A REMARK ON COLOR-BLIND AFFIRMATIVE ACTION

DEBRAJ RAY
New York University

RAJIV SETHI
Barnard College, Columbia University

Abstract

Faced with legal challenges to explicitly race-contingent admissions policies, elite educational institutions have turned to criteria that meet diversity goals without being formally contingent on applicant identity. We establish that under weak conditions that apply generically, such color-blind affirmative action policies must be nonmonotone, in the sense that within each social group, some students with lower scores are admitted while others with higher scores are denied. In addition, we argue that blind rules can generate greater disparities in mean scores across groups conditional on acceptance than would arise if explicitly race-contingent policies were permitted.

Elite colleges and universities in the United States have recently faced a number of legal challenges that restrict their use of explicitly race-contingent admissions policies.1 Because these institutions continue to seek broad representation from different social groups (and to view campus diversity as an essential ingredient in the provision of a first-rate education), they face strong incentives to adjust their admissions criteria in order to attain diversity goals through less direct means. There is considerable evidence that this

Debraj Ray, Department of Economics, New York University (debraj.ray@nyu.edu) and Rajiv Sethi, Department of Economics, Barnard College, Columbia University (rs328@columbia.edu).

We thank (without implicating) Dennis Epple, Erik Eyster, Glenn Loury, and Tim Van Zandt for comments on an earlier version.

Received October 21, 2009; Accepted November 23, 2009.

1Among the most visible of these are the 2003 Supreme Court ruling in Gratz v. Bollinger, which struck down the undergraduate admissions policy at the University of Michigan, and California’s Proposition 209, which in 1996 prohibited the use of race, sex, or ethnicity as an admissions criterion in public education; see Chan and Eyster (2009) for other examples.

© 2010 Wiley Periodicals, Inc.
process is well underway, and a literature dealing with the efficiency and
distributional implications of color-blind affirmative action policies has
emerged (Chan and Eyster 2003, 2009, Fryer and Loury 2007, Epple, Ro-

This note is concerned with one possible feature of a color-blind policy: the
use of admissions criteria that, while uniform across all social groups, are nonmonotone in standardized measures of past performance (such as test
scores). Under such policies individuals with lower scores may receive admis-
sion with greater likelihood than those in the same social group with some-
what higher scores, simply because their scores fall into a range which is dis-
proportionately populated by members of an underrepresented group. The
possibility that score-maximizing policies that are constrained to be color-
blind might have this structure was recognized by Chan and Eyster (2003),
although they assumed for the purposes of their analysis that only monotone
rules were feasible. More recently, Epple, Romano, and Sieg (2008) have
computed color-blind admissions policies using a calibrated general equilib-
rium model, and found them to be nonmonotonic in scores (conditional on
other nonracial characteristics such as income).

We establish here that under weak conditions that apply generically, non-
monotonicity is not simply a theoretical possibility or the predicted outcome
under a plausible calibration, but a necessary property of score-maximizing
color-blind admissions policies. In addition, we argue that blind rules can
generate greater disparities in mean scores across groups conditional on ac-
ceptance than would arise if explicitly race-contingent policies were permit-
ted. This is most easily seen in the case of score-maximizing (and hence non-
monotone) policies, but applies also to blind policies that are constrained to
be monotone.

We also briefly discuss the manner in which nonmonotone policies can
be implemented in practice, given some natural incentive compatibility is-
ues that arise from their use. However, while we do not model this, it should
be obvious that—quite apart from the score disparities already mentioned—
nonmonotone policies are particularly susceptible to issues of moral hazard
in educational effort. Thus, while we show that nonmonotonicity emerges as
a score-maximizing policy when that policy is constrained to be color-blind,
this finding is more to be viewed as a critique of color-blindness (conditional
on affirmative action as a goal) rather than an endorsement of such policies.

The nonmonotonicity we unearth is a corollary of the observation that
maximizing policies must be deterministic. This observation may also be of
intrinsic interest: randomized admissions, while allowed for, play no role.

Consider a population of measure 1 composed of two groups (black and
white) with population shares $\beta$ and $1 - \beta$, respectively. The within-group
test score distribution functions are $F_b(\theta)$ and $F_w(\theta)$, respectively, and are assumed to possess corresponding continuous densities $f_b(\theta)$ and $f_w(\theta)$. The aggregate distribution function is

$$F(\theta) = \beta F_b(\theta) + (1 - \beta) F_w(\theta),$$
with corresponding density
\[ f(\theta) = \beta f_b(\theta) + (1 - \beta) f_w(\theta). \]
We assume that whites score higher as a group relative to blacks in the sense of first-order stochastic dominance:
\[ F_b(\theta) \geq F_w(\theta), \tag{1} \]
for all \( \theta \), with strict inequality whenever \( F_b(\theta) > 0 \) and \( F_w(\theta) < 1 \).

Only a proportion \( \alpha \) of the total population can receive admission. Define \( \theta^* \) as the test score cutoff if admission is based on scores alone, with the highest scorers admitted. Then
\[ 1 - F(\theta^*) = \alpha. \]
Let \( \beta^* \) denote the share of the admitted population that is from the disadvantaged group under this policy. Then
\[ \alpha \beta^* = \beta(1 - F_b(\theta^*)). \]
It follows from (1) that \( \beta^* < \beta \) (members of the disadvantaged group are underrepresented in the population of admitted students). Among those accepted, the mean score for students belonging to group \( i \in \{b, w\} \) is
\[ m_i = \frac{1}{1 - F_i(\theta^*)} \int_{\theta^*}^{\infty} \theta f_i(\theta) d\theta, \]
and the mean score among all accepted students is \( \beta m_b + (1 - \beta) m_w \).

Now suppose that a target level of representation \( \tilde{\beta} > \beta^* \) is desired, and the institution wishes to maximize the average score among admitted students subject to the constraint that this target, as well as the capacity constraint, are both met. If race-contingent policies are permissible, this may be accomplished by selecting a distinct score threshold for each group and admitting all those whose scores exceed the threshold corresponding to group to which they belong. Let \( \theta_b \) and \( \theta_w \) denote these thresholds. Then the diversity constraint is
\[ \beta(1 - F_b(\theta_b)) = \tilde{\beta} \alpha, \]
and the capacity constraint is
\[ 1 - \beta F_b(\theta_b) - (1 - \beta) F_w(\theta_w) = \alpha. \]
There is a unique value of \( \theta_b \) consistent with the diversity constraint and, given this, a unique value of \( \theta_w \) consistent with the capacity constraint. It is clear that for any target \( \tilde{\beta} > \beta^* \), we must have \( \theta_w > \theta^* > \theta_b \); the advantaged group will face a more demanding threshold for admission. The mean score for accepted students belonging to group \( i \in \{b, w\} \) with this (sighted) affirmative action policy is
\[ m_i^* = \frac{1}{1 - F_i(\theta_i)} \int_{\theta_i}^{\infty} \theta f_i(\theta) d\theta, \]
and the mean for the entire population of admitted students is $\beta m^i_b + (1 - \beta) m^i_w$.

If colleges are prevented from making explicit use of group identity, they must apply the same set of admissions criteria to members of both groups. This makes it costlier (in terms of the mean score among accepted students) but not impossible to meet a diversity target. Following Fryer and Loury (2007), we refer to an admissions policy as *color-blind* if a student’s likelihood of acceptance under that policy depends only on his score and not on his identity, and *sighted* if it is explicitly race-contingent. Any color-blind policy can be represented by a function $p(\theta)$, interpreted as the probability of acceptance for someone having score $\theta$. We say that a color-blind admissions policy is *monotone* if $p(\theta)$ is nondecreasing in $\theta$.

The policy of simply admitting the highest scorers may then be written as

$$p(\theta) = \begin{cases} 1 & \text{if } \theta \geq \theta^* \\ 0 & \text{otherwise} \end{cases}$$

This is clearly a monotone policy, which results in the default black population share $\beta^*$ among admitted students. Any target $\tilde{\beta} \in [\beta^*, \beta]$ can be met using a policy that is color blind and monotone, for instance by the appropriate choice of two thresholds such that those above the higher threshold are admitted with certainty, those below the lower one rejected, and those between thresholds admitted with a suitably chosen probability. Chan and Eyster show that such a “two-step” policy can be used to maximize mean entering scores within the class of rules that are both blind and monotone.

A policy is *deterministic* if $p(\theta) \in \{0, 1\}$ for (almost) all $\theta$ in the support of test scores. The score-maximizing policy with no affirmative action is a deterministic policy. A little thought shows that a policy that needs to meet a target $\tilde{\beta} > \beta^*$ cannot be both deterministic and monotone.

Say that $p(\theta)$ is a *score-maximizing color-blind policy (with target $\tilde{\beta}$)* if it is a solution to the following problem (with limits of integration omitted):

$$\max_{p(\theta)} \int \theta p(\theta) f(\theta) d\theta,$$

subject to

$$\int p(\theta) f(\theta) d\theta = \alpha,$$

and

$$\beta \int p(\theta) f_b(\theta) d\theta \geq \tilde{\beta} \alpha.$$
We impose the following condition on the distributions of test scores:

\[ \text{[G]} \quad \text{For any } \theta \text{ such that } f_b(\theta) > 0, \frac{f_b(\theta)}{f(\theta)} \text{ is not locally affine in } \theta. \]

This condition is extremely mild and simply rules out degenerate cases in which the ratio of black and white score densities moves over some interval in a way that is precisely linear in the score.

**Proposition 1:** Under Condition G, if \( p(\theta) \) is a score-maximizing color-blind policy with target \( \tilde{\beta} > \beta^* \), then it is deterministic. In particular, such a policy cannot be monotone.

**Proof:** Consider the problem described in (2)–(4). Standard arguments for infinite-dimensional convex programming (see, e.g., Rockafellar 1974, especially Example 1, pp. 7 and 18, as well as Example 1’ p. 23) allow us to assert the existence of multipliers \( \lambda \) and \( \mu \) for the constraints (3) and (4), such that a score-maximizing policy must maximize

\[
\int p(\theta) \left[ \theta f(\theta) + \lambda f(\theta) + \mu \beta f_b(\theta) \right] d\theta,
\]

subject to the constraint that for every \( \theta \), \( p(\theta) \in [0, 1] \). The expression (5) tells us that the maximizing policy must be deterministic provided

\[
\theta f(\theta) + \lambda f(\theta) + \mu \beta f_b(\theta) \neq 0,
\]

for almost every \( \theta \) in the support of test scores. Because \( f(\theta) > 0 \) a.e. on the support of test scores, this condition is equivalent to

\[
(\theta + \lambda) + \mu \beta f_b(\theta) f(\theta) \neq 0,
\]

for almost every \( \theta \) such that \( f(\theta) > 0 \). But this follows right away from the continuity of \( f_b \) and \( f \), and the genericity condition [G].

In particular, then, \( p \) cannot be monotone. For if it were monotone and deterministic, it is easy to check that either condition (3) or (4) must be violated whenever \( \tilde{\beta} > \beta^* \). ■

The following numerical example illustrates the structure of a score-maximizing admissions policy. Suppose that both \( f_b(\theta) \) and \( f_w(\theta) \) are normal with variance 1/2 and means \( \mu_b \) and \( \mu_w \), respectively. Then for \( i \in \{b, w\} \),

\[
f_i(\theta) = \frac{1}{\sqrt{\pi}} e^{-\frac{(\theta - \mu_i)^2}{2}}
\]

More precisely, there is no interval around \( \theta \) such that for all \( \theta' \) in that interval, \( [f_b(\theta)/f(\theta)] = A + B\theta \) for constants \( A \) and \( B \).
and

\[ F_i(\theta) = \frac{1}{2} (1 + \text{erf}(\theta - \mu_i)). \]

Suppose that

\[ \alpha = \frac{1}{4}, \beta = \frac{2}{5}, \tilde{\beta} = \frac{1}{5}, \mu_b = 0, \mu_w = \frac{8}{5}. \]

Then the score-maximizing blind affirmative action policy is

\[ p(\theta) = \begin{cases} 
1 & \text{if } \theta \in (\theta_1, \theta_2) \cup [\theta_3, \infty) \\
0 & \text{otherwise}
\end{cases} \]

where \((\theta_1, \theta_2) = (0.07, 0.30)\) and \(\theta_3 = 1.94\). This policy is illustrated in Figure 1.

It is instructive to examine in detail the admission requirements and mean scores by group for admitted students under four policy alternatives: no affirmative action, the sighted policy, the blind score-maximizing policy, and the two-step blind and monotone policy. The following table summarizes admissions criteria and mean scores under each of these.
The mean score among all admitted students is highest when no affirmative action policy is implemented, but the level of diversity falls well below the desired threshold. Sighted affirmative action allows the diversity target to be met at some cost in terms of the overall mean score among admitted students. Relative to the case of no affirmative action, admitted white students have higher mean scores, and admitted black students have lower mean scores. This is a necessary consequence of the policy and does not depend on the particular specification used here.

The blind score-maximizing policy results in a greater disparity in mean scores across the two groups when compared with the sighted policy. The reasons for this are apparent from Figure 1: the diversity constraint is met by recruiting students from a part of the overall score distribution that is heavily populated by the underrepresented group, but which falls some distance to the left of the cutoff point for remaining students. A wide gap between mean entering scores across social groups also arises in the case of blind policies that are constrained to be monotone. The reasons are similar: in the case of monotone policies the diversity constraint is met by accepting students with low probability across a very broad range of the score distribution. In addition, the monotone policy has lower scores not only overall but also within each group when compared with the score-maximizing admission rule.

To this point we have considered an exogenously given representation target \( \tilde{\beta} \), but it is easily seen that the chosen policy must be nonmonotone even if the educational institution has an arbitrary, increasing objective function over mean score and the extent of minority representation. After all, at the chosen admissions policy, mean score must be maximal given the level of minority representation, so that Proposition 1 applies.

How might nonmonotone policies be implemented in practice? One possibility is to focus recruitment efforts on two disjoint applicant pools: those from elite high schools with high levels of past performance on standardized tests, and those from largely segregated schools with lower levels of past performance which allow diversity goals to be met in a manner that is not formally contingent on applicant identity. The former pool helps raise

\[ \text{AA Policy} \quad \text{Admission requirement} \quad \tilde{\beta} \quad m \quad m_b \quad m_w \]

\[
\begin{array}{|l|c|c|c|c|}
\hline
\text{None} & \theta > 1.76 & 0.01 & 2.26 & 1.99 & 2.27 \\
\text{Sighted} & \theta_b > 0.81, \theta_w > 1.90 & 0.20 & 2.13 & 1.16 & 2.37 \\
\text{Blind score-maximizing} & \theta \in (0.07, 0.30) \cup (1.94, \infty) & 0.20 & 1.87 & 0.23 & 2.28 \\
\text{Blind monotone} & \theta > 2.13, \theta \in (-0.92, 2.13) & 0.20 & 1.75 & 0.15 & 2.15 \\
\quad \text{with prob 0.14} & & & & & \\
\hline
\end{array}
\]

\[^3\text{Of course, it needs to also be assumed that the maximization of this function calls for a level of minority representation that exceeds the laissez-faire outcome.}\]
the value of the objective function, while the latter pool allows the diversity constraint to be met at relatively little cost in terms of overall mean scores. As long as movement of students across such disjoint pools is limited, such policies need not violate incentive compatibility constraints. Note, however, that admissions policies must be monotone conditional on social location if they are to be incentive compatible (Loury, personal communication). Indeed, the Texas 10% rule, which guarantees admission to a public university for any high school student in the top tenth of her graduating class, is an example of such a policy, as are similar plans that have been implemented recently in California and Florida.

A nonmonotone policy has the property that within each social group some students with lower scores are admitted while others with higher scores are denied. As noted by Chan and Eyster (2003), this violates certain intuitive notions of fairness. Furthermore, blind policies (both monotone and score-maximizing) can widen the disparity between black and white scores conditional on admission, resulting in the reinforcement and entrenchment of negative stereotypes. As Epple, Romano, and Sieg (2008, p. 476) note, a common justification for affirmative action is that “racial diversity in student bodies promotes cross-racial understanding and breaks down stereotypes, which better prepares students for an increasingly diverse workplace.” This particular goal is undermined by the use of color-blind policies to the extent that they induce larger gaps between groups in mean scores conditional on acceptance than would arise under more traditional forms of affirmative action.

References