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What Constitutes Evidence of Discrimination in Lending?

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ABSTRACT

We analyze a simple model of bank lending in order to ascertain what *can* be inferred from relative denial and default rates about lending discrimination. We show that if minority applicants are of lower average creditworthiness than majority applicants, then, contrary to a popular argument, a uniform, nondiscriminatory credit policy cannot simultaneously produce (i) higher denial rates for minority applicants, and (ii) equal default rates for minority and majority applicants. Moreover, we show that equality of denial or default rates always implies discrimination. In particular, equal denial (default) rates imply discrimination against majority (minority) applicants.

IS THERE DISCRIMINATION in the bank lending market? This question has recently attracted attention in the popular press and from federal regulators. This interest was spurred by a 1992 Boston Federal Reserve Bank study which concludes that minorities are discriminated against in the home mortgage market.¹ The study finds that minority applicants in the Boston area are sixty percent more likely to be denied a mortgage loan than whites, even after controlling for such factors as debt burdens, loan-to-value ratios, income, and credit histories. Not surprisingly, this conclusion has been controversial. Critics of the Boston Fed study have argued that the methodology used by the Fed is flawed. A representative example is Macey (1994), who writes that

There is not even support for concluding that subtle forms of discrimination exist in mortgage lending. The default rates for white and black mortgage loan applications are equal across census tracts. If bankers were discriminating by turning down marginally qualified black applicants while accepting marginally qualified white applicants, then default rates among whites would be higher. But, bankers are accepting the same level of risk from both black and white applicants.

Note that Macey cites *default* rates contained in the Boston Fed study to argue that the *denial* rates emphasized by the authors of that study are not evidence of discrimination. This is a common theme among critics of the

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¹ We refer to the "Boston Fed study" and Munnell *et al.* (1992) interchangeably.

Boston Fed study.² These critics generally make two related claims. The first claim is that differences in denial rates are likely due to differences in average credit quality between white and minority applicants. The second claim is that equal default rates indicate that minorities and whites are being held to the same credit standard. The conclusion then drawn by these critics is that there is little or no evidence of lending discrimination in the Boston Fed study.

The purpose of this article is to illustrate what policymakers can learn from observed loan denial and default rates about the relative credit standards being applied to different segments of the lending market. We will show that both of the claims made by critics of the Boston Fed study cannot be true *simultaneously*. In fact, if the first claim is correct, then contrary to the second claim, equal default rates imply that minorities *are* being discriminated against.

In this article we analyze a simple model of bank lending in which the pool of loan applicants can be decomposed into two distinct components. Our analysis is often clarified by thinking of these components as representing racial groups. However, the model is not limited to this racial interpretation. For example, we can interpret the components as representing applicants with high versus low income (wealth), applicants with stable versus unstable employment prospects, applicants from different geographic regions, etc. Due to the interest in the Boston Fed study, we employ the racial interpretation throughout the article.

Our analysis exploits the difference between the *marginal* and *average* borrower. A uniform credit standard (policy) implies that the marginal borrower from each segment of the population is an identical credit risk. But, when the segments have different distributions and a uniform credit policy is employed, the average credit quality of a successful loan applicant must differ across the segments. It follows that, contrary to popular sentiment, a higher denial rate for minority applicants is consistent with a uniform (nondiscriminatory) credit policy. This is essentially the first claim made by critics of the Boston Fed study. In light of this, it is particularly troublesome that the bulk of the data that are held up as evidence of discrimination in mortgage lending consist solely of mortgage applications and denials of those applications, partitioned by race.³ While these data certainly attest to economic inequalities in our society, they are not necessarily evidence of discrimination on the part of *lenders*, and, therefore, should not be a cornerstone upon which policy is formed.

² Other critics in the popular press who have also advanced this argument include Brimelow and Spencer (1993), Ferguson (1993), and unsigned editorials in *The Wall Street Journal* ("Duties at the Fed," November 23, 1993, A6) and *The National Review* ("The Week," September 12, 1994, 8).

³ See, for example, Arndorfer (1994a, 1994b). These articles summarize the National Credit Union Administration's investigation into lending discrimination based solely on disparate denial rates.

We also argue that *equal* denial or default rates across distinct populations imply that *different* standards are being used. Thus, contrary to the second claim made by critics of the Boston Fed study, “colorblind” lending will not result in equal denial or default rates. Many of these critics have been quick to argue this point when refuting the argument that unequal denial rates are evidence of discrimination. But, this logic cuts both ways: if differences in average credit quality explain differences in denial rates, then equal default rates imply discrimination against the minority population.

Section I of the article outlines a simple model of bank lending and examines two popular claims made about lending discrimination. Section II details what can be inferred about discrimination from denial and default rates. The final section briefly concludes.

I. A Simple Model of Bank Lending

A bank’s decision to grant credit comes after a loan applicant has passed through an initial screening process. This screening process often distills many different pieces of information (income, debt burden, employment history, credit history, etc.) down into a single number, the “credit score.” Therefore, we will assume that the relevant credit factors can be similarly reduced to a single number. The probability of the applicant repaying the loan is a monotonically increasing function of this score. Without loss of generality, we can assume that the credit scoring problem simply generates $\theta \in [0, 1]$, the probability of repayment.

We define a uniform credit policy as a θ^* such that the bank grants credit to an individual with creditworthiness greater than θ^* , and denies credit otherwise. Every borrower is charged the same interest rate, regardless of his credit score. This seems to be consistent with bank practice in the mortgage lending area and has been formally modelled in a series of papers initiated by Stiglitz and Weiss (1981).

A. Denial and Default Rates When a Bank Faces a Homogeneous Population

As a benchmark, consider the case where the population of loan applicants cannot be decomposed. Let the probability density function (PDF) of the population be $f(\theta)$ and the cumulative distribution function (CDF) be $F(\theta)$. We refer to a population by its cumulative distribution function, $F(\theta)$. The bank selects θ^* to maximize its profits given that it is lending to $F(\theta)$. Assume that each loan is for \$1, and that if the borrower repays the loan, the bank receives $(1 + r)$, where r is the interest rate it charges the borrower. Thus, the bank’s net profit is r if the borrower repays the loan. If the borrower fails to repay the loan, the bank loses the entire dollar. The bank’s expected profit on a loan is given by $E[\pi] = \theta r - (1 - \theta)$. The bank maximizes its profits by selecting a credit standard, θ^* , such that the profit on a marginal loan is zero. This implies $\theta^* = (1 - r)^{-1}$. Therefore, the bank is able to earn positive profits on the loans to borrowers with credit quality

$\theta \in (\theta^*, 1]$. Given the average creditworthiness of a borrower accepted by the bank, $\hat{\theta}$, is

$$\int_{\theta^*}^1 \frac{\theta f(\theta) d\theta}{1 - F(\theta^*)} = \hat{\theta}.$$

If we assume that applications are received randomly from the population, then the denial rate, R_F , is simply the proportion of the population that falls below the cutoff θ^* . Thus, $R_F = F(\theta^*)$. The probability that a borrower defaults is $(1 - \theta)$. Therefore the expected default rate, D_F , for $F(\theta)$, given θ^* , is

$$D_F = \int_{\theta^*}^1 \frac{(1 - \theta)f(\theta) d\theta}{1 - F(\theta^*)} = 1 - \hat{\theta}.$$

B. Relative Denial and Default Rates When the Bank Faces a Heterogeneous Population

We now consider the case where the lending market can be decomposed into two components. We begin by making two simplifying assumptions. First, the components of the population differ in some economically insignificant way that allows us to identify them. Second, the subpopulations differ in one economically meaningful way: members of one segment are better credit risks on average than are members of the other segment. The Boston Fed data suggest there is such a relationship between white and minority loan applicants:⁴

Minority applicants, on average, do have greater debt burdens, higher loan-to-value ratios, and weaker credit histories... than white applicants... (page 2)

Furthermore,

Denied black/Hispanic applications on average have poorer objective qualifications than denied white applications... denied minorities had lower income and wealth, higher [debt] obligations and lower loan-to-value ratios, and worse credit histories than denied whites. (page 4)

Thus, we refer to the segment with the higher average creditworthiness as the majority and the segment with the poorer average creditworthiness as the minority. Let the majority have PDF $g(\theta)$ and CDF $G(\theta)$, and the minority have PDF $h(\theta)$ and CDF $H(\theta)$. By assumption, $G(\theta)$ has a higher mean than $H(\theta)$. That is, $G(\theta) \leq H(\theta) \forall \theta \in [0, 1]$, which says that $G(\theta)$ first-order stochastically dominates (FOSD) $H(\theta)$.⁵ The presumed relation-

⁴ Duca and Rosenthal (1993) and Holmes and Horvitz (1994) report, as do Munnell *et al.* (1992), that the disparity between minorities and whites in lending outcomes is much greater if economic variables commonly used to assess creditworthiness are ignored. This also suggests that such variables are correlated with race.

⁵ Of course, individual applicants from different segments of the population that have identical θ s are identical from the perspective of the bank, as θ is measured without error.

ship between $g(\theta)$ and $h(\theta)$ is portrayed in Figure 1, where θ^* is the uniform credit standard being applied to the entire population.

Given θ^* , the average creditworthiness of a minority and majority borrower are $\hat{\theta}_H$ and $\hat{\theta}_G$, respectively. Moreover, given that $G(\theta)$ FOSD $H(\theta)$, $\hat{\theta}_G > \hat{\theta}_H$. However, the marginal creditworthiness of a borrower from either component is identical, θ^* . This is, in fact, our definition of a uniform credit standard.

C. Do Unequal Denial Rates Imply Discrimination?

One claim often made in the popular press is that higher denial rates for minority applicants prove that they are being discriminated against by lenders. It is clear from Figure 1 that, given a uniform credit standard, the observed *denial* rate for minority applicants will be greater than that for majority applicants. An applicant from the minority segment of the population is, on average, of lower creditworthiness than an applicant from the majority segment of the population. Thus, one would expect to observe more minority applicants being rejected as more of them fall below the uniform cutoff θ^* . It is interesting to examine the implications of *equal* denial rates, since policymakers frequently leave the impression that they believe that equal denial rates are implied by nondiscrimination.

To equate minority and majority denial rates, either more minority applicants must be accepted or more majority applicants must be rejected than under a uniform credit policy. Either alternative holds majority applicants to a higher credit standard than minority applicants. Although such a policy will equate the denial rates across the majority and minority segments of the population, it does so in a way that will lead to different lending decisions being observed for some applicants (from different segments of the population) with identical credit scores.

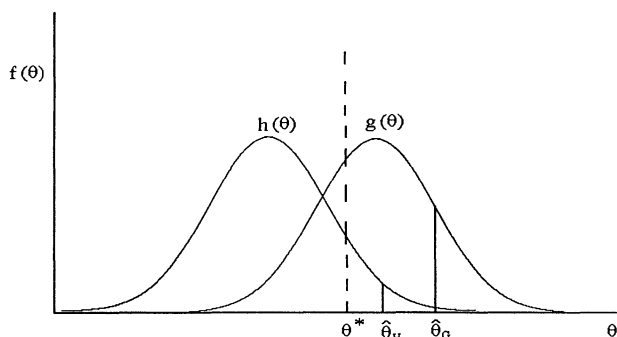


Figure 1. Marginal versus average creditworthiness. Probability density functions of credit scores, θ , for the minority, $h(\theta)$, and the majority, $g(\theta)$, components of the population. θ^* is representative of a uniform credit standard and is the creditworthiness of a marginal borrower from either segment of the population. Given a θ^* , $\hat{\theta}_H$ and $\hat{\theta}_G$ represent the average creditworthiness of minority and majority borrowers, respectively.

D. Do Equal Default Rates Imply Nondiscrimination?

A second claim that is often made, by commentators on the Boston Fed study in particular, is that equal default rates indicate that lenders are not using a different (more harsh) credit standard for minority applicants. Included in the Boston Fed study was a comparison of default rates across census tracts. They found no difference in default rates across census tracts of differing racial composition. Brimelow and Spencer (1993) argue in a recent *Forbes* article that the

data on default suggest [that]... mortgage lenders somehow weeded out the extra credit risk among minorities down to the point where white and minority defaults were at an equal, apparently acceptable, rate.

The conclusion that equal default rates prove that there is no discrimination in lending is erroneous. The observed default rate for minority borrowers will be *greater* than that for majority borrowers due to the difference in average creditworthiness between the majority and minority components of the population. The FOSD relation implies that for any given θ^* the average creditworthiness of minority borrowers will be lower than that of the majority borrowers. Therefore, a larger proportion of defaults ($D_H > D_G$) in the minority borrower pool would be expected. For default rates to be equal, it is necessary that fewer minority borrowers default or that more majority borrowers default than with a uniform credit standard. As with equating denial rates, one can generate equal default rates only through a credit policy under which some applicants of identical creditworthiness, but belonging to different segments of the population, will realize different lending decisions. In particular, minority applicants must be held to a higher credit standard than majority applicants in order to default rates to be equal.

These conclusions about denial and default rates stem from the difference in the relationship between marginal and average borrowers across the two components of the population. As noted above, a uniform credit standard implies that the marginal borrower from either segment has the same θ , namely θ^* . But, if credit quality is not identically distributed, then the average credit quality of borrowers from each segment must differ (i.e., $\hat{\theta}_G \neq \hat{\theta}_H$). It is this distinction between average and marginal borrowers that has not been fully recognized in the debate on lending discrimination.

II. On the Detection of Lending Discrimination

It is widely accepted that historical racial discrimination severely limited the economic opportunities available to minorities in the United States. Thus, even if there is not any ongoing discrimination, minority groups are likely to be socially/economically disadvantaged relative to whites. Of course, it is precisely because minority groups are disadvantaged that it is difficult to disentangle racial discrimination from legitimate economic discrimination in the lending market. That is, if minority groups currently fare poorly relative

$$D_G < D_H$$

$$D_G \geq D_H$$

$R_G < R_H$	No inference can be drawn.	The minority [$H(\theta)$] is being discriminated against.
$R_G \geq R_H$	The majority [$G(\theta)$] is being discriminated against.	This combination cannot be observed.

Figure 2. Combinations of loan denial and default rates. The possible combinations of relative denial rates, R_i , and relative default rates, D_i , where $G(\theta)$ represents the majority population and $H(\theta)$ represents the minority population.

to whites in the banking system, it may be due to historical discrimination against minorities in education, employment, etc.; it may be due to current discrimination by lenders; or it may be due to both. Thus, the issue is whether or not policymakers can detect *additional* racial discrimination at the bank credit level using denial and default rates. This is not merely an academic issue. Public policy has been influenced significantly by loan denial rates.⁶

We define lending discrimination to be the use of different credit standards across the two components of the population, i.e., a policy that leads to the marginal borrower from each component of the population having a different credit score. Figure 2 is a two by two matrix that details the possible combinations of relative denial and default rates that might be observed. Within each cell of the matrix is the inference that can be drawn if the combination of denial and default rates represented by that cell is observed.

First consider the lower right cell of the matrix. This cell indicates that it is not possible for the majority to have both higher denial rates and higher default rates simultaneously. This follows from the assumption that $G(\theta)$ FOSD $H(\theta)$. A higher relative credit standard for the majority is needed for

⁶ Bacon (1993) reports that the Clinton Administration has announced that it intends to "expand its attack against lending discrimination by targeting independent mortgage companies." This announcement was timed to coincide with the announcement that loan denial rate figures for minority applicants at commercial banks in 1992 were still "disappointing." The growing importance of the fair lending laws is further illustrated by the case of Shawmut National Corp. *The Wall Street Journal* (November 17, 1993) reports that as a signal that lending discrimination laws would be enforced more strictly, the Federal Reserve Board denied Shawmut National Corp.'s bid to acquire New Dartmouth Bank. *The Wall Street Journal* notes that the vote "put the first real teeth into laws aimed at . . . racial discrimination."

the majority to have a higher denial rate. This would, however, cause the average creditworthiness of majority borrowers to be even higher relative to minority borrowers. This, in turn, implies a lower, not higher, default rate for majority borrowers. Thus, it is not possible for both default rates and denial rates to be higher for the majority. More interestingly, this cell indicates that it is not possible to equate both denial rates and default rates across the majority and the minority segments of the population under a uniform credit policy.

Because the lower right cell will never be observed, Figure 2 indicates that detection of lending discrimination is sometimes possible relying only on denial or default rates. In the case of the lower left cell of Figure 2, the denial rate of majority applicants is greater than or equal to that of minority applicants. From Figure 1, the average majority applicant is of higher credit quality than the average minority applicant. Therefore, the only way to reject a higher proportion of majority applicants is to apply a higher credit standard to majority applicants, which implies that the marginal majority borrower has a higher credit score than the marginal minority borrower. Similarly, in the case of the upper right cell of Figure 2, the default rate of minority borrowers is less than or equal to that of majority borrowers. However, given the FOSD relationship between the two segments of the population, this requires that minority applicants be held to a higher credit standard than majority applicants.

These examples demonstrate that in some instances it is not only possible to reject the hypothesis of nondiscrimination, but it is also possible to infer the direction of the discrimination by focusing only on denial or default rates. A further implication of Figure 2 is that *equal* denial or default rates *do not imply nondiscrimination*. To the contrary, equal denial rates indicate discrimination against majority applicants (*lower left cell*), while equal default rates indicate discrimination against minority applicants (*upper right cell*).⁷

The first row of the matrix represents higher loan denial rates for minorities than for the majority, which is consistent with the findings reported in the Boston Fed Study. Based on this evidence, the conclusion that lending institutions engage in racial discrimination has been drawn. However, this result alone cannot be held up as evidence of discrimination. The upper left cell of the matrix indicates that if the denial rate and the default rate are both strictly lower for the majority than for the minority, then *nothing* can be inferred about the relative credit standards being applied across the two components of the population. The reason for this ambiguity is that, given the FOSD relationship between the groups, the credit standards for the two groups can have any relationship to each other if they are “close” in magnitude and still generate higher denial and default rates for the minority segment of the population. More detailed analysis of the relative characteristics of the distributions would be necessary to conclude whether or not the

⁷ Ferguson and Peters (1994) show that if information about applicant creditworthiness is noisy, then default rates alone do not have the power to identify discriminatory lending practices.

magnitude of the difference in default or denial rates would imply discrimination.

Taken together, the cells of Figure 2 imply that there is *only one* observable combination of denial and default rates that is consistent with nondiscrimination: $R_G < R_H$ and $D_G < D_H$. Since the most frequently reported relationship between majority and minority denial rates is $R_G < R_H$, this would seem to be good news for those who want to draw the inference from the current empirical studies that minorities are *not* discriminated against. However, discrimination *against either component of the population* is also consistent with this observation. In fact, this is a particular problem for those who want to draw the aforementioned inference. Given that the most frequently observed relationship between majority and minority denial rates is $R_G < R_H$, Figure 2 tells us that discrimination against minorities is consistent with any relationship between the default rates.⁸ Therefore, it is not possible using the most widely reported results, which focus on relative denial and default rates, to reject the null hypothesis that lenders discriminate against the minority.⁹ We believe that this is an important point because policymakers frequently imply that this is the null they have employed in analyzing lending data. As a result, it is our view that more informative empirical studies of lending discrimination will focus on *bank profits* instead of denial and default rates. We agree with Becker (1993) that the economic manifestation of discrimination consists of foregoing *profitable* lending opportunities in order to satisfy a “taste for discrimination.” As he writes,

The correct procedure for assessing whether or not banks discriminate . . . is to determine whether loans are more profitable to blacks (and other minorities) than to whites. This requires examining the default and other payback experiences of loans, the interest rates charged, and so forth. If banks discriminate against minority applicants, they should earn greater profits on the loans actually made to them than on those to whites. The reason is that discriminating banks would be willing to accept marginally profitable white applicants who would be turned down if they were black. (Emphasis in original, page 389.)

III. Concluding Remarks

In this article our goal has been to carefully illustrate what can be inferred from denial and default rates about lending discrimination. In particular, we have argued that many critics of the Boston Fed study have made internally inconsistent claims. In addition, we suggest that policy regarding discrimina-

⁸ Of course, $R_G < R_H$ is also consistent with discrimination against the *majority*.

⁹ If the null hypothesis is that there is no discrimination against the minority, then this null could be rejected if it is found that the default rate for minority borrowers is less than or equal to the default rate of the majority. A more careful analysis of default rates than appears in the Boston Fed study would be required to test this hypothesis.

tion in lending may better be formed on the basis of data beyond relative denial and default rates. Our analysis hinges on a comparison of the average and marginal borrower across different segments of the population. We show that "colorblind" lending will not result in equal denial or default rates across different segments of the population if credit risks are distributed unequally across the segments. Furthermore, contrary to many claims in the popular press, if differences in average credit quality explain differences in denial rates, then equal default rates imply discrimination against the minority population.

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