Diversity and Affirmative Action in Higher Education

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Abstract

We examine the practice of affirmative action and consequences of its proscription on the admission and tuition policies of institutions of higher education in a general equilibrium framework. Colleges are differentiated ex ante by endowments and compete for students that differ by race, household income, and academic qualification. Proscription of affirmative action requires that admission and tuition policies are race blind. Colleges then use the informational content about race in income and academic qualification in reformulating their optimal policies. We find that minority students pay lower tuition and attend higher-quality schools because of affirmative action. A ban of affirmative action will lead to a substantial decline of minority students in the top-tier colleges.

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1. Introduction

Consideration of race in admissions and provision of financial aid has become common practice among selective institutions of higher education, excepting instances where it has been banned. While college and university decision makers have shown a willingness to promote racial diversity with affirmative action policies, these practices are controversial and face frequent legal challenge. In *Regents of University of California vs. Bakke* (1978), the U.S. Supreme Court struck down use of minority quotas in admissions. The University of California's Board of Regents then eliminated race- and gender-based affirmative action policies in 1995. This ban expanded to all public institutions in California by referendum in 1996. The state of Washington followed suit by passing an identical referendum in 1998. The Fifth Circuit Court of Appeals ruled against race-related admissions in *Hopwood vs. Texas* (1996), eliminating such practices in universities receiving federal public funding in Louisiana, Mississippi, and Texas. The use of race in admissions at the University of Georgia was proscribed by federal court in *Johnson vs. University of Georgia* (2001). At Governor Jeb Bush's urging, the Florida legislature eliminated affirmative action at Florida public universities in 2000. In *Gratz vs. Bollinger et al.* (2003) and *Grutter vs. Bollinger et al.* (2003), the U.S. Supreme Court ruled, respectively, against the admission policy for undergraduates at the University of Michigan, while upholding that university's admission policy to its law school, both policies having elements of racially based affirmative action.

This paper examines the equilibrium practice of affirmative action by colleges. Several rationales for attention to race in admissions in higher education have been put forth.[1] One position is that educational benefits are produced from diversity in student bodies. The logic is that racial diversity in student bodies promotes cross-racial understanding and breaks down stereotypes, which better prepares students for an increasingly diverse workplace and society. The educational value of diversity was the crux of the University of Michigan's Law School's defense for their admission policy in *Gratz vs. Bollinger et al.,* the argument accepted in the Court's majority decision. As well, Justice Powell's opinion in *Regents of University vs. Bakke* stated that attainment of a diverse student body was the only interest expressed by the defendants that survives strict scrutiny. This paper examines the practice of affirmative action that is motivated by educational benefits from racial and socioeconomic diversity of the student body.

The starting point of our analysis is a competitive equilibrium model that allows affirmative action practices.[2] The model predicts that affirmative

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[1]We do not explore the original justification for affirmative action, which was, of course, to remedy past injustices.

[2]This paper is related to the theoretical literature in economics on affirmative action. Becker (1957) introduced the analysis of taste-based discrimination into economics. Phelps (1972) and Arrow (1973) developed a theory of statistical discrimination. The effects of

action increases minority students' access to high-quality colleges. There is much empirical evidence which supports this hypothesis. Bowen and Bok (1998) find that affirmative action has significantly increased the enrollment of minority students at the top-ranked U.S. colleges during the past decades. Our model assumes that minority students, as well as nonminority students, benefit from having access to top tier colleges. This view is also consistent with the results in Bowen and Bok, who report that the minority students in their sample have performed well on average after graduating from college, suggesting that minority students benefit from affirmative action.

In our model, colleges maximize a quality index that increases with academic qualification of the student body, inputs provided per student, and simple measures of racial and income diversity. Colleges are differentiated ex ante by access to nontuition revenues, for example, endowment earnings. Potential students differ by race, income, and academic qualification, and they maximize a utility function that increases in the quality of their education. Colleges compete for desirable students using financial aid policies and admission policies. Our framework has multiple colleges who compete against each other using admission and tuition policies. We can, therefore, investigate the way in which admission and tuition vary by income, ability, and race within and across colleges. In contrast to previous studies, we can also characterize the effects of competition among colleges on tuition policies and on access to college by students with differing demographic characteristics. Our inclusion of variation of income of potential students adds a realistic dimension to the analysis that is important to the nature of equilibria with and without affirmative action, and plays a key role in inference about race under the ban.

We find that, when affirmative action is allowed, minority students pay lower tuition and attend, on average, higher-quality schools than their equally qualified nonminority peers. Colleges provide merit and need-based aid in equilibrium, and pursue affirmative action in admissions and provision of financial aid. Our paper also develops a counterpart computational equilibrium model with multiple colleges, calibrated to U.S. data, which permits us to provide a quantitative investigation of the general equilibrium effects. We specify and calibrate the computational model for the year 2000. Our model is consistent with a U-shaped relationship between college quality and minority attendance. The fraction of minority students in the top tier of colleges is approximately 15.5% compared with 14.4% in the third tier and 21.7% in the outside option.

We then consider a ban in affirmative action policies and compute the equilibrium using race-blind admission and aid policies. Since colleges are

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affirmative action in employment have been studied by Lundberg (1991), Coate and Loury (1993), and Moro and Norman (2003, 2004). Chung (2000) considers the relationship between role models and affirmative action.

still interested in diversity, they give some preference to students with high or moderately high incomes who also have relatively low scores on standardized college entrance exam, these students are relatively more likely to be minorities. This prediction of our model is similar to Chan and Eyster (2003), who also analyze the proscription of affirmative action assuming that college administrators have preference for diversity and will employ alternative signals of race under the ban. They emphasize that such a ban may reduce the academic qualification of the admitted student body when one motivation for such a ban is to improve academic credentials.

In spite of colleges' strategies to maintain diversity, we find that minorities are significantly hurt by proscription of affirmative action. Minority presence in the top-tier of colleges declines by 35%. The finding that affirmative action largely affects the top-tier colleges is consistent with Kane (1998), who has shown that racial preferences in admission and aid policies are only common among the top 20% of colleges and universities.[3] Nonminorities gain from elimination of affirmative action, but those gains are generally modest. Arcidiacono (2005) also finds that removing advantages for minorities in admission policies substantially decreases the number of minority students at top-tier schools.

Conditioning on the attendance at college initially, the mean compensating variation from banning affirmative action for whites and minorities are \$111.81 and −\$859.03, respectively. This finding suggest that most nonminority students have little to gain from a ban of affirmative action as suggested by Fryer and Loury (2005). Dale and Krueger (1998) have argued that the benefits of attending top-tier colleges are rather small for nonminority students. However, that view is highly controversial. Card and Krueger (2004) find that the highly qualified minority students are not much affected by a ban on affirmative action policies. Our analysis suggests that the fraction of minority students at top-tier colleges will drop to 5% of the student population after a ban of affirmative action.

Our analysis thus suggests that race-blind affirmative action policies are rather inefficient substitutes for race-sighted affirmative policies. This view is shared by Loury, Fryer, and Yuret (in press), who investigate the consequences of a ban on affirmative action in a model where colleges maximize aggregate academic qualification of the student body subject to a racial quota while assuming the races have different costs of increasing their precollege academic qualifications. They show that under weak conditions the ban will lower academic qualification of the student body given race-blind admissions that satisfy the racial quota.

The rest of the paper is organized as follows. Section 2 develops the theoretical model. Section 3 discusses the properties of our model with and

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[3]The results in Epple, Romano, and Sieg (2003) suggest, however, that the set of universities that gives preferential treatment to minorities is large.

without affirmative action. Section 4 explores the quantitative implications of the model considering a hypothetical ban of affirmative action policies. Section 5 offers some conclusions.

2. Theory

We develop a theoretical model of provision of higher education.[4] The model considered here builds on Epple, Romano, and Sieg (2002, 2006). The economy consists of colleges and potential students.

2.1. Students

A potential student is characterized by three variables: race (r), household income (y), and ability (b). We will frequently refer to potential students as just students, when it is clear by context whether they attend a college or not. We specify "race" to be dichotomous, white (w) or nonwhite (nw). Let Γ^r, $r \in \{w, nw\}$, denote the proportion of potential students of race r in the economy.

ASSUMPTION 1: *The joint distribution function of income and ability for race r, $F^r(b, y)$, is continuous with support $S = (b_{\min}, b_{\max}) \times (0, y_{\max})$ and density $f^r(b, y)$.*

Let

$$f(b, y) = \sum_{r=w,nw} \Gamma^r f^r(b, y) \tag{1}$$

denote the population density of (b, y).

Students have preferences defined over a numeraire x and college quality q, given their ability. The numeraire is given by $x = y - p$, where p denotes tuition if a college is attended.

ASSUMPTION 2: *Student utility $U = U(x, q, b)$ is independent of race and an increasing and twice differentiable function in its arguments.*

We are thus assuming that preferences do not vary with race.[5] Differences in outcomes across the races derive solely from differences in their distributions over (b, y) and not from differences in preferences for education.

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[4]Closely related to this line of research is recent research that investigates normative and positive consequences of competition in primary, secondary and higher education, and the likely effects of policy changes including vouchers, public school choice, and changes in education financing. Recent theoretical studies include Caucutt (2002), Epple and Romano (1998), Fernandez and Rogerson (1998), Manski (1991), Nechyba (2000), and Rothschild and White (1995).

[5]We considered some alternatives to this in Epple et al. (2002).

ASSUMPTION 3: *The utility function satisfies the following single-crossing assumptions:*

$$\frac{\partial\left(\frac{\partial U/\partial q}{\partial U/\partial x}\right)}{\partial x} > 0. \tag{2}$$

and

$$\frac{\partial\left(\frac{\partial U/\partial q}{\partial U/\partial x}\right)}{\partial b} \geq 0. \tag{3}$$

The first single crossing condition (2) corresponds to a positive income elasticity of demand for educational quality, and the second (3) to a nonnegative ability elasticity of demand for quality.[6]

Taking as given college's tuition and admission policies, students choose among their educational options to maximize utility.

2.2. Colleges

Students can attend college (if they are admitted) or choose an outside option.

ASSUMPTION 4: *If no college is attended, $q = q_0$, e.g., the educational quality of high school.*

Hence, the quality of the outside option is the same for everyone.[7] Thus differences in educational outcomes are not driven in this model by differences in outside options.[8]

There are J colleges, differentiated ex ante by their "endowment earnings," R_i, $i = 1, 2, \ldots, J$. All nontuition earnings of a college make up R_i, including, for example, public subsidies.

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[6]Complementarity of ability and educational quality is a common modeling assumption. See, for example, Fernandez and Rogerson (2001) and Nechyba (2003).

[7]The outside option could also be a free two-year college where all members of the population of "potential students" attend the two-year or a four-year college. The extension having a low fixed price of the two-year college is simple.

[8]One could clearly argue that the outside option is not the same for all students. It is not difficult to extend the analysis in this paper to allow for the outside option to depend on student type. Admission and aid decisions of the lower ranked schools would be primarily affected by this change since they compete for students for which the outside option is the next best alternative. Affirmative action is most commonly practiced by the most selective schools. Students attending these colleges have lower-ranked colleges as their next best alternatives. Thus, allowing for type specific outside options would primarily affect our analysis of affirmative action via general equilibrium effects.

ASSUMPTION 5: *$R_i \neq R_j$ for all colleges i and j. Number the colleges so that $R_1 < R_2 < \cdots < R_J$.*

Each college chooses tuition and admission policies and educational inputs to maximize a quality index.[9]

ASSUMPTION 6: *College quality is an increasing, twice differentiable, and quasi-concave function of mean student ability (θ), educational inputs per student (I), a measure of student income diversity (D^y), and a measure of racial diversity (D^R):*

$$q_i = q\left(\theta_i, I_i, D_i^y, D_i^R\right). \tag{4}$$

There is no doubt that colleges care about at least two of the four variables in our quality functions. Colleges clearly pursue students with higher abilities, all else constant. The peer student-ability measure in the quality index embodies an ability-related peer effect on educational quality that could operate through several channels. This could be due to students learning from one another in and outside of the classroom, enhanced competition among students for grades, student-body effects on hiring and motivation of teachers, or a variant of signaling Spence (1974). Colleges' quality also obviously depends on instructional expenditures per student.

More controversial is the assumption that college quality depends on the diversity of the student body. This assumption is typically justified by appealing to a "production function" argument; that is, student achievement increases in a diverse environment. As already noted, the logic is that racial diversity in student bodies promotes cross-racial understanding and breaks down stereotypes, which better prepares students for an increasingly diverse workplace and society. Socioeconomic diversity breaks down class barriers and enhances the educational experience of all parties. Admittedly these arguments are controversial.

Our racial diversity measure is

$$D_i^R = \Gamma_i^{nw}/\Gamma^{nw} \tag{5}$$

assuming that nonwhites are the under-represented race in college i.[10] Hence a college strives to have a student body representative of the population.

Similarly, a simple measure of income diversity that we adopt is

$$D_i^y = \mu_y/\mu_i, \tag{6}$$

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[9]Tuition to a student can itself, of course, induce or prohibit attendance, so our specification of a separate admission policy is for clarity and analytical convenience.

[10]If $\Gamma_i^{nw} > \Gamma_i^w$, then nonwhites are "overrepresented" in college i, and increases in D_i^R would not increase (and perhaps decrease) college quality. But we restrict our analysis here to cases with underrepresentation of nonwhites, as we find consistently in our computational analysis.

where μ_y is the mean income in the population, μ_i is the mean income of students in college i, and we are assuming $\mu_i > \mu_y$ as is empirically relevant. Inclusion of an income "diversity" measure is motivated by empirical evidence. In Epple et al. (2006) we find that such a specification of college quality helps to explain the prevalence of need-based aid.

Costs of college i are given by

$$C(k_i, I_i) = F + V(k_i) + k_i I_i; \tag{7}$$

letting k_i denote the number of students attending. "Custodial costs" $F + V$ are independent of quality-enhancing educational inputs, implying an efficient scale $k^* = \text{argmin}_{k_i} C(k_i, I_i)/k_i$ that is independent of I_i.

ASSUMPTION 7: *$V(k)$ is a twice differentiable, increasing, and convex function in k, i.e., $V', V'' > 0$.*

To prevent colleges from spending an infinite amount of resources on a vanishing small number of students, we also assume that

ASSUMPTION 8: $F > R_J = \max_i R_i$.

Colleges take type (r, b, y)'s alternative utility as given when maximizing quality. This assumption conforms to a competitive model and is further discussed below. Let $v_i = v_i(r, b, y, q_i)$ denote a student's reservation price for attending a college of quality q_i. That is, v_i, satisfies

$$U(b, y - v_i, q_i) = U_i^A(r, b, y), \tag{8}$$

where $U_i^A(r, b, y)$ denotes the beliefs that college i and the student hold about the maximum alternative utility that type (r, b, y) can attain if the student does not attend college i. Equilibrium requires that these beliefs are correct, i.e., are consistent with optimization by other colleges as detailed below.

College i chooses an admission function

$$\alpha_i(r, b, y) \in [0, 1] \tag{9}$$

that indicates the proportion of type (r, b, y) in the student population admitted. Let $P_i = \{\succ_i, =_i, \prec_i\}$ describe college i's preferences as to whether an admitted student matriculates, where $\succ_i$ signifies strict preference of college i, etc. Let

$$\alpha_i^m(r, b, y) \in [0, 1] \tag{10}$$

denote college i's beliefs about the proportion of type (r, b, y) that will matriculate conditional on admittance, implying the college believes $\alpha_i(r, b, y)\,\alpha_i^m(r, b, y)$ of the type (r, b, y) will actually attend. At tuition p_i to a particular student, in equilibrium college i's beliefs are

$$\alpha_i^m(r,b,y) = \begin{cases} 1 & if \quad U(y-p_i, q_i, b) > U_i^A(r,b,y) \\ 1 & if \quad U(y-p_i, q_i, b) = U_i^A(r,b,y) \;\; and \succ_i \\ 0 & if \quad U(y-p_i, q_i, b) = U_i^A(r,b,y) \;\; and =_i \\ 0 & if \quad U(y-p_i, q_i, b) < U_i^A(r,b,y). \end{cases} \tag{11}$$

Note that beliefs about matriculation make sense only if $\alpha_i(r, b, y) > 0$, hence are not specified if $\prec_i$. Optimal tuition satisfies

$$[p_i(r,b,y) - v_i(r,b,y,q_i)]\alpha_i(b,y)\alpha_i^m(b,y) = 0. \tag{12}$$

Lower tuition than v_i to an admitted student would imply the student has a strict preference for matriculating and college i could increase tuition and thus I_i and q_i while still attracting the student. Higher tuition than v_i would necessarily imply that $\alpha_i^m = 0$ and would be suboptimal if the college prefers a student's attendance. Tuition to nonadmitted students is arbitrary, but it is convenient to specify that p_i equals their reservation price (with no effect on equilibrium).

Given beliefs about matriculation and substituting $p_i = v_i$, college i's optimization problem is

$$\max_{\theta_i, I_i, \mu_i, k_i, \Gamma_i^{nw}, \alpha_i(r,b,y)} q\left(\theta_i, I_i, \mu_y/\mu_i, \Gamma_i^{nw}/\Gamma^{nw}\right) \tag{13}$$

subject to a feasibility constraint

$$\alpha_i(r,b,y) \in [0,1] \forall (r,b,y), \tag{14}$$

a budget constraint

$$\sum_r \int_S \alpha_i(r,b,y)\alpha_i^m(r,b,y) v_i(r,b,y,q_i)\Gamma^r f^r(b,y)\, db\, dy + R_i = C(k_i, I_i), \tag{15}$$

and identity constraints

$$k_i = \sum_r \int_S \alpha_i(r,b,y)\alpha_i^m(r,b,y)\Gamma^r f^r(b,y)\, db\, dy \tag{16}$$

$$\theta_i = \frac{1}{k_i}\sum_r \int_S b\alpha_i(r,b,y)\alpha_i^m(r,b,y)\Gamma^r f^r(b,y)\, db\, dy \tag{17}$$

$$\mu_i = \frac{1}{k_i}\sum_r \int_S y\alpha_i(r,b,y)\alpha_i^m(r,b,y)\Gamma^r f^r(b,y)\, db\, dy \tag{18}$$

$$\Gamma_i^{nw} = \frac{1}{k_i}\int_S \alpha_i(nw,b,y)\alpha_i^m(nw,b,y)\Gamma^{nw} f^{nw}(b,y)\, db\, dy. \tag{19}$$

College i's optimum satisfies the following first-order conditions:

$$\alpha_i(r, b, y) \begin{pmatrix} = 1 \\ \in [0, 1] \\ = 0 \end{pmatrix} \text{ as } v_i(r, b, y, q_i) \begin{pmatrix} > \\ = \\ < \end{pmatrix} EMC_i(r, b, y), \tag{20}$$

where

$$EMC_i(nw, b, y) \equiv V' + I_i + \frac{q_\theta}{q_I}(\theta_i - b) + \frac{q_{\mu_i}}{q_I}(\mu_i - y) + \frac{q_{\Gamma_i^{nw}}}{q_I}\left(\Gamma_i^{nw} - 1\right), \tag{21}$$

$$EMC_i(w, b, y) \equiv V' + I_i + \frac{q_\theta}{q_I}(\theta_i - b) + \frac{q_{\mu_i}}{q_I}(\mu_i - y) + \frac{q_{\Gamma_i^{nw}}}{q_I}\Gamma_i^{nw}, \tag{22}$$

and

$$\lambda_i = \frac{q_I}{k_i - \partial T/\partial I} > 0, \tag{23}$$

where (20)–(22) hold for all student types, λ_i is the multiplier on the budget constraint, and T denotes tuition revenues.[11] Condition (20) describes the admission policy, using what we call a student's effective marginal cost of admission (EMC). EMC for nonwhites and whites are defined, respectively in (21) and (22), these differing only by the last term. The first two terms in EMC equal the marginal resource cost of educating any student. The third term is the academic peer effect, equal to the change in mean ability from attendance by a type b student, multiplied by the resource cost of maintaining quality. Note that this "cost" is negative for students with ability exceeding the college's mean ability. The fourth term quantifies the analogous effect on the income-diversity measure. Note that since $q_{\mu_i} < 0$, this cost is positive (negative) for students with income above (below) the college's mean income. The last term is the cost of the effect of admission on racial diversity, which can again be analogously decomposed, but differs across the races. The cost of admitting a student from the underrepresented race (nonwhite) is negative since $\Gamma_i^{nw} < 1$, while positive for the overrepresented race.

The economic implication of (23) is that college i spends more on educational inputs than the Samuelsonian level, as the latter would equate the collective marginal willingness to pay in the college (equal here to $\frac{\partial T}{\partial I}$ since students pay their reservation prices) to the marginal cost (k_i). Colleges value educational inputs both for their revenue generating effect and for the direct effect on quality. In equilibrium, colleges will be differentiated and have some market power, allowing them to depart from student optimality (i.e., $\lambda_i < \infty$).[12]

[11] Local second-order conditions are satisfied in equilibrium provided V'' is sufficiently high.
[12] Students would prefer that colleges provide Samuelsonian levels of inputs and lower tuition.

2.3. Equilibrium

To define a market equilibrium, it is necessary to determine the equilibrium alternative utility functions and beliefs about matriculation of each college, and to consider competitive interaction between colleges. We assume that colleges are utility takers and students take college policies and qualities as given. The assumption of utility taking by colleges is a generalization of price taking that has been utilized in the competitive club goods literature.[13] In equilibrium, the alternative utility and thus reservation price functions of each college and their beliefs about student matriculation must be consistent with utility maximization and the actions of the other colleges. We refer to the set of colleges that admit a student in equilibrium along with the outside option as the effective choice set of a student and denote it $\tilde{J}(r, b, y)$. More formally,

$$\tilde{J}(r, b, y) = \{i \mid \alpha_i(r, b, y) = 1\} \cup \{0\}. \tag{24}$$

Knowing the colleges in the effective choice set allows us to characterize alternative utilities and impose the equilibrium restriction that alternative utility functions must be consistent with optimal choices. In summary, the economy is defined as follows:

DEFINITION 1: *The economy E of our model consists of an outside option with quality q_0; a college quality function $q(\cdot)$; a set of colleges $\{1, \ldots, J\}$, a vector of endowment incomes $(R_1, \ldots, R_J)$ and a cost function $C(k, I)$; a discrete distribution of racial types, a conditional continuous distribution F^r of household types (b, y) for each race r, and a utility function $U(y - p, q, b)$.*

A competitive (utility-taking) equilibrium for this economy can then be defined as follows:

DEFINITION 2: *A competitive equilibrium for this economy E consists of a set of admission and pricing functions, $\alpha_i(r, b, y)$ and $p_i(r, b, y)$, an alternative utility function $U_i^A(r, b, y)$ for each college, a vector of college characteristics $(k_i, \theta_i, \mu_i^y, I_i, D_i)$ for each college; a set of matriculation functions $\alpha_i^m(r, b, y)$; and an allocation of students into the J colleges and no college such that:*

1. *Every student (r, b, y) is allocated to a preferred option in his or her effective choice set.*
2. *Each college chooses its size, peer quality, diversity measures, expenditures, as well as admission and tuition policies to maximize quality, taking as given its endowment, alternative utility function, and beliefs about matriculation.*

[13]This assumption has substantial precedence in the club good literature with nonanonymous crowding. See the discussion in Scotchmer (1994).

3. *Beliefs about alternative utilities and matriculation are consistent with optimal choices. Letting* $p_0 = 0$, *for each household type* (r, b, y) *and each college* i:

$$U_i^A(r, b, y) = \max_{j \neq i,\, j \in \tilde{J}(r,b,y)} U(b, y - p_j, q_j) \tag{25}$$

Thus the maximum alternative utility is the maximum over the outside option and the next best college alternative taking qualities, tuitions, and admission policies as given.

4. *Each student attends at most one college; that is, markets for the J colleges clear:*

$$\sum_{i=1}^{J} \alpha_i(r, b, y)\alpha_i^m(r, b, y) \leq 1 \tag{26}$$

where types for whom the inequality is strict are attending no college.

Equilibria exist for sufficiently different college endowments and can be computed numerically as discussed in detail in Epple et al. (2006).[14] We show there that beliefs must be as specified in (11).[15]

3. Properties of Equilibrium

3.1. Equilibrium with Affirmative Action

Next we summarize the properties that equilibria must have if affirmative action policies are feasible; that is, if colleges can condition admission and aid policies on race as assumed in the previous section.

PROPOSITION 1: *An equilibrium of this model has the following properties:*

1. *There is a strict educational quality hierarchy:* $q_J > q_{J-1} > \cdots > q_1 > q_0$.

[14]While we do not have a uniqueness proof, we consistently find equilibrium to be unique in our computations. The intuition for uniqueness is the following lines: The hierarchy among colleges is exogenously determined by the endowments. That rules out the most obvious source for multiplicity. Given the ranking of the schools, the size of school is largely determined by the shape of the cost function as long as the market is fairly competitive. The composition of each school reflects preferences for diversity and peer ability.

[15]The upper and lower lines of (11) must obviously be satisfied for college beliefs to be consistent with optimal student choices. More subtle are the middle lines of (11), which specify the character of tie breaking that is necessary for existence of equilibrium. Colleges will charge students that they strictly prefer will attend their reservation prices. These students need to attend or the college would reduce tuition; but no such tuition exists. This is why beliefs (and student behavior) must satisfy the second line of (11). The third line of (11) permits colleges to offer admission to students for whom the college is indifferent to attendance at the margin at the students' at EMC. This allows determination of alternative utilities. As noted, this is a matter of tie breaking. The beliefs and corresponding student behavior are consistent with college and student optimization.

2. *There are nonoverlapping attendance sets for a given race, i.e., given r, the set of* (b, y) *types that attend college i and college* $j \neq i$ *(or no college if* $j = 0$*) is of measure* 0.
3. *We refer to a locus in the* (b, y) *plane that partitions attendance sets as a "boundary locus." Tuition policies satisfy*
   a. *Along a boundary locus of college i,* $p_i(r, b, y) = EMC_i(r, b, y)$.
   b. *In the interior of college i's attendance set (i.e., off boundary loci),* $p_i(r, b, y) > EMC_i(r, b, y)$.
   c. *Equilibrium student choices are the same as would result if* $p_i(r, b, y) = EMC_i(r, b, y)$, $i = 1, 2, \ldots, n$, *for all* (r, b, y), *all else constant. That is, if student* (r, b, y) *chooses option i in equilibrium, then*

$$U(y - EMC_i, q_i, b) \geq \max\left[\max_{j=1,\ldots,J; j\neq i}\{U(y - EMC_j, q_j, b), U(y, b, q_0)\}\right] \quad (27)$$

   with strict inequality in the interior of attendance sets.
   d. *Alternative utility to college i is given by:*

$$U_i^A(r, b, y) = \max\left[\max_{j\neq i, j\in\tilde{J}(r,b,y)}\{U(b, y - EMC_j, q_j), U(b, y, q_0)\}\right]. \quad (28)$$

The proof of Proposition 1 is similar to the one reported in Epple et al. (2006) and is therefore omitted.[16] A central property of equilibrium is that the tuition any college student pays is such that their utility is the same as if they select among the free outside option and other colleges with tuition equal to effective marginal cost. This follows from Proposition 1.3 (d), (8), and that equilibrium tuition equals reservation price. While college students pay their reservation price at the college they attend, it is constrained by competitively priced alternatives.

We now characterize the effects of affirmative action afforded to members of the underrepresented race who attend college in equilibrium. We assume that the (b, y) distributions differ across races so that no attention to race would cause underrepresentation of the minority in all colleges.[17] We have the following result:

PROPOSITION 2: *Given minority underrepresentation-in all colleges, affirmative action implies the following equilibrium properties:*

a. *Higher Utility. Members of the underrepresented race who attend college have higher utility than those from the other race with the same* (b, y), *with the*

[16]Below we provide a numerical example which illustrates these properties.
[17]This arises for realistically specified distributions as we show below.

exception of those from the under-represented race with no college as their best alternative (who have the same utility as their counterparts from the other race).

b. *Lower Tuition. Members of the under-represented race with the same* (b, y) *and in the same college as members of the other race pay lower tuition, with the exception of those from the under-represented race who have no-college option as their best alternative (who pay the same tuition as their counterparts from the other race).*

c. *Higher College Quality. If the shadow value of racial diversity rises along the college quality hierarchy, i.e., if* $q_{\Gamma_i^{nw}}/q_{I_i}$ *increases with i, then, for given* (b, y), *the quality of education is at least as high for the under-represented race.*

A proof of this proposition is given in the Appendix.

Minority students whose best alternative is another college have higher utility than their majority counterparts because both have access to other colleges at EMC, but minority students have lower EMCs. It is the desirability of minorities to promote diversity combined with competition for them that underlies Proposition 2a. The reason members of the under-represented race who attend college and have no college as their best alternative are not better off than their counterparts from the other race is that colleges price away surplus and utilities are the same across the races in the no-college alternative. Lower tuition to minorities in the same college is again explained by their having higher utility alternatives (with the analogous exception). A minority might, however, attend a different college than his majority counterpart. Proposition 2c provides a sufficient condition such that gains to the under-represented race entail weakly higher quality education. While the condition is not necessary for this result in general, absent it a nonwhite might choose to attend a lower-quality college than a counterpart white, obtaining utility gains due to a sizable tuition break. It is important to keep in mind that the relatively more favorable outcomes for nonwhites we find in equilibrium depend on the "lower" distribution of (b, y) associated with nonwhites. In our model, if $f^w(b, y) = f^{nw}(b, y)$, then outcomes are race neutral. While some nonwhites with the same (b, y) as whites are better off due to affirmative action for realistic parameter values, nonwhite presence in colleges will be proportionally lower than for whites, so we do not mean to imply nonwhites are better off as a group.

3.2. Proscription of Affirmative Action

We model the proscription of affirmative action practices by colleges as requiring that college policies are race blind. Even the Supreme Court decision that upheld the limited use of race in Michigan's law school admissions suggested a time limit on such practices so a ban is not unlikely.[18] A college's

[18]The majority opinion in *Grutter vs. Bollinger et al.* (2003) stated, "Finally, race-conscious admission policies must be limited in time."

admission and tuition policies are then restricted to be functions of (b, y) only. Colleges will factor the informational content of (b, y) about race into their decision calculus in an effort to promote racial diversity.

We take the position in our analysis that, under a ban on affirmative action, a college could not legally employ correlates with race in admissions that are otherwise educationally irrelevant. Colleges might, for example, use student addresses in admissions to largely circumvent a ban on affirmative action. But such practices would clearly be a pretext, well established in U.S. law to be actionable. Hence, we permit only use of student variables in admissions that are otherwise educationally relevant, that is, (b, y) in our model.[19]

Since the races are treated the same, the reservation price function is also race blind: $v_i = v(b, y; q_i)$. College i now solves

$$\max_{\theta_i, I_i, \mu_i, k_i, \Gamma_i^{nw}, \alpha_i(b,y)} q\left(\theta_i, I_i, \mu_y/\mu_i, \Gamma_i^{nw}/\Gamma^{nw}\right) \tag{29}$$

subject to a feasibility constraint

$$\alpha_i(b, y) \in [0, 1] \forall (b, y), \tag{30}$$

a budget constraint

$$\int_S v(b, y, q) \alpha_i(b, y)\ \alpha_i^m(b, y) f(b, y)\, db\, dy + R_i \geq C(k_i, I_i), \tag{31}$$

and the following identity constraints

$$k_i = \int_S \alpha_i(b, y) \alpha_i^m(b, y) f(b, y)\, db\, dy \tag{32}$$

$$\theta_i = \frac{1}{k_i} \int_S b \alpha_i(b, y) \alpha_i^m(b, y) f(b, y)\, db\, dy \tag{33}$$

$$\mu_i = \frac{1}{k_i} \int_S y \alpha_i(b, y)\ \alpha_i^m(b, y) f(b, y)\, db\, dy \tag{34}$$

$$\Gamma_i^{nw} = \frac{1}{k_i} \int_S \alpha_i(b, y) \alpha_i^m(b, y) \Gamma^{nw} f^{nw}(b, y)\, db\, dy. \tag{35}$$

The next proposition characterizes colleges' responses to the prohibition of affirmative action:

[19] Manipulating the use of (b, y) in admissions due to racial diversity motives might, as well, be deemed illegal. But this would be more difficult to prove. An interesting legal-economic issue concerns the bound on what would be feasible in admissions under a ban. As noted, we model the case where only nonrace characteristics that are educationally relevant could be used, but without further constraint.

PROPOSITION 3: *When affirmative action is prohibited, colleges will try to achieve the diversity objective by exploiting the fact that income and ability are correlated with race. As a consequence, admissions and aid decisions will reflect the fact that ability and income provide signals of race.*

Proof: Solving the college's race-blind optimization problem, the admission policy satisfies

$$\alpha_i(b, y) \begin{pmatrix} = 1 \\ \in [0, 1] \\ = 0 \end{pmatrix} \quad \text{as} \quad v(b, y, q_i) \begin{pmatrix} > \\ = \\ < \end{pmatrix} EMC_i(b, y), \tag{36}$$

where

$$EMC_i(b, y) = V' + I_i + \frac{q_\theta}{q_I}(\theta_i - b) + \frac{q_{\mu_i}}{q_I}(\mu_i - y) + \frac{q_{\Gamma_i^{nw}}}{q_I}\left(\Gamma_i^{nw} - \frac{\Gamma^{nw} f^{nw}(b, y)}{f(b, y)}\right). \tag{37}$$

The race-blind EMC is analogous to equations (21) and (22), except for the last term. With and without affirmative action, the last term in EMC measures the cost of admitting a student type on racial diversity, but now using (b, y) as a signal of race. Multiplying the term in parentheses at the end of (37) by $1/k_i$, one has the expected change in the diversity measure Γ_i^{nw} from increasing $\alpha_i(b, y)\alpha_i^m(b, y) f(b, y)$, which is then multiplied by the dollar cost of maintaining quality $(k_i \frac{q_{\Gamma_i^{nw}}}{q_I})$. Admitting types (b, y) with proportion of nonwhites in the population of potential students exceeding the college's proportion of nonwhites $(\Gamma^{nw} f^{nw}/f > \Gamma_i^{nw})$ improves racial diversity, with then negative diversity cost. The diversity cost is positive (or zero) for the remaining set of student types. ■

4. Quantifying the Effects of Banning Affirmative Action

To provide evidence regarding the quantitative effects of a ban on affirmative action, we employ a computational counterpart to the theoretical model above. In calibrating the model, we seek to characterize the distributions of income and "abilities" by race for the U.S. population. In doing so, we employ data from the U.S. Census, data purchased from Petersons that is a survey of the universe of colleges and universities, data from the NSF WebCASPAR system, and data on a sample of college students from the National Postsecondary Student Aid Survey of the National Center for Education Statistics (NCES).

We focus in this paper on the entire market for higher education. We define the relevant market as consisting of all public and private four year colleges and universities. We also include an outside option, which allows study of the effects of affirmative action on participation decisions. While affirmative action is most common in the most selective colleges and universities, it is large in scale. It is therefore plausible to assume that affirmative action affects colleges and universities that do not directly pursue these policies because of general equilibrium effects. To capture these general equilibrium effects, one needs to model all relevant alternatives.[20]

The computational model has five "colleges" in addition to the noncollege option. Data for nonwhites are obtained by combining data for African American and Hispanic students and households. We set the proportion of nonwhite potential students to 0.20, using 2000 Census data on household proportions. The income distribution of each race is taken to be log-normal. The parameters of the income distribution for each race are chosen to match mean and median incomes in the U.S. population. This yields $\ln(y) \sim N(9.92, 0.764)$ and $\ln(y) \sim N(9.85, 0.746)$ for whites and nonwhites respectively.

We use scores on SAT (and adjusted ACT) to proxy for student ability, which is obviously problematic and controversial.[21] The race-conditioned distributions of ability are for the populations of potential students. The distributions thus characterize the ability of college attendees as well as predicted scores of those who do not attend college. The parameters of the distributions of ability in the model are chosen so that the means and variances of $\ln(b)$ conditional on college attendance in computed equilibrium equal the means and variances of total SAT (in thousands) for white and nonwhite colleges attendees in the NCES data. This yields $\ln(b) \sim N(0.924, 0.190)$ and $\ln(b) \sim N(0.735, 0.20)$ for whites and nonwhites respectively. The correlation of $\ln(y)$ and $\ln(b)$ for each race is set equal to the correlation for the population of students in the NCES data, yielding a correlation of 0.25.

College endowments per student are chosen to correspond to those in the NSF WebCASPAR data. Colleges are ranked by SAT score and combined into five groups with an equal number of students in each group. To compute endowment per student we assume that a draw of 2% per year from endowment is allocated to undergraduate education. This yields endowment income per student of \$155, \$243, \$386, \$755, and \$4149 for the five colleges.

The combined utility and quality function is chosen to be Cobb Douglas:

$$U = (y - p)qb^{\phi_1} \tag{38}$$

with

[20]Epple et al. (2006) only consider private universities.

[21]Ability is, of course, to be understood as college preparedness. No single measure of college preparedness is likely to be a good one, but we examine SAT score to maintain simplicity and because it is widely used in admissions. In a working paper version of this paper, we have extended the basic analysis to allow SAT score to be mitigated as a signal of academic potential by hardships students face while growing up. Here minority status can potentially serve as a signal of hardship, providing colleges with another incentive to encourage minority attendance.

$$q = I^{\phi_2}\theta^{\phi_3}(D^y)^{\phi_4}(D^R)^{\phi_5}. \quad (39)$$

For the analysis presented here, ϕ_1 "drops out" in all computations and need not be calibrated. The parameters we need to calibrate are thus the exponents on inputs, mean ability, income diversity, and racial diversity. We choose these parameters and the quality of the outside option so that the computed equilibrium proportion with affirmative action of college attendance of the two races combined corresponds to that observed in four-year colleges in the United States (estimated to be 28.2%) and equilibrium average cost per student approximately equals average instructional expenditures reported in the NSF WebCASPAR data.

The parameters of the utility–quality function are also chosen so that equilibrium shadow prices on income, score, and race correspond roughly to magnitudes we obtained from Tobit. regressions of financial aid on those variables using the NCES data.[22] The exponents on inputs, mean score, income diversity, and racial diversity in the quality function are 0.0705, 0.0825, 0.02, and 0.0029, respectively.

The custodial cost function $F + V(k)$ is a cubic polynomial. Parameters are chosen to generate colleges that are roughly equal in size and to yield average custodial costs that are approximately one fourth as large as instructional expenditures per student. The complete cost function is: $33.43 + 200k + 2{,}043\,k^2 + 925{,}000(k - k^*)^3 + Ik$. The efficient scale in the chosen function is $k^* = 0.069$.

The top panel of Table 1 summarizes the equilibrium when affirmative action is permitted. Nonwhites are underrepresented in each college. Note that the shadow prices (sp) on racial diversity ascend in the equilibrium. From Proposition 2c it then follows that the quality of education for nonwhites is at least as high as for whites for given (b, y). This in turn is illustrated by a comparison of the boundary loci for whites and nonwhites. The boundary loci are overlaid in Figure 1 to facilitate comparison of the admission spaces. For each race, those types above the most northeasterly boundary locus attend the highest-quality college. The "diagonal slices" as one moves towards the origin delineate the student bodies of progressively lower-ranked colleges, and the largest set below the bottom boundary locus do not attend college. The upper boundary loci for nonwhites relative to whites illustrate the improved access by same (b, y) nonwhites to quality colleges as a result of affirmative action. A comparison of average SAT scores and average incomes across colleges in the upper panel of Table 1 provides further illustration.[23]

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[22]Those estimates were an approximate \$1,100 increase in financial aid per standard deviation of SAT, \$30 dollar reduction in aid per \$1,000 increase in family income, and financial aid to nonwhites relative to whites of \$1,500 (Epple et al. 2003).

[23]Income stratification for any ability results in this specification if quality multiplied by one plus the shadow value of income increases along the college quality hierarchy. This condition is satisfied here.

Table 1: Equilibrium Outcomes with and without Affirmative Action

		Average SAT					Average Incomes						Average
College	**k**	**White**	**Nonwhite**	**Total**	**sp SAT**	**Inputs**	**White**	**Nonwhite**	**sp Income**	**% Nonwhite**	**sp Race**	**Quality**	**Tuitions**
							Affirmative action permitted						
0	71.4%									21.7%		1.320	
1	6.4%	977	810	943	$892	$3,825	$33,333	$29,223	−0.033	14.2%	$1,108	1.565	$4,833
2	6.2%	995	829	962	$941	$4,107	$39,559	$33,666	−0.030	14.4%	$1,175	1.570	$5,028
3	6.0%	1019	855	986	$1,020	$4,562	$48,569	$40,117	−0.027	14.5%	$1,292	1.579	$5,366
4	5.6%	1061	900	1029	$1,210	$5,644	$64,046	$51,005	−0.026	14.7%	$1,583	1.599	$6,203
5	3.8%	1186	1052	1159	$2,087	$11,005	$94,403	$66,740	−0.034	15.5%	$2,915	1.681	$10,090
							Affirmative action prohibited						
0	71.4%									23.6%	$-	1.320	
1	6.4%	974	870	953	$874	$3,771	$32,171	$35,084	−0.033	11.9%	$1,305	1.563	$4,840
2	6.2%	989	859	963	$929	$4,075	$38,041	$41,772	−0.030	11.2%	$1,498	1.569	$5,072
3	6.0%	1010	866	981	$1,020	$4,572	$46,671	$51,324	−0.028	9.9%	$1,901	1.577	$5,471
4	5.6%	1044	895	1014	$1,233	$5,739	$61,934	$68,522	−0.026	7.8%	$3,021	1.598	$6,429
5	3.8%	1161	888	1107	$2,177	$11,372	$92,967	$100,028	−0.035	5.0%	$9,326	1.677	$10,772

Note: sp denotes shadow price.

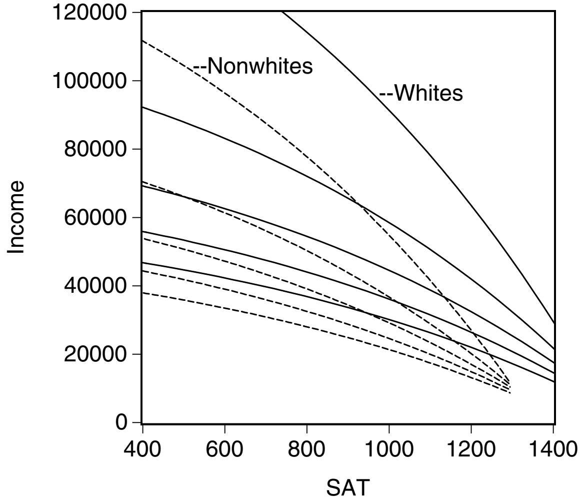

Figure 1: Boundary loci for nonwhites and whites when affirmative action permitted.

Table 1 also reports shadow prices (sp) for SAT score, income, and race, that is, the coefficients on these variables in EMC. By analyzing the variation of tuition with income and ability within colleges for this equilibrium, we have established that these shadow prices correspond closely to actual variation in tuition with student characteristics in colleges 1 through 4 in computed equilibrium. Those colleges thus have little market power, with tuitions closely approximating effective marginal costs. In college 5, the marginal increase in tuition with income is approximately twice as large as the shadow price. The marginal decrease in tuition with score is approximately half the shadow price on score and the discount to nonwhites is approximately half the shadow price on racial diversity. These features of pricing in college 5 reflect the greater market power of the top college as compared to the remaining colleges, as it faces competition only from lower-quality colleges.

The bottom panel of Table 1 reports the equilibrium outcomes when affirmative action is proscribed. This change results in a 35% drop in college attendance by nonwhites. This drop is particularly pronounced in the higher-ranked colleges and is accompanied by a dramatic increase in the shadow price on racial diversity along the quality hierarchy. In the top college, the attendance by nonwhites drops by two thirds, and by about half in the second highest-quality tier. Recall that in our computational model, the top "college" represents the top tier of institutions. In the computed equilibrium the top college is attended by approximately 13.5% of the college student population. The second tier of colleges comprises about 19.5% of the college population. Obviously, impacts on minorities are substantial. The computational analysis supports the conclusion that the effects of proscribing

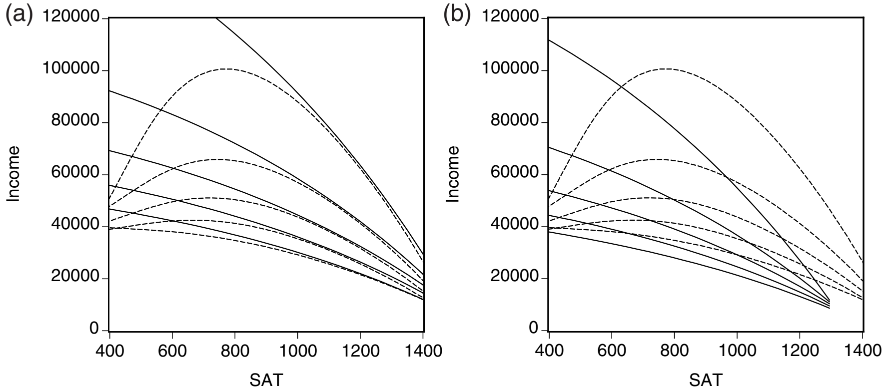

Figure 2: (a) Boundary loci for whites with and without affirmative action. (b) Boundary loci for nonwhites with and without affirmative action.

affirmative action will be substantial and will be increasingly pronounced as one moves up the college quality hierarchy.

Admission spaces with and without affirmative action are shown by race in Figure 2. The solid lines are the boundary loci when affirmative action is permitted, the same as in Figure 1. The dashed lines, common to both races, delineate admission spaces when affirmative action is proscribed. Where the loci are shifted upward by a ban on affirmative action, college access is more restricted and conversely where the loci have shifted downward. A combination of three effects on effective marginal cost of admission of type (b, y) from proscribing affirmative action, discussed below, explains the changes in the admission spaces in Figure 2. Without affirmative action, (b, y) types with higher ratio of nonwhites in the population than in the college have lower EMC and are then relatively preferred by the college.

Figure 3 shows the boundary loci (solid) under the ban, again the same for both races, and introduces contours (dashed) with constant ratios of nonwhites. Admission of relatively higher-income and higher-score types will worsen diversity, and the reverse for relatively lower-income and lower-score types. As seen in Figure 2, colleges modify their admission policies as they accept lower-scoring types with high and moderately high income, students who are relatively likely to be nonwhite, leading to the hump-shaped boundary loci without affirmative action. A second effect is that, relative to when affirmative action is permitted, the signal of race is weakened under the ban, this increasing EMC under affirmative action for nonwhites and decreasing it for whites. This signal weakening corresponds to the loss in power to discount tuition to nonwhites and charge a premium to whites. The third effect is the change in the shadow value of racial diversity, which rises in equilibrium under the ban in all colleges. The three effects approximately offset at high scores for whites, which implies higher EMC for the same (b, y) for nonwhites

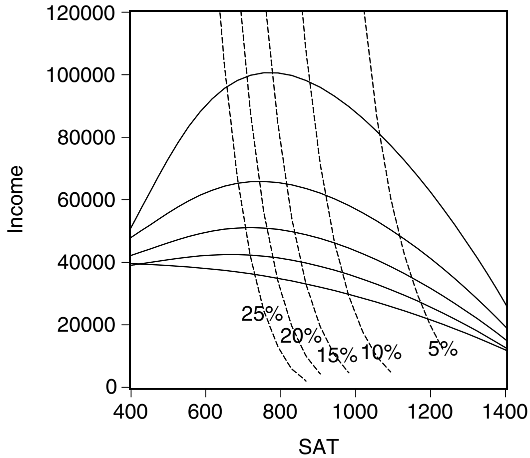

Figure 3: Boundary loci when affirmative action proscribed and contours of constant density of nonwhites relative to whites.

due to the opposite direction of the second effect. For high scores, boundary loci are approximately the same for whites but shift out at high incomes for nonwhites (see Figure 2). For whites, a ban on affirmative action improves college access particularly for those with relatively lower incomes and scores. For nonwhites, the shift is generally toward more restricted access except for those with relatively higher incomes and lower scores.

The upward sloping segment of the boundary loci under the ban raises the issue of incentive compatibility since some students might under-perform on the exam to gain access to a higher quality college. The equilibrium allocation in Table 1 is, however, incentive compatible with respect to claiming a lower b than the actual value. In the equilibrium, we have verified that tuition declines with b in each college for given y. Hence, no student who would stay in the same college with a lower score would claim to have such a b. Neither would a student who would attend a higher quality college with a lower score under-report b. Utility of a student reporting a lower b while staying within any college declines as we have discussed, and utility of a student reporting a b that places him on a boundary locus is the same in each college (as is easily shown). Combining the latter facts implies incentive compatibility.[24]

We are aware of no evidence that supports the "backward bending" property that our model predicts for admission policies under the ban. The equilibrium attendance at better colleges of less qualified candidates with middle range incomes might not be acceptable in practice. Hence, one might extend

[24] As pointed out by one of the referees, the incentive compatibility constraints would need to to be imposed directly in the analysis with a more general model. For example, a model with additional sources of preferences heterogeneity would require this approach.

the analysis by imposing constraints on admission and tuition policies that prevent such an outcome. This is a nontrivial extension in our model because admission and tuition policies must be simultaneously constrained so that equilibrium matriculation rules out the backward bending attendance property.[25] However, we believe that such a constraint would not change very much our computational findings because the mass of students that are affected by the backward bending admission curves is small in our numerical example.

A comparison of the two panels in Table 1 reveals the ban on affirmative action results in an increase in average SAT scores of nonwhites in lower-ranked colleges and a decline in higher-ranked colleges. This is a consequence of the reduced access of nonwhite students to higher-ranked colleges. Note that average SAT among all students declines in the higher ranked colleges. This is, of course, because colleges resort to inefficient means to attract minorities. We also see an increase in average income for nonwhites relative to whites in colleges. To understand this phenomenon, first note that along the downward sloping portion of boundary loci (where most students fall), tuition declines as score rises, hence the minimum income level for attendance also declines with score. This, equal treatment of the races under a ban, and more whites having higher scores induces the change in relative incomes of nonwhites to whites in colleges.

The effects on household welfare are exhibited in Table 2.[26] These are expressed as the within cell mean of the compensating variation from eliminating affirmative action relative to household income, the cells defined by the racially dependent deciles of the (b, y) distribution. The effects on welfare are generally favorable for whites while unfavorable for nonwhites.[27] Given the relative magnitudes of the shifts in boundary loci, it is not surprisingly that the welfare effects for nonwhites are proportionately larger than for whites. The per capita compensating variation (not as a percentage of income) is only −\$8.90, with per capita amounts by race equal to \$33.32 and −\$177.82 for whites and nonwhites respectively. The latter values are misleading because they include potential students who do not attend college in either equilibrium and are unaffected by the ban. Conditioning on the attendance at college initially, the means by race rise to \$111.81 and −\$859.03.[28] Thus, we find that the predicted distributional effects are quite large.

[25]A constraint on just admissions itself, e.g., $\alpha(b, y) \geq \alpha(b', y)$ for $b > b'$, is meaningless without also constraining tuition.

[26]We have also specified an educational attainment function and computed the effects of the ban on educational achievement. These results are not presented here to conserve space and are available upon request from the authors.

[27]The prevalence of zeros in Table 2 is, of course, due to the fact that the majority of students do not enroll in college under either policy regime.

[28]Whites who attend college without affirmative action is 29.8%, and nonwhites attending is 20.7%.

Table 2: Welfare Effects

	Average within Cell of CV/Income Rows are Deciles of Income and Columns are Deciles of Score									
Whites										
0	680	764	824	876	924	973	1024	1085	1168	1600
$7,638	0	0	0	0	0	0	0	0	0	0.01
$10,689	0	0	0	0	0	0	0	0	0	0.01
$13,621	0	0	0	0	0	0	0	0	0	0.01
$16,755	0	0	0	0	0	0	0	0	0	0.02
$20,333	0	0	0	0	0	0	0	0	0	0.05
$24,675	0	0	0	0	0	0	0	0	0.01	0.14
$30,353	0	0	0	0	0	0	0.03	0.13	0.22	0.14
$38,677	0.01	0.08	0.18	0.26	0.31	0.35	0.34	0.26	0.18	0.09
$54,128	0.98	0.77	0.59	0.46	0.36	0.29	0.23	0.17	0.1	0.04
Inf	0.88	0.49	0.35	0.25	0.19	0.14	0.09	0.04	0	−0.04
Nonwhites										
0	479	567	630	684	735	786	840	903	991	1600
$5,591	0	0	0	0	0	0	0	0	0	−0.04
$7,763	0	0	0	0	0	0	0	0	0	−0.05
$9,836	0	0	0	0	0	0	0	0	0	−0.09
$12,040	0	0	0	0	0	0	0	0	0	−0.16
$14,545	0	0	0	0	0	0	0	0	0	−0.34
$17,571	0	0	0	0	0	0	0	0	0	−0.67
$21,508	0	0	0	0	0	0	0	0	0	−1.55
$27,251	0	0	0	0	0	0	0	−0.09	−0.74	−3.43
$37,837	0	−0.08	−0.24	−0.47	−0.77	−1.13	−1.61	−2.28	−2.98	−3.79
Inf	−0.25	−0.93	−1.27	−1.5	−1.7	−1.87	−2.02	−2.18	−2.39	−2.76

5. Concluding Remarks

Independently of what one thinks about the desirability of racial diversity and affirmative action, our analysis indicates that a ban of affirmative action and the resulting adoption of race-blind admission policies will likely have a substantial impact on the racial composition of colleges, the educational achievement of minority students, and the distribution of gains resulting from higher education in the population. The racial composition of the most selective colleges in the United States is predicted to decline drastically and minority presence in all colleges is predicted to drop substantially.

We view the model developed in this paper and our main results as promising for future research. An interesting extension of our model allows for additional sources of unobserved heterogeneity. Our specification does not contain additively separable idiosyncratic errors in the utility function as typically assumed in random utility models. If we were to add these error terms to our specification of the utility function, the resulting model would more closely correspond to a model developed by Anderson and de Palma (1988).

One can also explore different specifications of student preferences for diversity. For example, it is distinctly possible that some students do not care about diversity, especially if diversity does not directly affect their achievement. We have explored this to some extent in Epple et al. (2002) but have not examined the consequences of a ban on affirmative action.

Alternatively one could explore a richer characterization of student ability along the lines suggested by Sarpca (2006). Treating ability as multidimensional would be especially interesting for the analysis of a ban of affirmative action since it offers more scope for colleges to pursue their diversity objectives. Another avenue for further research would examine affirmative action and a ban on it when colleges are constrained to charge the same tuition. This might arise when state or national policies set tuition and the private market plays a more limited role. Disallowing price discrimination would likely reduce minority presence when race can be used in admissions because minorities have lower incomes. Under a ban on affirmative action, colleges would still use income and score as a signal of race. Our intuition is that disallowing price discrimination would also undermine to some extent the use of such signals as substitutes for race because tuition discounting provides more scope to attract students. Finally, one could consider a version of our model in which not all universities are proscribed from using affirmative action. For example, a ban on affirmative action may only be imposed on schools receiving state funding.

Appendix

Proof of Proposition 2:

(a) For convenience, define effective marginal cost for the outside option to be identically zero: $EMC_0(r, b, y) = 0$. We show first that, if a student (r, b, y) attends college i in equilibrium, then $p_i = v_i$ satisfies:

$$U(y - p_i(\cdot), q_i, b) = \max_{j=0,1,2,\ldots,J; j\neq i} U(y - EMC_j(\cdot), q_j, b) \quad \text{(A1)}$$

Since $\alpha_i \alpha_i^m > 0$ in equilibrium, (11), (20), and market clearance implies $p_j(\cdot) \leq EMC_j(\cdot)$ for all $j \neq i$. If $p_i(\cdot)$ exceeds the value satisfying (A1), then $v_j > EMC_j(\cdot)$ for some college $j \neq i$, a contradiction (or the no college option is preferred to i, also a contradiction). If $p_i(\cdot)$ is below the value satisfying (A1), then, since $p_j(\cdot) \leq EMC_j(\cdot)$ for all $j \neq i$, $p_i(\cdot) < v_i$, a contradiction to quality maximization by college i. This establishes (A1). The result then follows since $EMC_j(nw, b, y) < EMC_j(w, b, y)$ for all $j \neq 0$ and $EMC_0(nw, b, y) = EMC_0(w, b, y)$.

(b) This follows as well from the proof of part a of this proposition.

(c) Suppose the alternative, which by Proposition 1 implies:

$$U(y - EMC_i(r, b, y), q_i, b) \\ \geq (\leq) U(y - EMC_j(r, b, y), q_j, b) \quad \text{for } r = w(nw), \tag{A2}$$

for some (b, y) and colleges i and j having $q_i > q_j$. To simplify notation here, let $z_i \equiv (q_{\Gamma_i^{nw}}/q_I)_i$ denote the shadow value of racial diversity. Given the first inequality in (A2),

$$U(y - EMC_i(w, b, y) + z_j, q_i, b) \\ > U(y - EMC_j(w, b, y) + z_j, q_j, b) \\ = U(y - EMC_j(nw, b, y), q_j, b), \tag{A3}$$

the inequality in (A3) by normality of demand for quality (see (2)) and the equality by definition (see (21) and (22)). By supposition, $z_i - z_j > 0$, this with (A3) implying:

$$U(y - EMC_i(w, b, y) + z_i, q_i, b) > U(y - EMC_j(nw, b, y), q_j, b). \tag{A4}$$

Since the left-hand side of (A4) equals $U(y - EMC_i(nw, b, y), q_i, b)$ (again by (21) and (22)), we have a contradiction of the second inequality in (A2), implying the result. ■

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