Extended Abstract: *Quotas versus Handicaps: A Game Theoretic Analysis of Affirmative Action Policies in India*

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We analyze the affirmative action policy implemented in India, the Quota Policy, in which preference is given to the disadvantaged section of the populace by reserving a certain fraction of positions for them. We compare it to a hypothetical policy called the "Handicap Policy" in which the performance index of the disadvantaged is given an artificial boost instead, by means of an additive handicap.

We conclude that on many important metrics of performance of affirmative action policies, Quotas and Handicaps can be shown to be equivalent to each other.

Literature

Brent R. Hickman [2010], is a working paper that asks the same question in the context of American college admissions. He analyzes the problem as a game of incomplete information and models it as an all pay auction with heterogenously distributed costs of bidding.

Our approach, however, is different from that in Brent R. Hickman [2010]. In Brent R. Hickman [2010] there is an absence of scarcity in that every player is guaranteed admission in *some* college. In our problem, the set of those who manage to "win" is *not more than* 5%.

Another critical difference is in the definition of the Quota game. Brent R. Hickman [2010] defines the quota game as one in which the disadvantaged get positions *only* from the set reserved for them, while the quota policy, as practised in India, allocates *at least* as many positions to the disadvantaged as the quota decrees. For all the other unreserved positions, there is an open contest between the disdvantaged and the advantaged.

The Model

We describe a simplified setup in which there is a continuum of players uniformly distributed in $[0, 1]$. There is a competitive examination that is administered in which the players obtain certain final scores. Based on these scores, there are some "winners" — those whose scores are in some top percentile of the

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population's scores. These top rankers, or winners, are then awarded highly desirable jobs.

The setup is as follows:

- *Players*: Are denoted by $z \in [0,1]$, where z is understood to stand for "test taking skills".

- *Jobs*: A measure J of jobs are available. These are highly valued by all players and are very scarce. We assume, throughout the paper, that J is of the order of not more than 5%.

- *Actions*: Each player has a binary action set: $e(z) \in \{0,1\}$, $z \in [0,1]$ where the action '0' stands for shirking, or putting in no effort while '1' stands for studying hard and exerting full effort.

- *Disutility*: All players $z \in [0,1]$ experience disutility 0 when shirking and a constant $\delta > 0$ when exerting full effort.

- *Valuation of Jobs*: The jobs are very highly valued by all players $z \in [0,1]$ at a constant $v > 0$.

- *Score Functions*: Each player receives a final score on the competitive test which is dependent on whether she shirked or worked. If she shirked, her score is governed by a random variable $s(z,0)$ while in case of working, the score is given by $s(z,1)$. We assume that the score functions' structure is as follows:
$$s(z,0) \sim \mathbb{U}[f(z), f(z)+\eta]$$
$$s(z,1) \sim \mathbb{U}[g(z), g(z)+\eta]$$
where $\mathbb{U}(\cdot)$ is the uniform distribution, η is an exogenous positive constant and $f(\cdot)$ and $g(\cdot)$ are increasing functions of z.

  Assumptions On the Score Functions:

  1. $\forall\ z \in [0,1]$, $g(z) > f(z) + \eta$: For all players, there are significant returns to studying hard.
  2. $f(\cdot)$ and $g(\cdot)$ are strictly increasing in z: Higher test taking skills translate to higher scores achieved, all other things being equal.

- *Payoffs*: The payoffs of the players are:
$$u_z(0, e(-z)) = v \Pr(z \in W)$$
$$u_z(1, e(-z)) = v \Pr(z \in W) - \delta$$
where $e(-z)$, in the spirit of the notation s_{-i}, stands for the action profile of all players but $\{i\}$ and W denotes the set of winners of the measure J of jobs.

- *Nash Equilibrium*: The Nash Equilibrium is a threshold equilibrium in which the effort profile is of the following kind:
$$e(z) = \begin{cases} 0 & \forall z \in [0, z_*) \\ 1 & \forall z \in [z_*, 1] \end{cases}$$

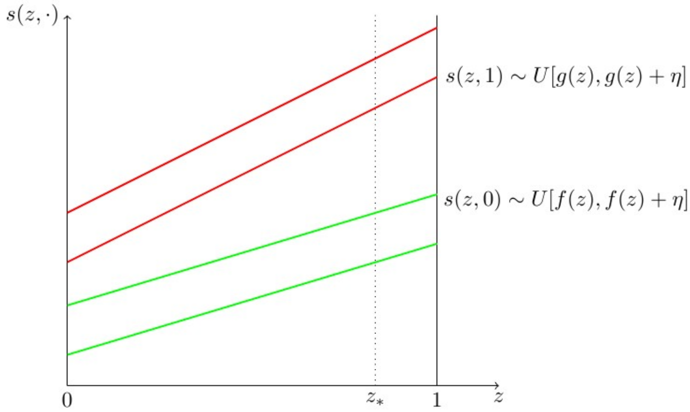

Figure 1: The horizontal axis describes the set of players. The vertical axis describes their scores. The critical player z_* characterizing the equilibrium is also shown.

In equilibrium, no player works unless her test taking skills are sufficiently high. The exact value of this threshold is determined by equilirium. All those who shirk in equilibrium end up with a payoff of exactly 0 while those who work have an ex ante expected payoff of at least 0.

Under this Nash Equilibrium, the set of winners W, is the set of players $z \in [0,1]$ who manage to get a score beyond a certain cutoff value $\underline{s}$. That is,

$$W = \{z \in [0,1] : s(z,1) \geq \underline{s}\}$$
$$\Rightarrow \Pr(z \in W) = \Pr(s(z,1) \geq \underline{s})$$

The level of the cutoff value $\underline{s}$ is determined by equilibrium.

Under certain conditions on the parameters of the model, the equilibrium is unique.

Quotas or Handicaps?

We modify this setup in order to make it able to handle two classes of players: α and β. The βs come from the disadvantaged part of the population. In the modified setup, which is extremely similar to the stylized game we described, we are able to describe players' Nash Equilibrium strategies and find that for many desirable criteria used to rate different affirmative action policies, Quota and Handicap are equivalent.

References

Brent R. Hickman. Effort, Race Gaps, And Affirmative Action: A Game Theoretic Analysis Of College Admissions. Working Paper, 2010.