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Evidence of Discrimination in Lending: An Extension

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ABSTRACT

We generalize the model of Ferguson and Peters (1995) to allow for unequal recovery rates in the event of default by majority borrowers versus minority borrowers. This simple extension has two direct implications: (i) a uniform credit policy, as defined by Ferguson and Peters, entails cross-subsidization across groups; and (ii) it is possible for a profit-maximizing (and therefore economically nondiscriminatory) lending policy to generate lower average default rates among minority borrowers than among majority borrowers.

IN A RECENT ISSUE of this journal, Ferguson and Peters (1995; F&P hereafter) derive the striking theoretical result that "If differences in average credit quality explain differences in denial rates (between minority and nonminority applicants), then equal default rates (between minority and nonminority borrowers) imply discrimination against the minority population" (p. 741). Their study illustrates the important role of formal analysis in characterizing the types of conclusions that policymakers can and should draw from available empirical evidence. The F&P study focuses on the case where the information set includes denial and default rates. In this note, we extend the analysis to include information about the lender's recovery rates in instances of default.

With this extension, two additional findings emerge when average recovery rates among defaulting majority borrowers differ from those of defaulting minority borrowers. First, a uniform credit policy (as defined by F&P) entails cross-subsidization across groups. Second, it is possible for a profit-maximizing (and therefore economically nondiscriminatory) lending policy to generate lower average default rates among minority borrowers than among majority borrowers. These results demonstrate that policymakers and regulatory agencies must consider recovery rates in order to understand whether a particular pattern of default rates may imply discriminatory lending behavior. This analysis extends in a natural way that of F&P, who call for future research to focus on profits and their relationship to lending policies.¹

* Sherrill Shaffer is from the Federal Reserve Bank of Philadelphia. This note embodies the views of the author and does not necessarily represent the views of the Federal Reserve Bank of Philadelphia or of the Federal Reserve System. The author is grateful to Loretta Mester, René Stulz, and two anonymous referees for helpful comments.

¹ Previous studies imply a linkage between lenders' profits and expected losses from default options embedded in mortgage contracts (see Merton (1974), Masulis (1982), and Smith (1982)). These expected losses are a function of various borrower-specific and neighborhood-specific factors

To explore these issues, we adopt the notation of F&P. For each loan of \$1, the bank is to be repaid $(1 + r)$ in the next period. This repayment occurs with probability θ , which we assume is observable by the bank as the applicant's credit score. Each borrower, regardless of credit score, is charged the same interest rate r . There are two groups of applicants: a majority group with probability density function (PDF) $g(\theta)$ and a minority group with PDF $h(\theta)$. The corresponding cumulative density functions (CDF) are $G(\theta)$ and $H(\theta)$, respectively. We extend F&P's model by assuming that the bank receives a partial repayment of α from each defaulting majority borrower and β from each defaulting minority borrower. The bank's expected profit is then $(1 + r - \alpha)\theta + \alpha - 1$ from each majority borrower and $(1 + r - \beta)\theta + \beta - 1$ from each minority borrower. We examine the case in which $1 > \alpha > \beta > 0$, an empirically relevant case according to Berkovec *et al.* (1994) and other studies.

The bank chooses a minimum credit score θ^* at which to approve a loan application. We first show that expected profit maximization requires unequal values of θ^* across the two groups, an outcome permissible under law.² The expected profit of all loans to majority borrowers is:

$$E\pi_G = (1 + r - \alpha) \int_{\theta_g^*}^1 \theta g(\theta) d\theta + (\alpha - 1) \int_{\theta_g^*}^1 g(\theta) d\theta \quad (1)$$

where θ_g^* is the minimum credit score at which the bank approves an application by a member of group g . The first-order condition establishes that the value of θ_g^* that maximizes the bank's expected profit is:

$$\theta_g^* = (1 - \alpha)/(1 + r - \alpha). \quad (2)$$

The credit policy that maximizes the expected profit of loans to minority borrowers is:

$$\theta_h^* = (1 - \beta)/(1 + r - \beta). \quad (3)$$

Because $\partial \theta_g^* / \partial \alpha = -r / (1 + r - \alpha)^2 < 0$ and $\alpha > \beta$, we conclude that $\theta_g^* < \theta_h^*$. In other words, an economically nondiscriminatory (profit-maximizing) credit policy will set a higher minimum standard for applicants belonging to the group exhibiting a lower recovery rate in default, an intuitive result. This outcome is driven by the fact that θ , the probability of repayment, does not convey all the economically relevant information when average recovery rates differ in the event of default. This result requires no assumptions about the

including, among others, the loan-to-value ratio, depreciation rates, and variability in collateral market values. To the extent that such observable factors vary, the expected post-default recovery rates will also vary.

² Current policy recognizes "credible and legitimate nondiscriminatory explanations" of different treatment across groups (Interagency (1994), p. 6), along with "business necessity" based on such factors as "cost and profitability" in the case of disparate impact, unless alternative policies or practices could achieve comparable outcomes with less discriminatory effect (*ibid.*, pp. 7f.).

way in which $g(\theta)$ differs from $h(\theta)$, and indeed would apply even if $g(\theta) = h(\theta)$.

The expected loss rate, L , encompasses both the average default rate and the recovery rate. For the majority group, it is calculated as:

$$L_g = (1 - \alpha) \left\{ 1 - \int_{\theta_g^*}^1 \theta g(\theta) d\theta / [1 - G(\theta_g^*)] \right\} \quad (4)$$

which equals $(1 - \alpha)D_G$ where D_G is the expected default rate as defined by F&P. Similarly, for the minority group, $L_h = (1 - \beta)D_H$. F&P show that a uniform credit policy ($\theta_g^* = \theta_h^* = \theta$) implies $D_H > D_G$. Since $\alpha > \beta$ and thus $1 - \beta > 1 - \alpha$, a uniform credit policy implies $L_h > L_g$, so that the expected dollar loss rate is higher among minority borrowers than among majority borrowers. Because the bank charges the same interest rate to both groups, the outcome in this case is that the bank uses profits earned on loans to majority borrowers to subsidize loans made to minority borrowers.³

Alternatively, consider the case in which the bank sets an economically nondiscriminatory lending policy, represented by θ_g^* and θ_h^* as derived above. Then the comparison between L_g and L_h depends on the particular PDFs and on parameter values such as r , α , and β . We therefore look at a specific example, satisfying F&P's assumption that $G(\theta)$ first-order stochastically dominates $H(\theta)$. Let the minority group be characterized by $h(\theta) = 1$ and $H(\theta) = \theta$ for all $\theta \in [0, 1]$, implying an average repayment probability of $1/2$. The majority group is specified by $g(\theta) = 2\theta$ and $G(\theta) = \theta^2$ for all $\theta \in [0, 1]$, implying an average repayment probability of $2/3$. Then $D_G = (\theta_g^* + 1 - 2\theta_g^{*2})/[3(\theta_g^* + 1)]$ and $D_H = 1/2(1 - \theta_h^*)$.

In this example, the average default rate on minority loans is less than or equal to that on majority loans if $D_G \geq D_H$, or $4\theta_g^{*2} + \theta_g^* - 3\theta_g^*\theta_h^* - 3\theta_h^* + 1 \leq 0$, or:

$$4(1 - \alpha)^2/(1 + r - \alpha)^2 + (2\beta + r - 2)/(1 + r - \beta) \leq 0. \quad (5)$$

If $r = 0.1$ (corresponding to a 10 percent interest rate on loans) and $\alpha = 0.9$ (corresponding to a 90 percent recovery rate on majority defaults), then minority loans exhibit a lower average default rate for all $\beta < 0.8$. Such examples, in conjunction with the results derived by F&P, demonstrate that a comparison of default rates alone cannot establish the presence or absence of discriminatory lending, but must be combined with additional information about average recovery rates in the event of default.

³ Charging different interest rates for a given loan to borrowers from different groups is among the practices prohibited by the Equal Credit Opportunity Act and the Fair Housing Act (Interagency (1994), p. 3).

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