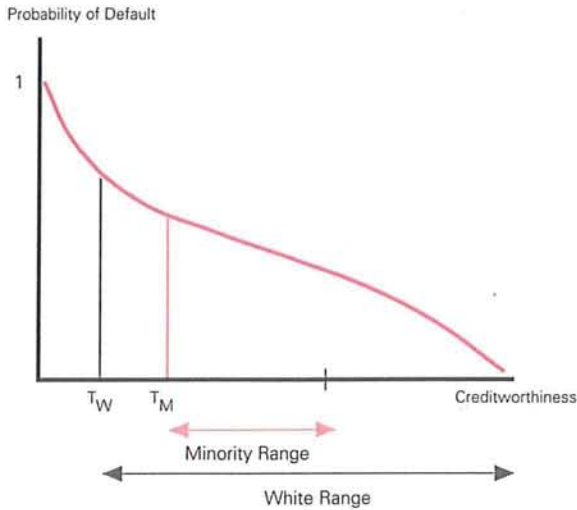
Case Where Variables Relating to Creditworthiness Are Included

But would a default study, even one controlling for creditworthiness, provide evidence consistent with discrimination if discrimination were taking place? Figure 2 depicts a case where minority applications must be more creditworthy at the margin to get a loan. A default study holding creditworthiness constant, so as to avoid problems with different distributions between the two groups, still will not be able to discern discrimination. The default experience of whites and minorities over the range of minority acceptances will be identical when all other creditworthiness variables are held constant. Over the areas where only whites have acceptances, from T_W to T_M, no data will exist on minority loans to reveal that minority applications with lower probabilities of default, just to the left of T_M, were being rejected in favor of less profitable white applications, just to the right of T_W. A default study would show no racial effect, no differences in default rates holding creditworthiness constant, when discrimination was, in fact, taking place. Further, the average default rate of minorities in this case could be higher or lower than that for whites depending on the different distributions of creditworthiness of the two groups. Since no

minority denials are included in the default data, the sample cannot reveal where discrimination is actually occurring, from T_W to T_M.
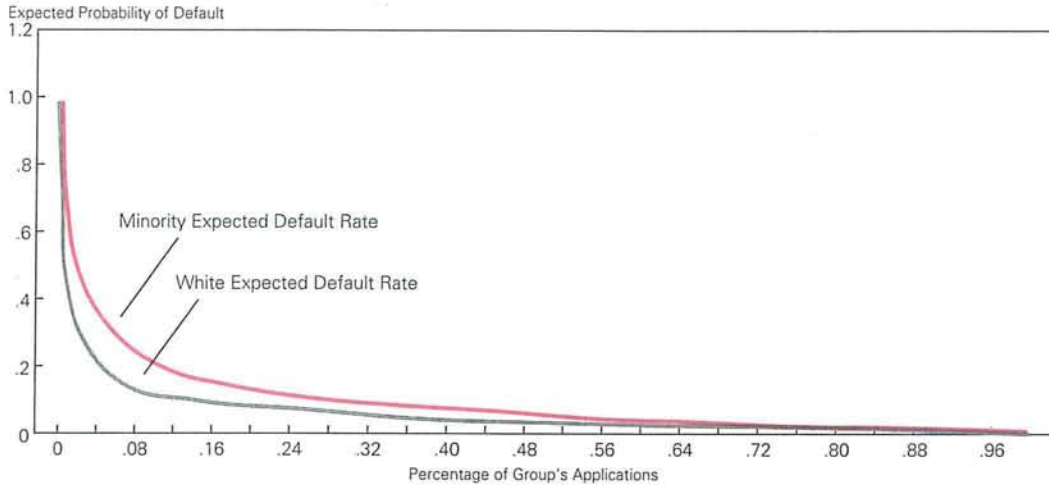
Case Where a Relevant Variable Is Omitted

What if minorities, for some reason not related to the measure of creditworthiness, tend to default more frequently than whites? Here it is assumed that an omitted variable exists, one that is correlated with race and increases the probability of minority defaults. As a result, the probability of default is higher for minorities than for whites, even given the measure of creditworthiness. This case is illustrated in Figure 3. Again, the lender maximizes profit by selecting the threshold for the marginal, not the average, loan. The higher minority default distribution will produce a positive coefficient on race in an equation of defaults on race and all the other creditworthy variables, yet, again, discrimination against whites is not occurring.

In fact, discrimination against minorities takes place even with a positive race coefficient, if the threshold for minorities is to the right of the actual T_M shown in Figure 3. At T_M, the marginal probability of

Figure 4

Minority and White Probabilities of Default

Expected Probability of Default

Minority Expected Default Rate

White Expected Default Rate

Percentage of Group's Applications

Source: Data on creditworthiness of mortgage applications from Munnell,
Browne, McEneaney and Tootell (1992).

default would be the same for both groups, and no discrimination would be occurring. However, if the actual minority threshold is to the right of T_M, the marginal white loan has a higher probability of default than the marginal minority loan. Even with a minority threshold to the right of T_M so that discrimination is occurring, the coefficient on race in a regression of defaults on creditworthiness would be positive, and at a given level of measured creditworthiness minority default probabilities would be higher. Since minority observations on defaults occur only to the right of this threshold, the data will not reveal that at the margin whites with higher default rates are getting accepted.

Finally, assume that Figure 3 shows the perceived, but incorrect, default probabilities of the lender. The number of loans granted will be the same as in Figure 3. This time, for the same measure of creditworthiness, the default probabilities will be equal, and race will have no independent effect. In this case, Figure 3 simply condenses to Figure 2. Yet, just because race has no effect in the regression of defaults on creditworthiness does not mean discrimination has not occurred, as the minority threshold is higher.

III. Some Evidence

Default studies shed little light on the issue of discrimination in mortgage lending. Given that the groups being examined have different distributions of creditworthiness, default studies suffer from the same problem of omitted variable bias that afflicts analyses of denials. Even if they included every relevant variable, however, these studies are unable to discern discrimination.

Ultimately the questions raised by Figure 1 are empirical. Do the distributions of white and minority acceptances over the range of creditworthiness look the same? Figure 4 charts the pattern of minority and white creditworthiness found by MBMT (1992). The applications for each group were ordered by their expected probability of default, or their creditworthiness. The horizontal axis gives the percentage of each group's applications while the vertical axis is a measurement of the expected probability of default. The curves indicate the percentage of each group's applications that is greater than or equal to the probability of default given on the vertical axis.

A much higher proportion of the minority applications are clustered at the low end of the creditwor-

thiness spectrum than white applications. The distributions of white and minority creditworthiness are very different, and credit history, a variable omitted by, for example, the Van Order, Weston, and Zorn (1993) study of default rates, is one important reason. Since all current evidence suggests that white and minority distributions of creditworthiness are not identical, a study of average defaults is unable to uncover discrimination. And given the problems with default analysis in general, depicted in Figures 2 and 3, the ability of default analysis to uncover discrimination is suspect, even if creditworthiness is accounted for.

IV. Conclusion

Default analysis suffers from the same difficulty with possible omitted variable bias as does the study of denials. Figure 1 reveals that no magic solution to the problem of omitted variable bias is to be found in empirical work on mortgage lending. Studies of both denials and defaults must account for all relevant explanatory variables that might be correlated with race in order to detect discrimination in lending.

Even if default studies do account for all relevant variables, however, an analysis of defaults is a poor approach to examining discrimination. If discrimination in mortgage lending is occurring, it is occurring against minority applications that are rejected, the very observations that default studies do not examine. In order to test for discrimination using default analysis, the profitability of the marginal minority loan must be compared to that of the marginal white loan. Studies of denials are much more effective at making these comparisons than analyses of defaults. Since denial data include both accepted and rejected applications, they permit comparisons of rejected minority applications with accepted white applications. The criticisms leveled at studies of mortgage denials by those who advocate studies of defaults are basically unfounded, and their claims about the importance of default analysis are significantly overstated.

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