How Costly is Diversity? Affirmative Action in Light of Gender Differences in Competitiveness

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Abstract

Affirmative action is often criticized for causing reverse discrimination and lowering the qualifications of those selected under the policy. However the magnitude of such adverse effects depends on whether the best suited candidate is hired absent the policy. Indeed an attraction of affirmative action is that it can compensate for the distortion discrimination imposes on the selection of candidates. This paper examines whether affirmative action may have a similar corrective effect when some of the best qualified individuals fail to apply for the job. Specifically, we evaluate the effect of introducing a gender quota in an environment where high performing women fail to enter competitions they can win. Guaranteeing women equal representation among winners increases entry by high performing women. This response is greater than predicted by the change in the probability of winning and is in part attributed to women being more willing to compete against women than men. The boost in supply implies that in contrast to expectations we do not observe severe reverse discrimination nor do we observe a substantial decrease in the quality of those winning the tournament.

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I. INTRODUCTION

Affirmative action has been hotly debated since its introduction following the passage of the landmark Civil Rights Act of 1964. These debates have more recently resulted in some states banning the policy. The main arguments against affirmative action are that it may result in reverse discrimination and lower the qualifications of those selected under the policy. While it is not surprising that diversity can come at a cost, it is important to recognize that the magnitude of such costs depends on whether the best suited individuals are hired prior to the policy. If the best qualified candidates fail to apply or fail to be selected then the costs of the policy may be less transparent. Indeed an argument for affirmative action is that it may reduce the distortion that discrimination has on the selection of candidates.\(^1\) This paper examines whether affirmative action may have a similar corrective effect when the decision to apply for a position is not payoff-maximizing.

We examine an environment where “minority” candidates fail to apply for positions they are qualified for and ask whether affirmative action may encourage them to apply. To isolate the effect on the application decision we ignore distortions that may occur from potential biases by those who select candidates. Thus we are interested in an environment where absent affirmative action the most qualified applicant is selected. This and other abstractions imply that our study is not intended to measure the actual costs of such a policy. Rather the objective is to demonstrate that the effect of affirmative action on the application decision by qualified “minorities” may mitigate the expected costs of the policy.

To study the decision to apply for a job or a promotion, we conduct a controlled laboratory experiment where participants must decide whether to enter a competition. Recent research documents that individuals fail to make payoff-maximizing decisions in this environment and that these decisions vary by gender.\(^2\) For example Niederle and Vesterlund

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\(^1\) For a survey on the literature see Holzer and Neumark (2000). Biases in hiring can occur even when there are no fundamental differences between two groups, see e.g. Coate and Loury (1993) and Mailath, Samuelson and Shaked (2000).

\(^2\) A gender gap in the willingness to compete has been documented by Balafoutas and Sutter (2010), Cason, Masters and Sheremeta (2009), Dargnies (2009), Gneezy and Rustichini (2005), Gupta, Poulsen and Villeval (2005), Herreiner and Pannell (2009), Niederle and Vesterlund (2007), Prize (2008a), Sutter and Rützler (2009) and Wozniak (2009). Gneezy, Leonard and List (2009) replicate the finding in a patriarchal African society, but not in a matrilineal Indian one. Prize (2008b) examines men and women who are equally confident and find that there is no gender difference in competitive entry. Related is the Babcock and Laschever (2003) result that women are more reluctant to negotiate. The finding by Gneezy, Niederle and Rustichini (2003) that women, while able to compete, fail to do so in competition against men is also consistent with women avoiding competition.
(2007), henceforth NV, examines an environment where participants perform in a non-competitive piece rate and in a competitive tournament. While there are no gender differences in performance they find substantial differences in the choice of compensation scheme for a subsequent task: the majority of men select the tournament and the majority of women select the piece rate. Specifically, high performing women compete too little, and few women succeed in and win the tournament. Thus despite there being no gender differences in performance, when agents can decide whether to enter tournaments, the decision to compete causes women to be in the minority among the set of winners. This gender difference in the willingness to compete may help explain why men are disproportionately allocated to professional and managerial occupations.

It is particularly costly for the firm if high performing women fail to select into competitions, as reluctance to apply prevents the firm from hiring the best available candidate. The president of University of Illinois, B. Joseph White, explains, “Getting more women into MBA programs means better access to the total talent pool for business”. Another concern for the lower entry by women is that diversity in and of itself may benefit the firm (Page, 2007). Certainly there is evidence that corporate America is concerned by the underrepresentation of women as they are increasingly developing programs to improve the number of highly skilled women employees.

The question is whether a policy such as affirmative action can encourage more high-performing women to enter competitions. Specifically, may affirmative action influence the factors that caused women to avoid the competition in the first place? The study by NV found that the gender gap in tournament entry was explained by men being more overconfident than women and by women being more averse to performing in a mixed-sex competition. An affirmative action quota may influence both of these factors. Consider for example a quota

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1 For example Bertrand and Hallock (2001) find that women only account for 2.5 percent of the five highest paid executives in a large sample of US firms. Women are also underrepresented among people who have the training frequently required for senior management. Only 30 percent of students at top tier business schools are women, and, relative to their male counterparts, female MBA’s are more likely to work in the non-profit sector, work part time, or drop out of the work force (E.g., Hewlett and Luce, 2005, and Blau and Kahn, 2004). While the competitive pressure of upper management may cause women to opt out factors such as discrimination, preference differences for child rearing, and ability differences also play a role see e.g. Altonji and Blank (1999), Black and Strahan (2001), and Goldin and Rouse (2000).


3 Affirmative action programs in the US have historically been of two forms: preferential treatment and quota. Quotas have recently been used throughout Europe to improve the representation of women in both the corporate
system which requires that out of two winners of a tournament at least one must be a woman. This quota will not only change the probability of winning, but also introduce a more gender-specific competition, which in turn may influence the two factors identified above.

We study an environment similar to that of NV to assess the effect of affirmative action when high performing women fail to enter the competition. Our focus is on determining whether affirmative action changes the decision to compete and the gender composition of the pool of competitors. Accounting for changes in entry we ask how costly it is to secure that women be equally represented among those who win competitions. In particular, how much lower will the performance requirement be for women than for men? How many better performing men will have to be passed by to hire a woman? And to what extent will reverse discrimination arise?

We find that the introduction of affirmative action results in substantial changes in tournament entry. While the entry of women increases, that of men decreases, and the response exceeds that predicted by changes in the probability of winning. The substantial changes in tournament-entry induced by affirmative action, in particular the significant increase in entry of high performing women, have important implications when assessing the sacrifice in performance required to secure a more diverse group of winners. Ignoring the change in entry, it is anticipated that equal representation of women will result in a substantial decrease in the performance requirements for women and that many better performing men will be passed by. However the change in tournament entry increases the number of women and, in particular, increases the number of high performing women in the applicant pool. This decreases the cost of securing equal representation and causes the minimum performance requirement under affirmative action to be the same for women and men. These results suggest that when high performing women shy away from competition and do not enter when it is payoff maximizing to do so, then a policy such as affirmative action may have a larger than expected effect on applications and this response may significantly reduce, if not eliminate, the anticipated cost of achieving a more diverse set of winners.

We attribute the excessive response to affirmative action to three factors. Two relate to affirmative action making the competition more gender specific. First, participants hold different

and political arena, see Fréchette, Maniquet and Morelli (2008) and Jones (2004). For a debate on quotas, see also Fryer and Loury (2005). A recent study by Balafoutas and Sutter (2010) replicates our quota results and extend them to a setting with preferential treatment. Preferential treatment is also examined by Calsamiglia, Franke and Rey-Biel (2010) in the context of advantaged and disadvantaged students.
beliefs on their relative performance within versus across gender, and second, participants seem to change their attitudes towards competition when competing against groups where the opposite gender is more poorly represented. Finally, mentioning affirmative action increases women’s willingness to compete.

In the next section we discuss how affirmative action may alter tournament-entry decisions. We then describe our experimental design and explain how it helps us investigate the potential effects of affirmative action. We introduce our analysis by first showing that we replicate previous findings. Specifically, many high performing women fail to enter the tournament. This suggests that a requirement of equal representation may have a significant impact in our environment. We proceed by determining the effect of affirmative action on entry and examine how changes in tournament entry mitigate the anticipated costs of affirmative action. Finally, we conclude by examining the extent to which the more gender-specific competition can account for these changes.

II. POTENTIAL EFFECT OF AA ON GENDER GAP IN TOURNAMENT ENTRY

The central question of this paper is whether affirmative action may entice more high performing women to compete and thereby reduce the anticipated costs of the policy. The hope is that such a policy may influence the factors that initially caused women to opt out of the competition. We therefore introduce affirmative action through a quota whereby at least one of two winners must be a woman. Such a quota has the potential to influence the suboptimal entry decisions by high performing women as it makes the competition more gender specific. Both confidence and attitudes towards competition, as discussed below, may change when individuals are competing in groups where their own gender is better represented. There are however other reasons why behavior may change under a quota system. We discuss all of these below and explain how our experiment is designed to account for them.

Factor 1. Change in the probability of winning: The direct effect of a quota is that it distorts the objective probability of winning the tournament in favor of women and against men. To the extent that participants respond to changes in incentives, tournament entry is expected to increase for women and decrease for men. To account for this effect we will condition the analysis on the probability of winning.
Factor 2. Within-gender beliefs: A consequence of an affirmative action quota is that the tournament-entry decision does not only depend on the individual’s perception of rank within the whole group, but also on the perception of rank within their gender. Specifically, in our design a woman should enter either if she thinks she is the best performing woman or among the top two performers overall. In contrast a man should enter if he thinks he is both the best performing man and among the top two performers overall. If participants hold different beliefs on relative performance in single versus mixed gender groups then this may cause the gender gap in tournament entry to change under a quota. We elicit the participant’s beliefs on relative performance to determine if they differ within- versus across gender, and to determine how they affect tournament entry.

Factor 3. Mentioning affirmative action: Another reason why participants may respond differently to the affirmative-action tournament is that the mere mention of affirmative action may discourage men and encourage women to select the competitive compensation. To control for this possibility we compare the compensation choices under the standard and the affirmative action rule when these choices do not require a future competitive performance.

Factor 4. Competing against own gender: A final factor that may influence the decision to enter and actively compete in an affirmative-action tournament is that the competition becomes more gender specific. For women the competition is no longer simply a competition against all other members of the group, but more directly a competition against the other women in the group. If women do not generally shy away from competitions, but rather shy away from competing in mixed-gender groups, then a quota may change their behavior. Changes may also be seen for men as under a quota it is no longer sufficient to be among the top two performers overall, rather a man also needs to be the best performing man. Having controlled for Factors 1 through 3, we

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6A response to the existence of affirmative action may not be restricted to the lab. It is possible that women (and men) respond to workplaces just having affirmative action policy in a similar manner to their reaction to mentioning affirmative action in the lab (i.e., women will be overly eager to apply).

7Sensitivity to gender composition is documented by Gneezy et al. (2003) and emphasized by advocates of single-sex schooling. It may be that girls do not dislike competition per se, but rather that they dislike competing against boys, i.e., girls in all-girl schools may be more competitive (e.g., Harwarth, Maline and DeBra, 1997, Booth and Nolen, 2009).
will ascribe any unexplained response to affirmative action as evidence that Factor 4 influences behavior.

III. EXPERIMENTAL DESIGN

The experiment was conducted at the Harvard Business School, using students from the CLER subject pool. Groups of 6 participants, three women and three men, participated in each session. The gender composition of the group was made clear to participants as they were seated in the laboratory, and they were shown who the other 5 members of their group were. Fourteen groups participated in the experiment for a total of 42 men and 42 women.\(^8\)

Participants were asked to perform a real effort task under varying compensation schemes. The task was to add up sets of five 2-digit numbers. Participants were not allowed to use a calculator, but could use scratch paper. The numbers were randomly drawn and each problem was presented in the following way:

\[
\begin{array}{cccccc}
21 & 35 & 48 & 29 & 83
\end{array}
\]

For each problem participants were asked to fill in the sum in the blank box. Once the participant submitted an answer on the computer, a new problem appeared jointly with information on whether the former answer was correct.\(^9\) A record of the number of correct and incorrect answers was kept on the screen. Participants had 5 minutes to solve as many problems as they could. A stop watch was shown at the front of the room via a projector and a buzzer would go off at the end of the 5 minutes. The participant’s final score was determined by the number of correctly solved problems.

Participants were told that they had to complete six tasks of which one was randomly chosen for payment at the end of the experiment. By paying only for one task, we diminish the chance that decisions in a given task may be used to hedge against outcomes in other tasks. In addition to their payment for performance each participant also received a $10 show-up fee, and an additional $5 for completing the experiment. Participants were informed of the nature of a task only immediately before performing the task. While participants knew their absolute

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\(^8\) In one session (two groups) the stop watch malfunctioned for the fourth task. This session is excluded from our analysis. The behavior and performance prior to the fourth task resemble those of the other sessions.

\(^9\) For instructions see http://www.pitt.edu/~vester/AAInstructions.pdf. The program was written using the software zTree (Fischbacher 2007).
performance on a task, i.e., how many problems they solved correctly, they were not informed of their relative performance until the end of the experiment. The specific compensations and order of tasks were as follows.  

**Task 1 – Piece Rate:** Participants are given the 5-minute addition task and receive 50 cents per correct answer.

**Task 2 – Tournament:** Participants are given the 5-minute addition task. The two participants among the three women and three men who provide the largest number of correct answers in the group each receive $1.50 per correct answer. The other participants receive no payment.

In the third task participants also perform the five-minute addition task, but this time they select which of the two compensation schemes they want to apply to their future performance, piece rate or tournament. We refer to the tournament as a standard (ST) tournament. A participant with a given performance has higher expected earnings in the tournament when the probability of winning exceeds 33 percent. There are two reasons for presenting participants with the compensations prior to their choice, first it provides them with experience of both, and second it provides us with performance measures which enable us to determine whether men and women of equal performance make similar compensation choices.

**Task 3 – Choice:** Before performing the 5-minute addition task, participants select whether they want to be paid according to a piece rate, i.e., 50 cents per correct answer, or a tournament. A participant who selects the tournament wins the tournament and receives $1.50 per correct answer if the participant’s task-3 performance exceeds that of at least 4 of the other group members in task 2, otherwise the participant receives no payment.

Winners of the task-3 tournament are determined by comparing their task-3 performance to the task-2 performance of the other group members, rather than others’ task-3 performance. Thus, participants compete against the past performances of others. This has several advantages;

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10 In the event of ties in a competitive task the winner was chosen randomly among the high scorers.
11 By paying the tournament winner per correct problem we avoid the issue of choosing a high enough fixed prize to ensure that high-performing participants benefit from tournament entry.
first, participants are competing against competitive performances of others; second, the
tournament-entry decision only depends on beliefs about one's relative performance and not on
the expected tournament-entry decisions of others;\textsuperscript{12} and third, a participant’s choice does not
impose any externalities on others.\textsuperscript{13} Effectively the task-3 decision is an individual-decision
problem.

Next we examine entry into an affirmative-action tournament. We refer to this as an AA
tournament. In the AA tournament at least one of the winners will be a woman. To avoid any
effect due to simply mentioning gender, we mentioned the group’s gender composition at the
beginning of the experiment.

\textbf{Task 4 – Affirmative-Action Choice:} Before performing the 5-minute addition task,
participants select whether they want to be paid according to a piece rate, i.e., 50 cents per
correct answer, or an AA tournament. A participant who selects the AA tournament receives
$1.50 per correct answer when winning the tournament, and $0 otherwise. The two winners are
the highest performing woman and the highest performer of the remaining 5 participants. That is,
a woman wins the AA tournament if her task-4 performance \textit{either} exceeds the task-2
performance of the two other women in the group or exceeds that of at least four other group
members. A man wins the AA tournament if his task-4 performance \textit{both} exceeds the task-2
performance of the two other men in the group and exceeds that of at least four other group
members.

There are several reasons why men and women may differ in their willingness to enter a
competition; there may be gender differences in preferences for performing in a competitive
environment, beliefs on relative performance, risk aversion, and in the reluctance to be in an
environment where one receives feedback on relative performance.\textsuperscript{14} What distinguishes gender

\textsuperscript{12} This secures that the gender composition and size of the competitive group is held constant across participants.
\textsuperscript{13} Our design allows for the possibility that participants who enter the tournament all lose or all win. The absence of
externalities rules out that women may avoid competition to not decrease the chance that others win. For a
discussion of gender differences in altruism see e.g., Andreoni and Vesterlund (2001), Eckel and Grossman
(forthcoming), Croson and Gneezy (2009).
\textsuperscript{14} There are a number of reasons why women may enter competitions less. Both nurture and nature may cause men to be
more competitive (e.g., Daly and Wilson, 1983, Campbell, 2002, Ruble, Martin, and Berenbaum, 2006, Gneezy,
Leonard and List, 2009, Sutter and Rüetlzer, 2010). If women anticipate a psychic cost from competing and men
anticipate a psychic benefit then fewer women will compete. The same prediction results from the finding that men
are more overconfident than women (e.g., Lichtenstein, Fischhoff and Phillips, 1982, Beyer, 1990, Beyer and
differences in preferences for competing from the other differences, is that the former relies critically on the entry decision resulting in a subsequent competitive performance. The other explanations are more general, and should be present in other decisions as well. To jointly control for the role played by these three general factors we present participants with two additional decisions which mimic the entry decisions in tasks 3 and 4, without involving an actual competitive performance. Specifically we first ask participants to choose between a competitive and a non-competitive compensation scheme for their past non-competitive task-1 piece-rate performance, thus a choice of tournament does not require participants to subsequently perform in a competition. As the potential thrill, anxiety or fear of performing in a competition is absent from this choice, this decision only incorporates the effect of overconfidence, risk and feedback aversion. Participants are reminded of their task-1 piece-rate performance prior to their choice of compensation scheme.

**Task 5 – Submit Piece Rate to a Tournament:** Participants do not have to perform in this task. They choose which compensation scheme they want to apply to their past task-1 piece-rate performance: a 50-cent piece rate per correct answer or a tournament. A participant who enters the tournament receives $1.50 per correct answer if the participant’s piece-rate performance is among the two highest in the group of three women and men, otherwise no payment is received.

Finally, for the participants’ last task they make a similar decision in an AA tournament, that is, they decide whether they want to submit their piece-rate performance to an AA tournament. This decision serves as a control for general factors in the affirmative-action decision including the possibility that mentioning affirmative action results in an excessive response in behavior.

**Task 6 – Submit Piece Rate to AA Tournament:** Participants do not have to perform in this task. They choose which compensation scheme they want to apply to their past task-1 piece-rate performance: a 50-cent piece rate per correct answer or an AA tournament. A participant who selects the tournament receives $1.50 per correct answer when winning the tournament, and $0

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Bowden, 1997, and Niederle and Vesterlund, 2007). Similarly the finding that women are more averse to risk (e.g., Eckel and Grossman, forthcoming, Croson and Gneezy, 2009, Byrnes, Miller and Shafer, 1999) and respond more to negative feedback (e.g., Roberts and Nolen-Hoeksema, 1989, Dweck 2000) suggest less willingness to compete.
otherwise. The two winners are the highest performing woman and the highest performer of the remaining 5 participants.

Just like for tasks 3 and 4 a participant’s decision does not affect the earnings of any other participant, nor does it depend on the entry decisions of others. Hence tasks 5 and 6 are also individual-decision tasks.

Finally, at the end of the experiment participants were asked to guess their rank in the task-1 piece rate and task-2 tournament both within the whole gender balanced group of 6 participants and within their own gender. Each participant picked a rank between 1 and 6 and between 1 and 3, respectively, and was paid $1 for each correct guess. This allows us to determine if beliefs on relative performance differ in single versus mixed gender groups, and whether such differences affect tournament entry.

An attraction of the five-minute addition task is that performance does not appear to respond to the incentives we consider. The focus of our analysis is therefore on the decisions to enter a competition. We can use task 1, 2, 3 and 5 and across gender beliefs to determine whether in our sample high performing women fail to compete and why this may be the case. By comparing choices in task 3 and 4, we can examine the effect of affirmative action on the gender gap in tournament entry. Of particular interest is the extent to which changes are caused by the affirmative-action competition being more gender specific (Factor 4), or if it is accounted for by factors that are not associated with active competition. Such non-competitive factors involve changes in the probability of winning (Factor 1), the fact that under affirmative action the probability of winning depends both on across-gender beliefs and on within-gender beliefs (Factor 2), and that the mere mention of affirmative action may exaggerate the response to affirmative action (Factor 3). Performance in task 1 and 2 will help us control for changes in the probability of winning (i.e., Factor 1), within-gender beliefs serve as a test of Factor 2, and we can use choices in tasks 5 and 6 as controls for both Factor 3 and for risk and feedback aversion.

In the event of ties in actual rank we counted every answer that could be correct as correct. For example, if the performance in the group was 10, 10, 11, 12, 13, 13 then an answer of sixth and fifth was correct for a score of 10, and an answer of first and second was correct for a score of 13.

With respect to these four tasks, our study differs from NV in the following ways. First, participants in this experiment were informed that groups were gender balanced. Second, we examine groups of 6 individuals with 2 winners, rather than groups of four with one winner. Third, our return from winning is $1.5 per problem, rather than $2. Fourth, we use students from the Harvard Business School CLER lab subject pool, rather than the PEEL subject pool at the University of Pittsburgh. Finally, show-up and completion fees vary between the two studies.
IV. TOURNAMENT ENTRY WITH AND WITHOUT AFFIRMATIVE ACTION

We start by characterizing the tournament-entry decisions prior to the introduction of affirmative action. To assess the potential for affirmative action we determine if high performing women fail to compete. We then examine the effect of affirmative action on tournament entry.

IV.A. Entry into the Standard Tournament

The average number of correctly solved problems in the piece rate is 10.3 for women and 12.9 for men, and in the tournament it is 12.3 for women and 14.8 for men. Two-sided Mann-Whitney tests show that both of these gender differences are significant ($p = 0.03$ and $p = 0.06$, respectively).\(^\text{17}\) The NV results suggest that the increase in performance from the piece rate to the tournament is due to learning rather than to changes in incentives. To assess the probability of winning the tournament we randomly create six-person groups from the observed performance distributions and determine the 2 winners. Table I shows the probability of winning conditional on performance.\(^\text{18}\)

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<th>Task-2 Performance</th>
<th>Probability of Winning</th>
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<tbody>
<tr>
<td>8</td>
<td>Women 0.0, Men 0.0</td>
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<tr>
<td>9</td>
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<td>10</td>
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Having experienced the 50-cent piece rate and the $1.50 tournament, participants are asked which of the two they want to apply to their task-3 performance. As seen in Table I, the probability of winning is higher than one third for both male and female participants who solve 14 or more problems, thus this group has higher expected earnings in the tournament. If their performance in task 3 is exactly as in task 2, this corresponds to 28.6 percent of women and 50 percent of men benefitting from the tournament. The actual gender gap in tournament entry is even greater: 31 percent of women and 73.8 percent of men select the tournament. This gender

\(^{17}\) Note that NV does not find a gender gap in performance; it is not surprising that this result may vary by population. Our analyses throughout control for performance.

\(^{18}\) For any given performance level, say 15 for a woman, we draw 1,000,000 groups consisting of 3 men and 2 women, using the performance distribution of the 42 men and 42 women with replacement. We then calculate the woman’s frequency of wins in this set of simulated groups.
gap is significant \((p < 0.01)\) and greater than expected \((p = 0.04)\).\(^{19}\) While men enter significantly more than predicted \((p = 0.042)\), women do not \((p = 1.0)\). The gender gap in tournament entry is greatest among those who have higher expected earnings in the tournament than in the piece rate; among these, 100 percent of the men but only 33.3 percent of the women enter the tournament. Thus the entry by high performing women is suboptimal in terms of maximizing earnings.

We now examine whether it is possible to entice women, especially high performing women, to compete when we introduce an affirmative action requirement that at least one of two winners must be a woman.

**IV.B. Entry into the Affirmative Action Tournament**

The introduction of an affirmative action quota increases the probability of winning the tournament for women while decreasing it for men. The probabilities of winning the AA tournament conditional on gender and performance are reported in Table II. Participants with a 33 percent or higher chance of winning have higher expected earnings from the AA tournament than the piece rate. This corresponds to women with a performance of 13 or more and men with a performance of 15 or more.\(^{20}\) Affirmative action therefore decreases the performance at which it becomes profitable to enter the tournament by one correct problem for women while increasing it by one correct problem for men.

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<tbody>
<tr>
<td>Women</td>
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<td>10.5</td>
<td>25.3</td>
<td>46.9</td>
<td>64.6</td>
<td>77.3</td>
<td>85.7</td>
<td>91.1</td>
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<td>Men</td>
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<td>50.6</td>
<td>58.6</td>
<td>66.8</td>
<td>--</td>
<td>75.3</td>
<td>79.6</td>
<td>84.0</td>
<td>88.5</td>
<td>93.0</td>
<td>97.6</td>
</tr>
</tbody>
</table>

The payoff maximizing entries in the AA tournament correspond to 40.5 percent of women and 38.1 percent of men if the participant’s task-4 performance is the same as in task 2. In sharp contrast, we observe 83.3 percent of women and 45.2 percent of men entering. While the entry by women is greater than predicted, that by men is not \((p < 0.01)\) and \(p = 0.66\),

\(^{19}\) Unless otherwise noted the reported test statistics henceforth refer to a two-sided Fisher’s exact test.

\(^{20}\) Using the task-2 performance, five more women and five fewer men have higher expected earnings from entering the AA tournament compared to the standard tournament.
respectively). The resulting gender gap in entry into the AA tournament is significant \((p < 0.01)\) and differs from that predicted \((p < 0.01)\).\(^{21}\)

To assess the effect of affirmative action, Figure I panel A shows the proportion of men who enter the standard (ST) and AA tournament (AA) conditional on their probability of winning each tournament. Panel B shows the corresponding figure for women. Both figures use performance prior to the entry decision (i.e., task 2) to determine the probability of winning. The figures are similar if we instead use ex-post performance (i.e., task 3 and 4). If changes in tournament entry were solely driven by changes in the probability of winning, then the proportion of entrants should coincide for the standard and AA tournaments.

\[\text{Figure I: Proportion of Participants Entering the Standard (ST) and the AA Tournament (AA) Conditional on the Probability of Winning it Given Their Task-2 Performance.}\] \(^{22}\)

Figure I shows that affirmative action reduces entry by men and increases it for women beyond what is warranted by changes in the probability of winning. The overreaction by women is particularly large. Moreover, all the female participants who stood to gain from entering the

\(^{21}\) We calculate the difference between expected and actual gender gaps in the AA tournament entry decision for 1,000,000 simulations where we draw the 42 women and 42 men with replacement (using thresholds implied by Table II). The reported \(p\)-value is the percentage of strictly positive differences.

\(^{22}\) The bin size was chosen to secure similar numbers of participants in each bin, and such that the earnings are maximized if the top two bins enter the tournament while the others do not. The number of individuals in each bin is as follows: In panel A, in the standard tournament the numbers are 13, 8, 8, and 13. In the AA tournament there are 13, 13, 7, and 9, with 13 in 0-0.05. In panel B, the numbers are 15, 15, 6, and 6, and 11, 14, 9, and 8, respectively.
standard tournament (i.e., participants with a task 2 performance of at least 14) chose to enter the AA tournament as opposed to only a third who entered the standard tournament. This is a significant increase ($p = 0.001$) in female entry rates.$^{23}$

### TABLE III

**PROBIT OF TOURNAMENT CHOICE (TASK-2 PERFORMANCE)**

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th>Women</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>-0.37</td>
<td>(0.00)</td>
<td></td>
</tr>
<tr>
<td>Female*AA</td>
<td>0.26</td>
<td>(0.00)</td>
<td></td>
</tr>
<tr>
<td>AA</td>
<td>-0.29 (0.01)</td>
<td>0.51 (0.00)</td>
<td>-0.27 (0.01)</td>
</tr>
<tr>
<td>Tournament</td>
<td>0.90 (0.00)</td>
<td>0.28 (0.28)</td>
<td>0.64 (0.00)</td>
</tr>
<tr>
<td>Tournament-piece rate</td>
<td>-0.35 (0.22)</td>
<td>0.30 (0.25)</td>
<td>-0.09 (0.61)</td>
</tr>
<tr>
<td>Observations</td>
<td>84</td>
<td>84</td>
<td>168</td>
</tr>
</tbody>
</table>

The table presents marginal effects evaluated at an individual (a man in the last column) in the standard tournament, with a probability of winning the tournament (Tournament) of 0.33 and a change in the probability of winning (Tournament-piece rate) of 0.16. We cluster on the participant to account for there being 2 observations for each of the 84 participants. $p$-values of the underlying coefficients are in parenthesis.

In Table III we present probit regressions of the decision to enter a tournament on the probability of winning as well as an affirmative-action dummy. For each individual we use both the decision to enter the standard tournament, and the decision to enter the AA tournament. We condition the entry decision on the probability associated with winning the tournament in question (Tournament) and on the change in the probability of winning when using tournament rather than piece rate performance (Tournament-piece rate). We cluster on the participant to account for the lack of independence between the two individual observations. If entry decisions depend solely on the probability of winning the tournament, then the marginal coefficient on the affirmative action dummy (AA) should be zero. Consistent with Figure I we see that the effect of affirmative action on entry is negative for men and positive for women.$^{24}$ As seen by the significant female and affirmative-action interaction term in the pooled regression, changes in the probability of winning do not fully account for the change in the gender gap induced by affirmative action.

$^{23}$ Among female participants who gain from entering the AA tournament, i.e. those with a performance of 13 or higher, 88.2 percent entered the tournament. This is a significant increase in the entry rates of women compared to the case when there was no affirmative action ($p = 0.01$).

$^{24}$ The result is the same if we condition on the probability of winning after the entry decision, i.e., on tasks 3 and 4.
Introducing affirmative action changes tournament entry. While men in the standard tournament enter more than predicted and more than women, this result is reversed under affirmative action, as women enter more than predicted and more than men. Before investigating why affirmative action is successful in changing the entry decisions of women, we examine how the excessive response in entry influences the pool of tournament entrants and thereby the costs of affirmative action.

V. How Costly is Affirmative Action

The primary concern when introducing affirmative action is how costly it will be to achieve a more diverse set of winners. How much lower will the performance of the winners be and to what extent will there be reverse discrimination when we require equal gender representation among the winners? To assess the costs of affirmative action we view all the participants in the experiment as (potential) candidates and those who enter competitions as applicants for jobs. We then ask how much lower the minimum performance requirement has to be if we want to hire the same number of applicants under the equal representation rule. To evaluate the degree of reverse discrimination we determine how many strictly better performing men will be passed by to secure that women are at least equally represented among those hired. Passing by better performing applicants is not only inequitable, it is also costly for the firm who no longer can hire the best available applicants. Crucial for assessing these two adverse effects is the performance and gender composition of those who decide to enter the competition.

We start by examining how changes in tournament entry under affirmative action affect the performance distributions of entrants. We measure their performance after their compensation choice. Since the performance in task 4 is slightly higher than in task 3, we will throughout this section rely on the task-3 performance to not bias the costs of affirmative action downward.25 Figure II Panel A shows the proportion of participants with a given task-3 performance who choose to enter the standard (ST) or AA tournament (AA).

---

25 To understand the behavior of participants, we focused on task 2, the performance before they made choices. When considering the effect on outcomes, focusing on the performance after the choice seems more natural. However, the results are similar when we use performances in task 2 or 4, or if we use performance in task-3 for entrants in the standard tournament and in task-4 for entrants in the AA tournament. This is due to the fact that performance is largely not affected by the incentive scheme, just as in NV. Given the higher task-4 performance this later comparison would bias the results in favor of affirmative action.
Panel A
Proportion of Participants with a Given Performance Who Enter the Standard (ST) and Affirmative Action (AA) Tournaments using Task-3 Performance.

Panel B
Number of Entrants with a Performance above a Minimum Threshold in the Standard (ST) and Affirmative Action (AA) Tournaments using Task-3 Performance.

FIGURE II: Performance of Entrants

While affirmative action increases entry for those who solve 13 problems or less, the proportion of participants who enter is, while slightly higher, not affected for those with a superior performance.\(^{26}\) This finding is confirmed by Panel B, which shows the number of entrants who have performances at or above a certain level.\(^{27}\) At high performance levels we do not see substantial changes in the number of entrants. In both the standard and the affirmative action tournament we have slightly more than 20 entrants who solved 15 or more problems in the task-3 tournament.

Affirmative action has however a large effect on the gender composition of the pool of entrants. Figure III shows the proportion of women among entrants whose performance is at or above a specified performance level. For example, among entrants with a performance of 15 and higher only 26 percent are women in the standard tournament, in contrast 50 percent of these are women in the AA tournament.

\(^{26}\) A two-sided Mann-Whitney test for the equality of the distribution of entrants in the two treatments yields \(p = 0.26\) (when using tasks 3 and 4 or task 2 performances it yields \(p = 0.88\) and \(p = 0.24\), respectively).

\(^{27}\) Since less than ten percent of participants solve more than 20 problems, we focus the analysis on groups with minimum performances of 20 and lower.
The extent to which affirmative action lowers performance of the winners and results in reverse discrimination can be assessed both ex-ante and ex-post. The ex-ante evaluation considers the expected effect of affirmative action, if it were implemented without women and men adapting their entry behavior. Hence the cost is assessed by employing affirmative action guidelines to the entrant pool of the standard tournament. We will denote the outcome of this analysis by ST w AA. The ex-post assessment instead evaluates realized costs of affirmative action, which occur after affirmative action is announced and individuals have responded to the change in policy. The ex-post effect can be assessed by imposing affirmative action restrictions on participants who decided to enter the affirmative action tournament. We denote the outcome of this exercise by AA w AA.

We first evaluate the effect affirmative action is expected to have on the qualifications of those selected under the policy when changes in entry are not taken into account. Figure IV Panel A shows based on ex-ante entry, for each minimum performance requirement, how many participants can be hired with and without affirmative action. Figure II Panel B showed that there are 23 applicants (entrants) to the standard tournament who solve 15 problems or more. Figure III documents that only 26 percent of them are female. Taken together, these figures imply that if we maintain the performance requirement and require equal representation then only 12 instead of 23 applicants can be hired. The number of applicants that a firm can expect to hire under affirmative action (given its current applicant pool) is shown by the ST w AA line in Figure IV.
Panel A. This figure also shows that ex-ante firms who want to hire the same number of participants (23) after introducing affirmative action would have to lower the minimum performance requirement from 15 to 10. Thus the expected effect of affirmative action on qualifications is substantial when we ignore that women and men can respond to the policy by changing their entry decisions. The assessment of performance costs is however quite different when we account for the suboptimal initial entry and the greater than expected response to the policy. Figure IV Panel B shows that when affirmative action is announced 22 participants with performance 15 and above enter the affirmative action tournament (AA). As half of these entrants are women (see Figure III) it will not be necessary to lower the performance requirement to secure that women are equally represented among those hired. Thus under an AA requirement we can hire 22 participants with a minimum performance of 15 (AA w AA). The number of candidates that a firm can actually hire under affirmative action (given the changed applicant pool) is shown by the AA w AA line in Figure IV Panel B. Thus the naively calculated expected performance costs greatly exaggerate the actual realized cost of the policy.

Next we examine the extent to which the policy gives rise to reverse discrimination. Figure V shows the number of strictly higher performing men that are passed by when hiring a
woman at a particular performance level, while satisfying the affirmative action requirement. Once again we assess the costs both ex-ante and ex-post. The expected ex-ante costs do not take into account the changes in entry that may result from the policy (ST w AA), while this response is accounted for in the ex-post assessment (AA w AA). Entry into the standard tournament predicts substantial reverse discrimination. For example recall that under the equal representation requirement we can only hire 12 of the 23 entrants who entered the standard tournament and solved 15 and more problems. As shown by the ST w AA line in Figure V this implies passing by 6 men who have a performance in excess of the required performance minimum of 15 for women. The introduction of affirmative action, however, causes women to be better represented among the set of entrants, and instead an equally representative pool of 22 people with a minimum performance of 15 can be hired. Thus ex-post there is no reverse discrimination at this performance level. As demonstrated by Figure V, accounting for the changes in tournament entry the experienced degree of reverse discrimination is substantially smaller than anticipated.

![Figure V: Cost of Affirmative Action Number of Better Performing Men Passed by to Secure Equal Representation of Women Given the Entrants to the Standard Tournament (ST w AA) and the Entrants to the AA Tournament (AA w AA).](image)

The substantial difference between ex-ante and ex-post costs of affirmative action implies that it may be very expensive, in terms of performance loss and reverse discrimination, to apply an affirmative action rule ‘secretly’ or to introduce affirmative action after the participants have
decided to enter a standard tournament. Furthermore, perceived inequity and performance costs may be vastly overestimated, if we fail to take into account that the pool of entrants changes along with a well-announced introduction of affirmative action. Since many more women, and in particular many high-performing women, select to enter the AA tournament the gender composition of tournament entrants is very different under affirmative action. These changes in entry mitigate the cost of the policy. Thus our results demonstrate that when the initial entry is suboptimal and high performing candidates fail to apply then it need not be that costly to secure a more diverse set of winners through affirmative action.

VI. THE EFFECT OF AFFIRMATIVE ACTION ON TOURNAMENT ENTRY

In this section we study why the observed response to affirmative action is greater than predicted. We first determine what factors caused women in our sample to shy away from competition in the first place. We then examine the extent to which affirmative action influenced these factors.

VI.A. Gender Differences in Tournament Entry

To examine the gender gap in entry into the standard tournament we ask what role was played by gender differences in beliefs and attitudes towards competition. We start by determining whether men are more overconfident and whether this explains the gender gap. As men outperform women we compare beliefs conditional on the participant’s optimal guessed rank. This is the guessed rank that, conditional on gender and performance, would maximize earnings.\textsuperscript{28} Figure VI panel A shows participants’ guessed rank conditional on the optimal guessed rank. A perfectly calibrated participant would lie on the 45-degree line. Overconfidence is seen by guessed ranks below the 45-degree line. While men are significantly overconfident, women are not, and the gender difference is significant.\textsuperscript{29} An ordered probit regression of the guessed tournament rank yields coefficients of 0.39 on the optimal guessed rank ($p < 0.01$) and 0.66 on a female dummy ($p = 0.01$).

\textsuperscript{28} For a given performance level, say 15 for a woman, we draw 1,000,000 groups consisting of 3 men and 2 women, sampling with replacement from the performance distribution of the 42 men and 42 women. We then determine the woman’s rank in each of these groups and the optimal guessed rank is the mode of these ranks.

\textsuperscript{29} For men, testing if the distribution of guessed ranks is independent of that of optimal guessed ranks yields $p = 0.04$. For women, the comparisons of guessed ranks to optimal guessed ranks yields $p = 0.37$. 
A method for summarizing beliefs which will prove helpful in our affirmative-action analysis is to determine whether the participant’s guessed rank is consistent with the belief that he or she will win the tournament, we refer to this measure as GuessWin. The results on beliefs are qualitatively the same when we use this binary belief measure.\(^{30}\) To examine the effect of beliefs on tournament-entry decisions we first regress the compensation choice on the probability of winning the task-2 tournament (Tournament) and on the change in the probability of winning a task-2 tournament between using the individual’s task-2 performance and their task-1 performance (Tournament-piece rate).\(^{31}\) Conditional on performance we find a significant gender gap of 36 percentage points.\(^{32}\) As seen in Column 2, this gap reduces to 25 percentage points.

\(^{30}\) In the AA tournament, GuessWin is a gender neutral summary of beliefs while guessed rank is not. A probit regression of the guess of winning the tournament yields marginal coefficients of -0.3 on female (\(p = 0.01\)), and 0.45 on optimal GuessWin (\(p < 0.01\)), evaluated at a man whose optimal guess is winning. Testing if the distribution of GuessWin is independent of the optimal GuessWin yields \(p = 0.07\) for men, and \(p = 0.48\) for women.

\(^{31}\) The change in the probability of winning the tournament when using the task-2 rather than task-1 performance is given by \(p_T(task 2) - p_T(task 1)\), where \(p_T(x)\) denotes the probability of winning the tournament with a performance of \(x\) (note that \(p_T(x)\) may differ by gender). Prior to the affirmative action analysis it is largely inconsequential to condition on the probability of winning rather than actual performance, however this distinction is important when we study the AA tournament where \(p_T(x)\) differs by gender.

\(^{32}\) The marginal effect is evaluated at the point where a participant is indifferent towards entering the tournament, i.e., the probability of winning is 33 percent. This corresponds to having a performance between 13 and 14. For these participants \(p_T(task 2) - p_T(task 1) = 0.16\) on average, thus we assess the marginal effect at this point.
when we control for the participants’ imputed beliefs on winning the tournament. Thus the overconfidence by men helps account for the gender difference in tournament entry.

**TABLE IV**

**PROBIT OF TOURNAMENT-ENTRY DECISION (TASK 3)**

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>-0.36</td>
<td>-0.25</td>
<td>-0.17</td>
</tr>
<tr>
<td></td>
<td>(0.00)</td>
<td>(0.03)</td>
<td>(0.04)</td>
</tr>
<tr>
<td>Tournament</td>
<td>0.79</td>
<td>0.45</td>
<td>0.22</td>
</tr>
<tr>
<td></td>
<td>(0.00)</td>
<td>(0.02)</td>
<td>(0.08)</td>
</tr>
<tr>
<td>Tournament-piece rate</td>
<td>-0.29</td>
<td>-0.31</td>
<td>-0.11</td>
</tr>
<tr>
<td></td>
<td>(0.27)</td>
<td>(0.15)</td>
<td>(0.45)</td>
</tr>
<tr>
<td>GuessWin</td>
<td>0.35</td>
<td>0.25</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.01)</td>
<td></td>
</tr>
<tr>
<td>Submit the Piece Rate</td>
<td></td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.10)</td>
<td></td>
</tr>
</tbody>
</table>

Dependent variable: task-3 compensation choice (1-tournament and 0-piece rate). The table presents marginal effects evaluated at a man with a 33 percent chance of winning the tournament (Tournament), a 0.16 change in probability of winning (Tournament-piece rate), who submitted his piece rate to the tournament (column 3), and thinks (columns 2 and 3) that he wins the tournament (i.e., ranks first or second in his group of six). p-values of the underlying coefficients are in parenthesis.

To determine whether attitudes towards competition help explain the remaining gap we include the task-5 compensation choice where participants choose between a competitive and a non-competitive compensation scheme for their past task-1 piece-rate performance. This decision is similar to the decision to enter a tournament and perform in a competition (task 3). The difference between the two is that only in task 3 do they subsequently have to compete. Thus while beliefs on relative performance, risk and feedback aversion can influence the compensation choices in both task 3 and 5, only in task 3 can differences in preferences for performing in a competition play a role.

As seen in Table IV the gender gap is further reduced to 17 percentage points when controlling for the decision to submit the piece rate (Column 3). This decrease may in part be explained by the submit-to-piece-rate decision serving as an additional measure of the individual’s degree of confidence. The reduction in the GuessWin coefficient in Column 3 is consistent with this interpretation. Despite controlling for the effect that gender differences in beliefs, risk and feedback aversion may have on tournament entry, a substantial gender gap in
tournament entry remains. We attribute this gap to women being more averse to choices that require a future performance in a competitive environment.

Although our design differs from that of NV the relevant findings are qualitatively and quantitatively similar.\textsuperscript{33} High performing women fail to enter the competition, and the substantial gender gap in tournament entry is explained by gender differences in beliefs and attitudes towards competition.

\textbf{VI.B. The Effect of Affirmative Action on Tournament Entry}

The affirmative action requirement was that at least one of two winners must be a woman. We focused on this institution because it not only changes the probability of winning, but also results in a more gender-specific competition. This may influence the two factors that reduced entry for women: the gender gap in beliefs and attitudes towards competition. In addition to these changes the mere mention of affirmative action may also influence behavior.

\textit{The Effect of Beliefs}

Can the excessive changes in entry be explained by the gender gap in beliefs on relative performance being smaller in the AA tournament? We first analyze beliefs on relative performance within-gender in the task-2 tournament. For women and men we calculate the optimal guess, i.e. the money-maximizing guess given individual performance. Neither women nor men seem overconfident. The distributions of guessed ranks within gender are not significantly different from optimal guessed ranks ($p = 0.21$ for women, and $p = 0.45$ for men, respectively). Ordered probit regressions show that the guessed ranks in single-sex groups are correlated with optimal guesses, and women are as confident in their relative performance among women, as men are among men.\textsuperscript{34} Figure VI shows for each optimal guessed rank the average guessed rank of women and men. While Panel A showed the guessed ranks among all 6 participants Panel B shows guessed ranks within one’s gender. Although men are significantly

\textsuperscript{33} To conform to the procedures of the present study we reran the regression in NV including all participants and controlling for the probability of winning and participants’ GuessWin. The NV gender gap in tournament entry is 38 percentage points controlling only for performance. Controlling also for beliefs on winning this gap reduces to 26 percentage points, finally adding the decision to submit the piece rate reduces the gap to 14 percentage points.

\textsuperscript{34} An ordered probit regression of guessed rank on optimal guessed rank in single-sex groups yields coefficients of 0.99 ($p < 0.01$) for men, and 0.46 ($p = 0.04$) for women. Pooling all 42 women and 42 men yields coefficients of -0.04 on a female dummy ($p = 0.87$), and 0.70 on optimal guessed rank ($p < 0.01$).
more confident than women when assessing relative ability in a mixed-sex group, there is no
gender difference in beliefs in single-sex groups.

To evaluate the impact of beliefs on the AA-entry decision we construct participants’
beliefs on whether they would have won the task-2 tournament under AA rules (GuessAAWin).
Recall that a woman wins the AA tournament if she is either the best performing woman or
among the two best performing participants in the group. A man, on the other hand, wins the AA
tournament if he is both the best performing man and among the top two performers overall. As
expected we find that relative to the standard tournament fewer men and more women think that
they will win the AA tournament. However the responses of men seem excessive.\textsuperscript{35} We compare
GuessAAWin to the belief of winning that is consistent with the participant’s optimal guessed
rank (optimal GuessAAWin). Similar to our guessed-rank results in single-sex groups,
conditioning on the optimal guess, neither women nor men are overconfident and there is no
gender difference in GuessAAWin.\textsuperscript{36} This result contrasts that of the standard tournament where
conditional on the optimal GuessWin, men are significantly more likely to believe that they will
win.

To determine the impact of beliefs on changes in tournament entry induced by
affirmative action we condition on the relevant guess-win measures, see Table V. For easy
comparison the first column in each category reports the results of Table III. Controlling for
performance the first four columns show that individuals who have beliefs consistent with
winning are more likely to enter the tournament, however in a two-sided test this effect is only
significant for women. Nonetheless, as seen by the coefficient on the AA dummy, for both men
and women, including beliefs on winning reduces the change in entry induced by AA by about
20 percent.

\textsuperscript{35} In the standard tournament 30 men (70\%) report guesses consistent with winning the tournament, compared to 17
(40.5\%) in the AA tournament. The numbers for women are 15 (35.7\%) in the standard and 20 (47.6\%) in the AA
tournament. The expected change is -3 for men and +4 for women.

\textsuperscript{36} On average the GuessAAWin is not significantly different from the optimal GuessAAWin (p = 1.0 for men and p
= 0.49 for women). A probit regression of GuessAAWin for the 84 participants delivers the following marginal
effects evaluated at a man with an optimal guess of winning: 0.08 on female (p = 0.43); 0.40 on the optimal
GuessAAWin (p < 0.01). Examining men and women separately yields coefficients on the optimalGuessAAWin of
0.53 (p < 0.01) for men, 0.27 (p = 0.12) for women.
The table presents marginal effects evaluated at an individual (a man in the last two columns), in the standard tournament, with a 0.33 percent probability of winning the tournament (Tournament) and a change in the probability of winning (Tournament-piece rate) of 0.16, with a guess of winning (in columns 2, 4, and 6). We cluster on the participant to account for there being 2 observations for each of the 84 participants. p-values of the underlying coefficients are in parenthesis. Note that GuessWin refers to the relevant tournament (ST or AA).

GuessWin is significant in the pooled regression and reduces the change in the gender gap induced by affirmative action. An explanation is that the gender gap in beliefs is substantially smaller in the AA tournament. The change in beliefs results from women being more likely to win the AA tournament, and from men being substantially more overconfident in mixed- than single-sex competitions. However note that controlling for beliefs the coefficient on the female and affirmative-action interaction term remain significant, indicating that changes in the gender gap in tournament entry induced by affirmative action are not fully explained.

### Mentioning Affirmative Action and Attitudes towards Competition

Next we examine whether merely mentioning affirmative action influences behavior. We use the decisions to submit the piece rate performance to a standard or an AA tournament to estimate this effect. We then determine the extent to which this accounts for the response to affirmative action, and the extent to which changes in tournament entry can be attributed to changes in attitudes towards competition due to competitions becoming more gender-specific.

37 The coefficient on the female-affirmative action interaction does not capture the change in the gender gap between the standard and AA tournament. The change in the gender gap is given by \([\Pr(AA=1, F=1, AA\cdot F=1;X) - \Pr(AA=1, F=0, AA\cdot F=0;X)] - [\Pr(AA=0, F=1, AA\cdot F=0;X) - \Pr(AA=0, F=0, AA\cdot F=0;X)]\). Conditioning only on the probability of winning the change in the gap equals 0.76. The additional control for beliefs reduces the gap to 0.59.
TABLE VI

<table>
<thead>
<tr>
<th>PROBIT OF SUBMITTING THE PIECE RATE</th>
<th>Men</th>
<th>Women</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>-0.17</td>
<td></td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>(0.11)</td>
<td></td>
<td>(0.17)</td>
</tr>
<tr>
<td>Female*AA</td>
<td>0.10</td>
<td></td>
<td>0.17</td>
</tr>
<tr>
<td></td>
<td>(0.00)</td>
<td></td>
<td>(0.06)</td>
</tr>
<tr>
<td>AA</td>
<td>-0.04</td>
<td>0.28</td>
<td>-0.06</td>
</tr>
<tr>
<td></td>
<td>(0.12)</td>
<td>(0.00)</td>
<td>(0.17)</td>
</tr>
<tr>
<td>Piece rate</td>
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<td>0.35</td>
<td>0.17</td>
</tr>
<tr>
<td></td>
<td>(0.52)</td>
<td>(0.10)</td>
<td>(0.06)</td>
</tr>
<tr>
<td>GuessWinPR</td>
<td>0.83</td>
<td>0.55</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.00)</td>
</tr>
<tr>
<td>Observations</td>
<td>84</td>
<td>84</td>
<td>168</td>
</tr>
</tbody>
</table>

The marginal effects are evaluated at an individual (a man in the last column), in the standard tournament, with a probability of winning (Piece rate) of 0.33, with a guess of winning (GuessWinPR). We cluster on the participant to account for there being 2 observations for each of the 84 participants. p-values are in parenthesis.

We first compare the decisions to submit the piece rate to the standard versus the AA tournament (task 5 vs. 6). Affirmative action may affect the decision to submit the piece rate through changes in the probability of winning, differences in beliefs on relative performance between mixed- versus single-gender groups, and the effect of mentioning affirmative action. The probit regression in table VI shows that controlling both for beliefs and the probability of winning, affirmative action has at best a small effect on men’s decision to submit the piece-rate to a tournament. Women on the other hand are 28 percentage points more likely to submit their piece-rate when we introduce affirmative action. In the pooled analysis, the coefficient on the female and affirmative-action interaction is significant, demonstrating that the gender gap in submitting the piece rate differs significantly between the standard and AA tournament. These findings suggest that while mentioning affirmative action has limited effects on men, it does affect women.

Note that the decisions in tasks 5 and 6 and differences in those decisions are not affected by the eagerness to perform and compete in single- or mixed-gender groups. However, the decisions in tasks 5 and 6 are influenced by factors such as beliefs, risk and feedback aversion, as well as the effect of mentioning affirmative action. To control for these factors we include tasks 5 and 6 when examining changes in the decision to enter a tournament induced by affirmative action.

Table VII examines changes in tournament entry under affirmative action, when we control for the probability of winning, beliefs, and the decision to submit the piece-rate to the
relevant tournament. Again, for an easy comparison, the first two columns in each category report the previous results of Tables III and V. Conditioning on these factors affirmative action decreases the probability that a man enters a tournament by 9 percentage points. This remaining effect may result from a reduction in the thrill of competing against a group with greater male representation. For women, the remaining effect of affirmative action is a 25 percentage point increase in tournament entry. We ascribe this difference to women being more inclined to compete in all female groups. Pooling men and women we see that the decision to submit the piece rate to the AA tournament helps explain the change in the gender gap, however, the female and affirmative action interaction term remains significant. Thus the gender gap in tournament entry differs between the AA and standard tournament. 38 We ascribe this remaining difference to the competition being more gender specific under affirmative action. Men may feel more pressure to compete when the fraction of male competitors increases, whereas the fear of competing may diminish when women are in all female groups.

Our results suggest that the excessive response to affirmative action in part can be attributed to the gender gap in beliefs and attitudes towards competition being smaller in the more gender specific competition. Thus affirmative action influences both of the factors that initially caused women to opt out of the competition.

38 The change in the gender gap is given by \[ \Pr(AA=1, F=1, AA \cdot F=1;X) - \Pr(AA=1, F=0, AA \cdot F=0;X) \] – \[ \Pr(AA=0, F=1, AA \cdot F=0;X) - \Pr(AA=0, F=0, AA \cdot F=0;X) \]. Conditioning only on the probability of winning the change in the gap equals 0.76. The additional controls for beliefs and the decision to submit the piece rate reduces the gap to 0.31, thus 41 percent of the change in the gap is not accounted for.
TABLE VII
PROBIT OF TOURNAMENT CHOICE (TASK-2 PERFORMANCE)

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th>Men</th>
<th>Men</th>
<th>Women</th>
<th>Women</th>
<th>Women</th>
<th>All</th>
<th>All</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>-0.37</td>
<td>-0.29</td>
<td>-0.18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.00)</td>
<td>(0.01)</td>
<td>(0.02)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female*AA</td>
<td></td>
<td></td>
<td></td>
<td>0.26</td>
<td>0.18</td>
<td>0.07</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.00)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AA</td>
<td>-0.29</td>
<td>-0.23</td>
<td>-0.09</td>
<td>0.51</td>
<td>0.40</td>
<td>0.25</td>
<td>-0.27</td>
<td>-0.18</td>
<td>-0.09</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.04)</td>
<td>(0.09)</td>
<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.01)</td>
<td>(0.07)</td>
<td>(0.11)</td>
</tr>
<tr>
<td>Tournament</td>
<td>0.90</td>
<td>0.70</td>
<td>0.19</td>
<td>0.28</td>
<td>0.06</td>
<td>-0.09</td>
<td>0.64</td>
<td>0.40</td>
<td>0.13</td>
</tr>
<tr>
<td></td>
<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.01)</td>
<td>(0.83)</td>
<td>(0.71)</td>
<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.03)</td>
<td></td>
</tr>
<tr>
<td>Tournament-piece rate</td>
<td>-0.35</td>
<td>-0.38</td>
<td>0.01</td>
<td>0.30</td>
<td>0.23</td>
<td>0.43</td>
<td>-0.09</td>
<td>-0.15</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>(0.22)</td>
<td>(0.15)</td>
<td>(0.92)</td>
<td>(0.25)</td>
<td>(0.41)</td>
<td>(0.11)</td>
<td>(0.61)</td>
<td>(0.31)</td>
<td>(0.42)</td>
</tr>
<tr>
<td>GuessWin</td>
<td>0.19</td>
<td>0.05</td>
<td>0.38</td>
<td>0.35</td>
<td>0.27</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.16)</td>
<td>(0.39)</td>
<td>(0.00)</td>
<td>(0.01)</td>
<td>(0.00)</td>
<td>(0.02)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Submit Piece Rate</td>
<td>0.30</td>
<td></td>
<td>0.29</td>
<td></td>
<td>0.24</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.00)</td>
<td></td>
<td>(0.07)</td>
<td></td>
<td>(0.00)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
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<td>84</td>
<td>84</td>
<td>84</td>
<td>84</td>
<td>168</td>
<td>168</td>
<td>168</td>
<td>168</td>
</tr>
</tbody>
</table>

The marginal effects are evaluated at an individual (a man in the last three columns), in the standard tournament, with a probability of winning the tournament (Tournament) of 0.33 and a change in the probability of winning (Tournament-piece-rate) of 0.16, who submitted the piece rate performance to the tournament (columns 3, 6, and 9) with a guess of winning (columns 2, 3, 5, 6, 8, and 9). We cluster on the participant to account for there being 2 observations for each of the 84 participants. p-values of the underlying coefficients are in parenthesis.

VII. CONCLUSION

There is a substantial literature which aims to understand how costly it may be to increase the representation of minorities. Of recent concern has been whether it is possible to improve the representation of women in high-profile and very competitive jobs. While discrimination and gender differences in preferences and ability help explain the absence of women in these positions, another explanation may be that men and women respond differently to competitive environments, with high performing women shying away from competition. Our study contributes to this literature by asking whether an affirmative action requirement of equal representation of women may entice more women to compete. Of particular interest is whether changes in supply mitigate the expected costs of such an institutional change.

We introduce an affirmative action quota into an environment where women shy away from competition and fail to maximize their payoffs. The quota requires that for every man at least one woman has to be a winner. While this affirmative action quota is expected to affect tournament entry through changes in the probability of winning, other factors could influence entry as well. In particular the competition is more gender specific under the quota and this may
affect the two factors that caused women to avoid the competition in the first place. A more gender-specific competition can affect tournament entry by reducing gender differences in beliefs about relative performance, and by reducing gender differences in the willingness to compete. Finally the mere mention of affirmative action may affect entry as well.

We find that affirmative action causes a large increase in the tournament entry by women and a decrease in the entry by men. This change in behavior goes beyond changes warranted by the different probability in winning and we find that the factors listed above all help explain the excessive response to the policy.

Prior to affirmative action women, including high-performing women, are shying away from competition. Despite there being no discrimination we therefore see very few women winning the tournaments. Using this initial applicant pool the requirement that at least one woman must be hired for every man implies that in order to hire the same number of applicants as without the quota restriction, the minimum standard of performance has to be lowered significantly for women and reverse discrimination is predicted. Absent a change in entry it is expected that many more qualified male applicants would have to be passed by to secure equal representation of women. The expected costs of affirmative action would still be substantial if the response to the institutional change only results from changes in the probability of winning. However, as mentioned above, we show that the introduction of affirmative action causes a response which is greater than that predicted by the probability of winning alone. While some high-performing men drop out of the competition, many women come in, and the overall number of high-performing participants in the entry pool is barely affected. This change in the gender composition of the applicant pool causes the ex post performance costs of affirmative action to be substantially smaller than those predicted ex ante. In fact the performance requirements for men and women are essentially the same under affirmative action and there is limited or no reverse discrimination. This difference in ex ante and ex post costs of implementing an affirmative action quota implies that applying such a policy secretly or without allowing for adjustment in behavior may be particularly expensive, as the behavioral response may help adjust for existing inefficiencies.

Our results show that to assess the costs of affirmative action it is important to account for the indirect effects that occur through self selection into competitions. Specifically, the effects of affirmative action on the set of applicants may be very large when entry decisions are
not payoff maximizing. If changes in behavior are not accounted for then we will exaggerate the costs of affirmative action. It is important to note that we are demonstrating the corrective feature of affirmative action in an environment where there is no discrimination, thus there may be circumstances where affirmative action can be justified absent discrimination.

Research on affirmative action has primarily focused on its remedy in the face of discrimination, and has mostly examined the consequences of changing the demand side of the market (see Holzer and Neumark, 2000, for an overview). That is, the focus has been on determining the consequences for diversity, performance, and reverse discrimination of altering the rules for admission and hiring. A small literature has focused on the effect of affirmative action on the supply side, as we do. For theoretical papers, see for example Coate and Loury (1993) and Mailath, Samuelson and Shaked (2000). They show that inequality can arise endogenously as long as otherwise (ex ante) identical agents have some identifiable characteristic. They also discuss the potential positive and corrective effects of affirmative action. Coate and Loury (1993) emphasize that the success of affirmative action depends on the extent to which the policy causes employers to update their assessment of the minority candidate. Of particular concern is whether the policy lowers the performance requirement for minority candidates. A lower performance requirement for minorities may cause them to acquire less human capital and further strengthen the negative stereotype. In this light it is significant to note that we find very limited reverse discrimination. For recent empirical work on a potential supply effect of affirmative action, Long (2004) and Card and Krueger (2005) examine how the elimination of the affirmative action policy in California and Texas influenced college applications. Long (2004) finds that fewer minority students send their SAT scores to top tier colleges, while Card and Krueger (2005) show that the policy does not influence the decisions of highly qualified minorities. Since the UC and UT systems rely on percentage rules whereby the top 4 and 10 percent, respectively, of any graduating high school class are guaranteed admission, these analyses unfortunately do not enable us to determine if absent such programs we may observe ‘sub-optimal’ application decisions from highly qualified applicants.\(^{39}\)

\(^{39}\) See also Fryer and Loury (2005) whose comment on Card and Krueger is: “A more persuasive test of this hypothesis would examine the impact of affirmative action on the grades and attendance patterns of high school students. These outcomes are elastic with respect to effort, and are likely to vary with changes in students’ perceptions of college opportunities.”
While our study demonstrates substantial supply side effects from the introduction of affirmative action, the long run effects may be even greater. Increasing the representation of women may improve mentoring possibilities (see e.g., Allen, 1995 and Athey, Avery and Zemsky 2000), and change the perception of a woman’s ability to hold a high ranking position. Perceptions can be those of women about their own aspirations or abilities or those of others.\footnote{Chung (2000) notes that merely increasing the representation of women through affirmative action will not enable subsequent minority candidates to update their belief on own ability in the profession. As emphasized by Coate and Loury (1993) affirmative action may have permanent effects when it causes employers to update their assessment of the candidate.}

For example Beaman, Chattopadhyay, Duflo, Pande, and Topalova (2009) examine the effect of introducing affirmative action quotas in Indian village councils. They find that the quota system reduces the stereotypes about gender roles and eliminates negative bias in the assessment of the effectiveness of female leaders.\footnote{For a discussion about possible cultural changes, and how perceptions correlate with female performance in math, see Pope and Sydnor (2010) and Niederle and Vesterlund (2010).}
References:


Balafoutas, Loukas and Matthias Sutter, “Gender, competition and the efficiency of policy interventions,” working paper 2010


Cason, T.N.; Masters, W.A. and Sheremeta, R.M. "Entry into Winner-Take-All and Proportional-Prize Contests: An Experimental Study." 2009.


Daly, Martin, and Margo Wilson, *Sex, Evolution, and Behavior*, 2nd ed. (Belmont, CA, Wadsworth Publishing Company, 1983)


Sutter, Matthias and Daniela Rützler, “Gender differences in competition emerge early in life: Three-year old girls compete as much as boys, but older girls don’t,” working paper 2010