

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

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## **Abstract**

Recent research documents that while men are eager to compete, many women, even high performing ones, often shy away from competition. We examine experimentally whether affirmative action can entice more women to compete. When women are guaranteed equal representation among winners, we find that more women and fewer men enter competitions, and the response is larger than predicted by changes in the probability of winning. An explanation is that under affirmative action the competition becomes more gender specific and this causes both beliefs on rank and attitudes towards competition to change. The changes in competitive entry affect the costs of affirmative action. Based on ex-ante entry affirmative action is predicted to lower the performance requirement for women and result in reverse discrimination towards men. Interestingly this need not be the case when entry is not payoff maximizing, in fact it may not be necessary to lower the performance requirement for women to achieve a more diverse set of winners.

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## I. INTRODUCTION

Despite decades of striving for gender equality, large differences between men and women still remain in the labor market. Particularly noteworthy is the vertical gender segregation within a sector. Across industries men are disproportionately allocated to professional and managerial occupations. In a large sample of US firms Bertrand and Hallock (2001) show that women only account for 2.5 percent of the five highest paid executives.<sup>1</sup> While it may be argued that such segregation is a result of past history, and that these differences will diminish over time, it is noteworthy that women are underrepresented among people who have the minimum 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 entirely drop out of the work force.<sup>2</sup>

It is commonly argued that discrimination, preference differences for child rearing, and ability differences can explain the absence of women in upper level management.<sup>3</sup> Recent research suggests that an additional explanation is that women are more reluctant to put themselves in a position where they have to compete against others (see e.g., Gneezy and Rustichini, 2005, Gupta, Poulsen and Villeval, 2005, and Niederle and Vesterlund, 2007, henceforth NV).<sup>4</sup> For example, NV examines compensation choices in an environment where men and women are equally good at competing. They find that the majority of men select the competitive tournament whereas the majority of women select the non-competitive piece rate. While low ability men are found to compete too much, high ability women compete too little, and few women succeed in and win the tournament.

From the firm's perspective it is particularly costly if the upper tail of the performance distribution does not enter competitions for jobs or promotions. As explained by B. Joseph White, president of University of Illinois, "Getting more women into MBA programs means better access to the total talent pool for business".<sup>5</sup> An additional argument for increasing the number of women in top managerial positions is that diversity in and of itself may benefit the

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<sup>1</sup> Similarly only about 17 percent of the partners at major law firms nationwide were women in 2005 (Timothy O'Brien, *The New York Times*, March 19, 2006).

<sup>2</sup> E.g., Hewlett and Luce (2005), and Blau and Kahn (2004).

<sup>3</sup> See Altonji and Blank (1999), Black and Strahan (2001), and Goldin and Rouse (2000).

<sup>4</sup> Gneezy, Niederle and Rustichini (2003) find that women, while able to compete, fail to do so in competition against men, this result is consistent with women avoiding competition. Babcock and Laschever (2003) find that women are more reluctant to negotiate. This too may be evidence of gender differences in willingness to compete.

<sup>5</sup> The University Record, May 22, 2000, [http://www.ur.umich.edu/9900/May22\\_00/8.htm](http://www.ur.umich.edu/9900/May22_00/8.htm).

firm.<sup>6</sup> Indeed US corporations are concerned by their inability to attain and recruit women, and they are increasingly developing programs to improve the number of women employees.<sup>7</sup>

When instituting programs to alter the gender composition in certain jobs it is of course important that we understand how these programs influence behavior. To begin this process, we use experiments to investigate how affirmative action may affect participants' willingness to compete. Specifically, we consider a quota system which requires that out of two winners of a tournament at least one must be a woman.<sup>8</sup> The reason for focusing on this institution is not only that it changes the probability of winning, but that it has the potential of affecting the two factors that NV identified as explaining suboptimal entry for women. 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 competition. The more gender specific competition introduced by our affirmative action institution may influence both beliefs and attitudes towards competition. Certainly the existing literature on performance in competitive environments suggests differences between single and mixed gender settings. While Gneezy, Niederle, and Rustichini (2003) found men to compete more eagerly than women in mixed-gender competitions, in single-gender competitions the behavior of women was comparable to that of men. If the gender gap in beliefs and in attitudes towards competition change in a more gender specific competition then the changes in tournament entry induced by affirmative action may exceed what we would predict based on changes in the probability of winning.

In examining the effect of affirmative action we focus on changes in the decision to compete and changes in 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 threshold be for women? How many better performing men will have to be passed by to hire a woman? To what extent will reverse discrimination arise? These questions are particularly interesting in light of the large fraction of high performing women who shy away from competition as documented by NV.

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<sup>6</sup> See e.g., Page, 2007.

<sup>7</sup> For example, corporations such as Ernst and Young, Goldman Sachs, IBM, and PricewaterhouseCoopers have all adopted substantial female retention and attraction programs (see e.g., The Economist, July 21, 2005).

<sup>8</sup> Affirmative action programs in the US have historically been of two forms: preferential treatment and quota.

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. We attribute the excessive response to three factors. One is that the mere mention of affirmative action increases women's willingness to compete. The other two factors relate to affirmative action making the competition more gender specific. First, participants hold different beliefs on 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.<sup>9</sup>

The substantial changes in tournament-entry induced by affirmative action have important implications when assessing the sacrifice in performance required to secure a more diverse group of winners. The costs of affirmative action depend on how much lower the minimum performance threshold will have to be to secure gender parity, compared to that found for a group in which gender is not taken into account. Ignoring the change in entry, it is anticipated that equal representation of women will result in a decrease in the minimum performance requirement for women and that many better performing men will be passed by. The change in tournament entry implies that women become better represented among the set of entrants, and in particular that more high performing women are in the applicant pool. Thus it becomes much less costly to achieve equal representation and indeed the minimum performance threshold is under affirmative action is the same for women and men. We therefore find that when high performing women shy away from competition and do not enter when it is payoff maximizing to do so, it need not be costly to use affirmative action to achieve a more diverse set of winners.

In the next section we discuss how our affirmative action institution may alter the 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 the relevant findings of NV. Specifically, many high performing women fail to enter the tournament, and the gender gap in entry is explained by gender differences in beliefs and in attitudes towards competition. This suggests that a requirement of

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<sup>9</sup> This argument is similar to that given for the benefits of single sex education for girls: it may be easier for girls to compete when competing against only girls (See Solnick, 1995, and Harwarth, Maline, and DeBra, 1997). See also Gneezy, Niederle and Rustichini (2003) for performance in single versus mixed sex competitions.

equal representation affirmative action may play a significant role in our environment. We then proceed by determining the effect of affirmative action on entry and the extent to which the more gender-specific competition can account for these changes. Finally we conclude by examining how changes in tournament entry mitigate the anticipated costs of affirmative action.

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

The central question of this paper is whether affirmative action can entice more high performing women to compete. NV found that the gender gap in tournament entry is explained by men being more overconfident than women, and by men and women having different attitudes towards competitions. We selected an affirmative action system that has the potential of affecting both of these factors. Under a quota system where at least one of two winners must be a woman the competition becomes more gender specific and this may influence both beliefs and attitudes towards competition. There are however other reasons why behavior may change under a quota system. We discuss each 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 affirmative action is that it distorts the 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 condition on the probability of winning.

*Factor 2. Within-gender beliefs:* A consequence of affirmative action 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 affirmative action. We elicit the participant's

within-gender beliefs to determine if they differ across gender and how they may 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 examine compensation choices under the affirmative action rule when these choices do not require a future competitive performance.

*Factor 4. Competing against own gender:* Finally a 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 rather 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 their behavior may be quite different under affirmative action.<sup>10</sup> Changes may also be seen for men as affirmative action implies that 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 will ascribe any unexplained response to affirmative action as evidence that Factor 4 influences behavior.<sup>11</sup>

### **III. EXPERIMENTAL DESIGN**

The experiment was conducted at the Harvard Business School, using students from the CLER subject pool.<sup>12</sup> Our design builds on that of NV. 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

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<sup>10</sup> Gneezy, Niederle and Rustichini (2003) find that women are as good as men at competing in single-sex but not in mixed-sex tournaments. Such differences are often 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. Thus girls in all-girl schools may be more competitive (see Harwarth, Maline and DeBra 1997 for an overview).

<sup>11</sup> This captures the possibility that men and women are more comfortable competing against women than men.

<sup>12</sup> For instructions see <http://www.stanford.edu/~niederle/Niederle.Segal.Vesterlund.Instructions.pdf>

members of their group were. A total of 14 groups participated in the experiment for a total of 42 men and 42 women.<sup>13</sup>

Participants were asked to perform a real 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:

21	35	48	29	83	
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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.<sup>14</sup> 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. An attractive feature of this 5-minute addition task is that it requires both skill and effort.

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 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.<sup>15</sup>

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

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<sup>13</sup> 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.

<sup>14</sup> The program was written using the software zTree (Fischbacher 2007).

<sup>15</sup> In the event that there are ties in a competitive task the winner was chosen randomly among the high scorers.

**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 next 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. A participant with a given performance has higher expected earnings in the tournament when the probability of winning exceeds 33 percent.<sup>16</sup> 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; first, participants are competing against competitive performances of others; second, the tournament-entry decision only depends on beliefs about ones relative performance, and not on the expected tournament-entry decisions of others;<sup>17</sup> and third, a participant's choice does not impose any externalities on others.<sup>18</sup> Effectively the task-3 decision is an individual-decision problem.

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<sup>16</sup> By paying the tournament winner per correct problem we avoid the issue of choosing a high enough fixed prize to ensure that even high-performing participants benefit from tournament entry.

<sup>17</sup> This secures that the gender composition and size of the competitive group is held constant across participants.

<sup>18</sup> Note that our design allows for the possibility that participants who enter the tournament all lose or all win. The absence of externalities helps us rule out that women avoid the competition to not decrease the chance that others win. For a discussion of possible gender differences in altruism see e.g., Andreoni and Vesterlund (2001), Eckel and Grossman (2002b), Croson and Gneezy (2004).



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. Having mentioned the group's gender composition at the experiment's beginning, we hope to isolate the effect of affirmative action.

**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. A woman wins the AA tournament if her task-4 performance *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 *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.<sup>19</sup> What distinguishes gender 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 environments which mimic the entry decisions in Task 3 and 4, without

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<sup>19</sup> The literature on gender differences in these factors all suggest differences that would cause fewer women than men to enter the competition. It has been argued that both nurture and nature would cause men to be more competitive (see e.g., Daly and Wilson, 1983, Campbell, 2002, Ruble, Martin, and Berenbaum, 2006, Gneezy, Leonard and List, 2006). If the prospect of engaging in a competition causes women to anticipate a psychic cost and men to anticipate a psychic benefit then fewer women should enter. This difference is also predicted by the finding that men tend to be more overconfident than women (e.g., Lichtenstein, Fischhoff and Phillips, 1982, Beyer, 1990, Beyer and Bowden, 1997, and Niederle and Vesterlund, 2007). Similarly the finding that women are more averse to risk (e.g., Eckel and Grossman, 2002a, Croson and Gneezy, 2004, Byrnes, Miller and Shafer, 1999) and that they respond more to negative feedback (see e.g., Roberts and Nolen-Hoeksema, 1989, Dweck 2000) would suggest less willingness to enter the tournament.

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 compensation choice.

**Task 5 – Submit Piece Rate to a Tournament:** Participants do not have to perform in this task. They choose which compensation 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 participants’ last task they are asked to 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 merely 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 piece-rate performance: a 50-cent piece rate per correct answer or an AA tournament. A participant who selected the 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.

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.<sup>20</sup> This allows us to determine if beliefs on relative performance differ in single versus mixed gender groups, and whether such differences affect tournament entry.

We can use Task 1, 2, 3 and 5 and across gender beliefs to determine whether we replicate the NV findings relevant for this paper. By comparing choices in task 3 and 4, we can then move on to examine the effect of affirmative action on the gender gap in tournament entry. Of particular interest is the extent to which such 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 the 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 result in an exaggerated 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 a control for Factor 3.

#### **IV. GENDER DIFFERENCES IN COMPENSATION CHOICES**

To determine whether high performing women fail to compete in our sample, we start by characterizing the tournament-entry decisions prior to the introduction of affirmative action. To assess the potential for affirmative action to improve outcomes we also determine whether gender differences in beliefs and attitudes towards competition explain the gender gap in entry.

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  $p$

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<sup>20</sup> 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.

= 0.06, respectively).<sup>21</sup> 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 that conditional on performance the probability of winning is similar for women and men.<sup>22</sup>

TABLE I  
PROBABILITY OF WINNING TASK-2 TOURNAMENT CONDITIONAL ON TASK-2 PERFORMANCE

	8	9	10	11	12	13	14	15	16	17	18	19	21	22	25	28	29	35
Women	0	0.1	0.6	2.5	8.6	21.8	40.7	58.1	71.4	80.2	87.1	92.2	--	96.2	--	--	--	--
Men	0	0.1	0.7	2.8	11.0	28.2	48.7	65.8	77.8	85.6	91.1	--	96.6	98.1	99.2	99.6	99.9	100

Having experienced both the 50-cent piece rate and \$1.50 tournament, participants are asked which of the two compensation schemes they want to apply to their task-3 performance. As shown by Table I, participants who solve 14 or more problems have higher expected earnings from the tournament, because their probability of winning is higher than one third. If their performance in task 3 is exactly as in task 2, this corresponds to a predicted entry of 28.6 percent for women and 50 percent for men. The actual gender gap in tournament entry is even greater than predicted: 31 percent of women and 73.8 percent of men select the tournament. This gender gap is significant ( $p < 0.01$ ) and greater than expected ( $p = 0.04$ ). While men enter significantly more than predicted ( $p = 0.042$ ), women do not ( $p = 1.0$ ).<sup>23</sup> The gender gap in tournament entry is greatest among those who for a given task-2 performance have higher expected earnings in the tournament than piece rate; among these, 100 percent of the men but only 33.3 percent of the women enter the tournament. Thus the entry by women is suboptimal, which leaves room for affirmative action to improve outcomes.

We next examine if this gender gap can be explained by beliefs and attitudes towards competition. We first examine whether men are more overconfident than women and whether this explains the gender gap in tournament entry. As men outperform women we compare beliefs conditional on the participant's optimal guessed rank. This is the guessed rank that,

<sup>21</sup> The results in NV suggest that the increase in performance from the piece rate to the tournament is due to learning rather than to changes in incentives.

<sup>22</sup> 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.

<sup>23</sup> Unless otherwise noted the reported test statistics henceforth refer to a two-sided Fisher's exact test.

conditional on gender and performance, would maximize earnings.<sup>24</sup> Figure 1 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 in confidence is significant.<sup>25</sup> 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 ( $p = 0.01$ ).

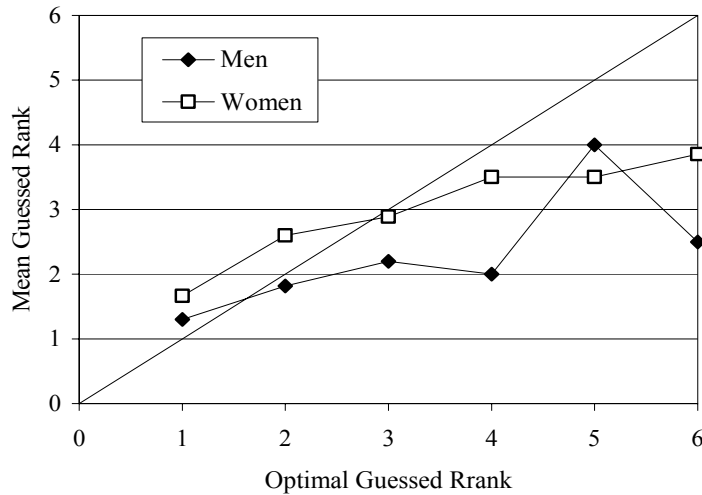


FIGURE I: Mean Gussed Rank for each Optimal Gussed Rank

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.<sup>26</sup>

To examine the effect of overconfidence on tournament-entry decisions we first regress the compensation choice on the probability of winning the task-2 tournament (Tournament)

<sup>24</sup>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.

<sup>25</sup> For men, testing if the distribution of guessed ranks is independent of that of optimal ranks yields  $p = 0.04$ . For women, the comparisons of guessed to optimal-guessed ranks yields  $p = 0.37$ .

<sup>26</sup> 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 OptimalGuessWin yields  $p = 0.07$  for men, and  $p = 0.48$  for women.

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).<sup>27</sup> Conditional on performance we find a significant gender gap of 36 percentage points.<sup>28</sup> As seen in Column 2, this gap reduces to 25 percentage points 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. Note however that a substantial portion of the gap remains unexplained.

TABLE II  
PROBIT OF TOURNAMENT-ENTRY DECISION (TASK 3)

	(1)	(2)	(3)
Female	-0.36 (0.00)	-0.25 (0.03)	-0.17 (0.04)
Tournament	0.79 (0.00)	0.45 (0.02)	0.22 (0.08)
Tournament-piece rate	-0.29 (0.27)	-0.31 (0.15)	-0.11 (0.45)
GuessWin		0.35 (0.01)	0.25 (0.01)
Submit the Piece Rate			0.15 (0.10)
Observations	84	84	84

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

<sup>27</sup> The change in the probability of winning the tournament when using the task-2 rather than task-1 performance is given by  $p_T(\text{Task 2}) - p_T(\text{Task 1})$ , 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.

<sup>28</sup> 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 of 13 and 14. For these participants  $p_T(\text{Task 2}) - p_T(\text{Task 1}) = 0.16$  on average, thus we assess the marginal effect at this point.

compensation choices in task 3 and 5, only in task 3 can differences in preferences for performing in a competition play a role.

As seen in Table II 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 fact that the decision to submit the piece rate serves as an additional measure of the individual's general 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.<sup>29</sup> 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.

## **V. THE EFFECT OF AFFIRMATIVE ACTION ON ENTRY**

In this section we examine whether it is possible to entice women, especially high performing women, to compete. We determine whether women and men change their entry decisions when we introduce an affirmative action requirement that at least one of two winners must be a woman. The reason for focusing on this institution is not only that it changes the probability of winning, but that it results in a more gender-specific competition. This may influence the two factors that reduced entry for women; i.e., the gender gap in beliefs on relative performance and attitudes towards competition. In addition to these changes the mere mention of affirmative action may also influence behavior. Our analysis first characterizes the response to affirmative action and then determines the extent to which the above mentioned factors account for it.

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<sup>29</sup> Differences in the two designs are as follows. 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. 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. In NV the gender gap in tournament entry is 38 percentage points when controlling only for performance. Controlling also for beliefs on winning the task-2 tournament this gap reduces to 26 percentage points, finally adding the decision to submit the piece rate reduces the gap to 14 percentage points.

### V.A. Entry into the Affirmative Action Tournament

The introduction of affirmative action 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 III. 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. 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.<sup>30</sup>

TABLE III  
PROBABILITY OF WINNING TASK-4 TOURNAMENT CONDITIONAL ON TASK-2 PERFORMANCE:

	9	10	11	12	13	14	15	16	17	18	19	21	22	25	28	29	35
Women	1.8	4.9	10.5	25.3	46.9	64.6	77.3	85.7	91.1	94.7	97.3	--	99.3	--	--	--	--
Men	0.1	0.4	1.6	5.5	14.2	26.8	39.6	50.6	58.6	66.8	--	75.3	79.6	84.0	88.5	93.0	97.6

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  $p = 0.66$ , respectively). The resulting gender gap in entry into the AA tournament is significant ( $p < 0.01$ ) and differs from that predicted ( $p < 0.01$ ).<sup>31</sup>

To assess how changes in the probability of winning affect tournament entry, we compare entry decisions under the standard and AA tournament. Figure II panel A shows the proportion of men who enter the standard and AA tournament 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

<sup>30</sup> Using the task-2 performance five more women and five fewer men have higher expected earnings from entering the AA tournament.

<sup>31</sup> We calculate the difference between expected and actual gender gaps in 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 III). The reported  $p$ -value is the percentage of strictly positive differences.



changes in tournament entry were solely driven by changes in the probability of winning, then the two propensities to compete should coincide for the standard and AA tournaments.

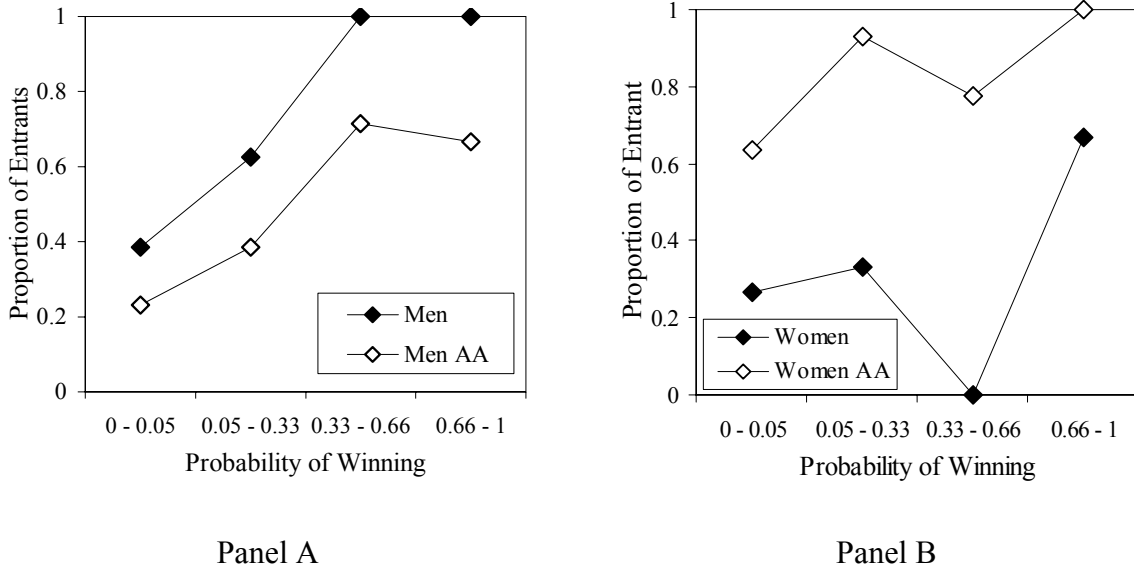


FIGURE II: Proportion of Participants Entering the Standard or the AA Tournament Conditional on the Probability of Winning the Tournament Given Ex-Ante Performance (Task 2).<sup>32</sup>

Figure II 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. This finding is confirmed by a probit regression of the decision to enter a tournament on the probability of winning as well as an affirmative-action dummy (Table IV). 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 II we see that the effect of affirmative action on entry is

<sup>32</sup> 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, with 13 in 0-0.05. In the AA tournament there are 13, 13, 7, and 9. In panel B, the numbers are 15, 15, 6, and 6, and 11, 14, 9, and 8, respectively.

negative for men and positive for women.<sup>33</sup> 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.

TABLE IV  
PROBIT OF TOURNAMENT CHOICE (TASK-2 PERFORMANCE)

	Men	Women	All
Female			-0.37 (0.00)
Female*AA			0.26 (0.00)
AA	-0.29 (0.01)	0.51 (0.00)	-0.27 (0.01)
Tournament	0.90 (0.00)	0.28 (0.28)	0.64 (0.00)
Tournament-piece rate	-0.35 (0.22)	0.30 (0.25)	-0.09 (0.61)
Observations	84	84	168

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 participant to account for there being 2 observations for each of the 84 participants.  $p$ -values of the underlying coefficients are in parenthesis.

Entry in the AA tournament contrasts with that of the standard tournament. 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. Interestingly the behavior of women is in line with that of Gneezy, Niederle and Rustichini (2003). While they found men to compete more eagerly than women in mixed-sex competitions, in single-sex competitions the behavior of women was comparable to that of men.

#### *V.B. 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 guess which would be money-maximizing 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

<sup>33</sup> The result is the same if we condition on the probability of winning after the entry decision, i.e., on task 3 and 4.

optimal guesses, and women are as confident in their relative performance among women, as men are among men.<sup>34</sup> Figure III shows for each optimal guessed rank the average guessed rank of women and men. Panel A shows the guessed ranks among all 6 participants, while Panel B shows guessed ranks within one's gender. Although men are significantly more confident than women when assessing relative ability in a mixed-sex group, there is no gender difference in beliefs in single-sex groups.

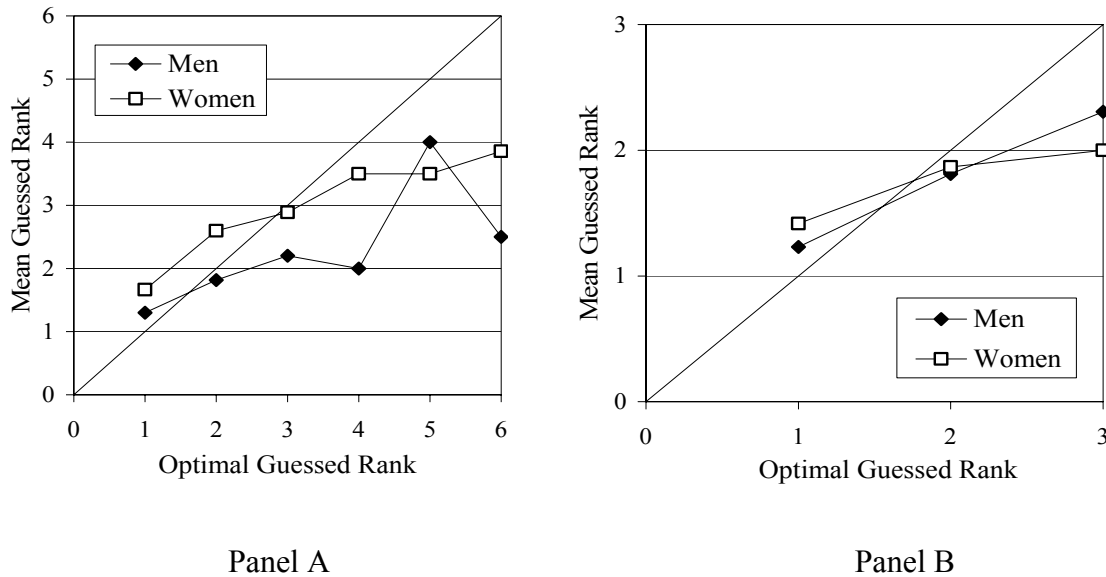


FIGURE III: Average Gussed Rank as a Function of Optimal Gussed Rank in the Group of 6 Participants (A), and among the 3 Group Members of One's Gender (B).

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 for

<sup>34</sup> 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 ( $p < 0.01$ ).

men seem excessive.<sup>35</sup> We compare GuessAAWin to the belief on winning that is consistent with the participant's optimal guessed rank (OptimalGuessAAWin). 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.<sup>36</sup> This result contrasts that of the standard tournament where conditional on OptimalGuessWin, 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 guess-win measures, see Table V. 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.

TABLE V  
PROBIT OF TOURNAMENT CHOICE

	Men	Men	Women	Women	All	All
Female					-0.37 (0.00)	-0.29 (0.01)
Female*AA					0.26 (0.00)	0.18 (0.00)
AA	-0.29 (0.01)	-0.23 (0.04)	0.51 (0.00)	0.40 (0.00)	-0.27 (0.01)	-0.18 (0.07)
Tournament	0.90 (0.00)	0.70 (0.00)	0.28 (0.28)	0.06 (0.83)	0.64 (0.00)	0.40 (0.00)
Tournament-piece rate	-0.35 (0.22)	-0.38 (0.15)	0.30 (0.25)	0.23 (0.41)	-0.09 (0.61)	-0.15 (0.31)
GuessWin		0.19 (0.16)		0.38 (0.00)		0.27 (0.00)
Observations	84	84	84	84	168	168

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.

<sup>35</sup> 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.

<sup>36</sup> On average the GuessAAWin is not significantly different from OptimalGuessAAWin ( $p = 1.0$  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 OptimalGuessAAWin ( $p < 0.01$ ). Examining men and women separately yields coefficients on OptimalGuessAAWin of 0.53 ( $p < 0.01$ ) for men, 0.27 ( $p = 0.12$ ) for women.

GuessWin is significant in the pooled regression and reduces the change in the gender gap induced by affirmative action.<sup>37</sup> An explanation is that the gender gap in beliefs is substantially smaller in the AA tournament. The change in beliefs result 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 remains significant, indicating that changes in the gender gap in tournament entry induced by affirmative action are not fully explained.

### *V.C. Mentioning Affirmative Action and Attitudes towards Competition*

Next we examine the decisions to submit the piece rate performance to a standard or AA tournament. This analysis helps determine whether merely mentioning affirmative action influences behavior, and whether the response to affirmative action may result from the AA tournament requiring performance in a more gender-specific competition. That is we determine whether the response results from attitudes towards competition differing in more gender-specific competitions.

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 between mixed- versus single-gender groups, and the effect of mentioning affirmative action. The probit regression in table VIII shows that controlling both for beliefs and the probability of winning, affirmative action does not cause men to change their decision to submit the piece-rate to a tournament. The coefficient on the AA dummy is small and at best marginally significant. 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 simply mentioning affirmative action does not affect men, it does affect women.

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<sup>37</sup> 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  $[\Pr(\text{AA}=1, \text{F}=1, \text{AA}\cdot\text{F}=1; \text{X}) - \Pr(\text{AA}=1, \text{F}=0, \text{AA}\cdot\text{F}=0; \text{X})] - [\Pr(\text{AA}=0, \text{F}=1, \text{AA}\cdot\text{F}=0; \text{X}) - \Pr(\text{AA}=0, \text{F}=0, \text{AA}\cdot\text{F}=0; \text{X})]$ . Conditioning only on the probability of winning the change in the gap equals 0.76. The additional controls for beliefs reduces the gap to 0.59.

TABLE VIII  
PROBIT OF SUBMITTING THE PIECE RATE

	Men	Women	All
Female			-0.17 (0.11)
Female*AA			0.10 (0.00)
AA	-0.04 (0.12)	0.28 (0.00)	-0.06 (0.17)
Piece rate	0.04 (0.52)	0.35 (0.10)	0.17 (0.06)
GuessWinPR	0.83 (0.00)	0.55 (0.00)	0.72 (0.00)
Observations	84	84	168

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.

Note that the decisions in tasks 5 and 6 and differences in those decisions are not affected by the eagerness to 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 merely 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 IX 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. Conditioning on these factors affirmative action decreases the probability that a man enters a tournament by 9 percentage points. This remaining effect may represent the 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.<sup>38</sup> We ascribe this remaining difference

<sup>38</sup> The change in the gender gap is given by  $[\Pr(\text{AA}=1, F=1, \text{AA}\cdot F=1; X) - \Pr(\text{AA}=1, F=0, \text{AA}\cdot F=0; X)] - [\Pr(\text{AA}=0, F=1, \text{AA}\cdot F=0; X) - \Pr(\text{AA}=0, F=0, \text{AA}\cdot F=0; X)]$ . Conditioning only on the probability of winning the

to the competition being more gender specific under affirmative action. Men may feel more pressure to compete when the fraction of male competitors increase, whereas the fear of competing may diminish when women are in all female groups.

TABLE IX  
PROBIT OF TOURNAMENT CHOICE

	Men	Men	Men	Women	Women	Women	All	All	All
Female							-0.37 (0.00)	-0.29 (0.01)	-0.18 (0.02)
Female*AA							0.26 (0.00)	0.18 (0.00)	0.07 (0.00)
AA	-0.29 (0.01)	-0.23 (0.04)	-0.09 (0.09)	0.51 (0.00)	0.40 (0.00)	0.25 (0.00)	-0.27 (0.01)	-0.18 (0.07)	-0.09 (0.11)
Tournament	0.90 (0.00)	0.70 (0.00)	0.19 (0.01)	0.28 (0.28)	0.06 (0.83)	-0.09 (0.71)	0.64 (0.00)	0.40 (0.00)	0.13 (0.03)
Tournament-piece rate	-0.35 (0.22)	-0.38 (0.15)	0.01 (0.92)	0.30 (0.25)	0.23 (0.41)	0.43 (0.11)	-0.09 (0.61)	-0.15 (0.31)	0.06 (0.42)
GuessWin		0.19 (0.16)	0.05 (0.39)		0.38 (0.00)	0.35 (0.01)		0.27 (0.00)	0.12 (0.02)
Submit Piece Rate			0.30 (0.00)			0.29 (0.07)			0.24 (0.00)
Observations	84	84	84	84	84	84	168	168	168

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.

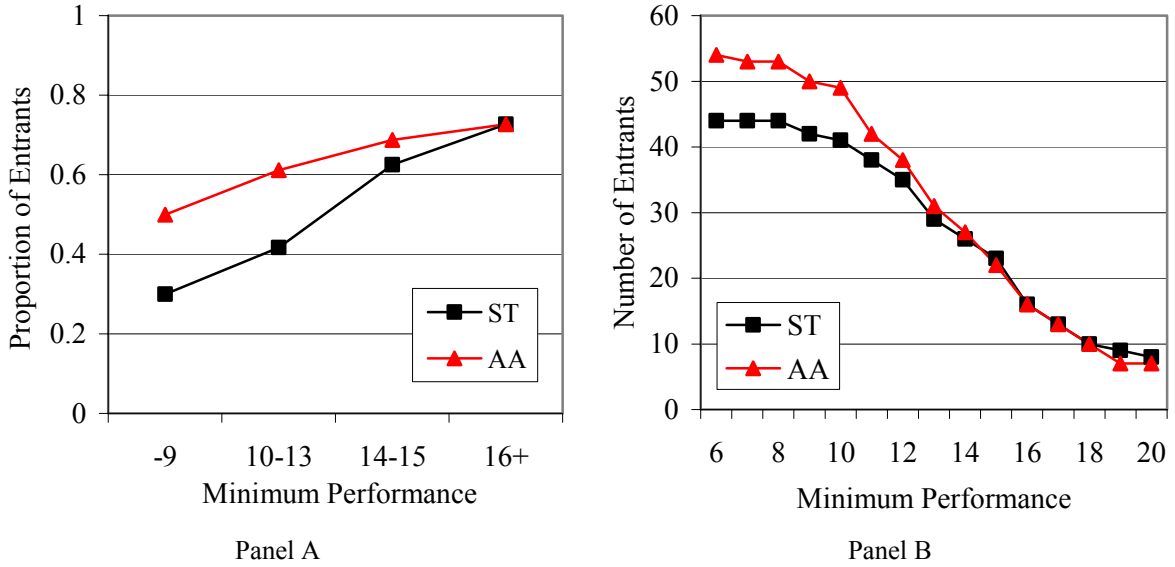
## VI: HOW COSTLY IS AFFIRMATIVE ACTION

The primary objective of affirmative action is to secure that a more diverse pool of applicants be selected as winners. Of course the mere design of our affirmative action rule secures this goal, the question is how costly it is to get a more diverse set of winners. If we view those who enter competitions as applicants for jobs then the costs of affirmative action depend critically on how many better performing men a firm will have to pass by to secure that women at least be equally represented among those hired. Passing by better performing candidates is not only inequitable, it is also costly for the firm who no longer can hire the best available candidate. To demonstrate these costs we examine the effect affirmative action has on the performance threshold applicants have to reach to get hired. Suppose a firm wants to hire 20 applicants, we ask what the minimum performance threshold will be for applicants to be hired when equal

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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.

representation is or is not required. Crucial for determining these performance costs is the gender and performance of those who enter the competition. The observed changes in entry documented before suggest that the costs calculated before the introduction of affirmative action may differ substantially from those actually experienced.



Panel A Proportion of Participants at a Given Performance Who Enter the Standard (ST) and Affirmative Action (AA) Tournaments. Panel B Number of Entrants with Performance above a Minimum Threshold in the Standard (ST) and Affirmative Action (AA) Tournaments.

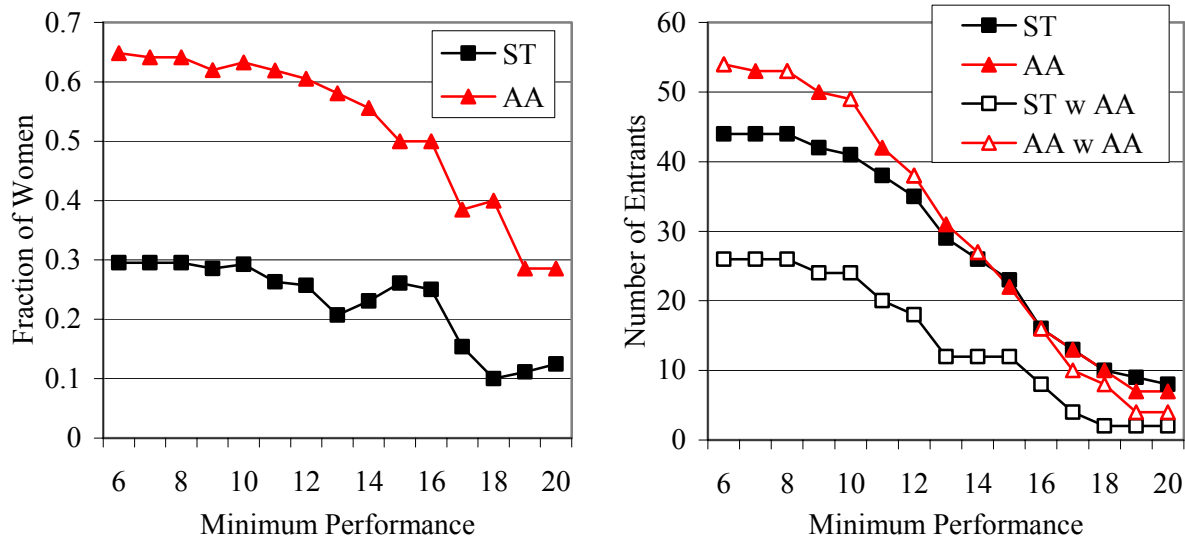
FIGURE IV: Tournament Entry

To assess the costs of the affirmative-action requirement, we focus on the actual performances after the compensation choice. Since the performance in task 4 is slightly higher than in task 3, we rely on the task-3 performance to not bias the results in our favor.<sup>39</sup> We start by examining how changes in tournament entry under affirmative action affect the performance distributions of entrants. Figure IV Panel A shows the proportion of participants with a given task-3 performance who choose to enter the standard (ST) or AA tournament (AA). While affirmative action increases entry for those who solve less than 14 problems, the number of entrants is not affected for those with a superior performance. This finding is confirmed by Panel B, which shows the number of entrants who have performances at or above

<sup>39</sup> 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. Given the higher task-4 performance this later comparison would bias the results in favor of affirmative action.



a certain level.<sup>40</sup> While the number of entrants with a minimum performance below 14 is greater under affirmative action, there is no change in the number who have a minimum performance between 14 and 20.



Panel A  
Proportion of Tournament Entrants above a Minimum Performance Level Who are Women in Standard (task-3) and AA tournament (task-4)

Panel B  
Number of Entrants above a Minimum Performance Threshold in Task-3 (ST), in Task-3 with AA Requirement of Equal Representation of Women (ST w AA), and for Task-4 without (AA) and with AA Requirement (AA w AA).

FIGURE V: Performance of Entrants

Affirmative action has however a large effect on the gender composition of the pool of entrants. Figure V panel A shows the proportion of women among entrants whose performance is at or above a specified performance level. While the number of high-performing entrants is similar in the standard and AA tournament, the proportion of women is very different. 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. This difference in gender composition implies that when choosing participants with a performance of 15 and higher it will be costly to secure equal representation among standard-entrants, but not when choosing among AA-entrants. Note that while women are never equally represented among standard-entrants, among entrants with a performance of 16 or lower at least 50 percent are women in the AA tournament. That is, ex-post the affirmative action requirement will not

<sup>40</sup> 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.

imply that more qualified men have to give way to less qualified women. Indeed the affirmative action requirement is simply not binding.

Figure V Panel B demonstrates the performance costs of affirmative action, when choosing among standard-entrants (task-3) and among AA-entrants (task-4). For each performance, say 15, panel B shows the number of standard-entrants (ST) whose task-3 performance is 15 or higher, and similarly the number of AA-entrants (AA) with a task-3 performance at or above this level. Thus the ST and AA lines are identical to those of Panel B of Figure IV. In addition we also show the number of people who can be hired among the entrants satisfying a given minimum performance requirement, when there must be at least one woman for every man hired. For standard-entrants this is shown by the ST w AA line, and for AA-entrants it is shown by the AA w AA line. Given the few high-performing women who enter the standard tournament, requiring equal representation implies that very few individuals of a given minimum performance can be hired among standard-entrants. For example, for performances above 15, there are 23 standard-entrants and 22 AA-entrants. When we require that for every man one woman has to be selected, then only 12 people can be hired among the standard entrants (only six female standard-entrants have a performance of 15 and higher). In contrast, all 22 AA-entrants can be hired (a total of 11 female AA-entrants have a performance of 15 and higher). Furthermore, to hire another pair of standard-entrants under the affirmative action rule, one has to lower the minimum performance requirement to 12 to add a woman, while passing by 8 additional men with higher performances. Using instead AA-entrants the same requirement implies that no men of higher performance are passed by to hire an additional woman. If we were to hire 22 standard-entrants among whom women are equally represented, we would have to lower the minimum performance threshold from 15 to 10.

While equal representation in the standard tournament implies that many more qualified men will be passed by, such inequity does not arise once affirmative action is introduced and the minimum requirement for performance is 16 or less. This effect on reverse discrimination is further demonstrated in Figure VI, which shows for each minimum performance level the number of better performing men that must be passed by to secure that women be equally represented among those hired. The number of men affected by reverse discrimination is demonstrated by ST w AA when using standard-entrants, and by AA w AA when using AA-entrants.

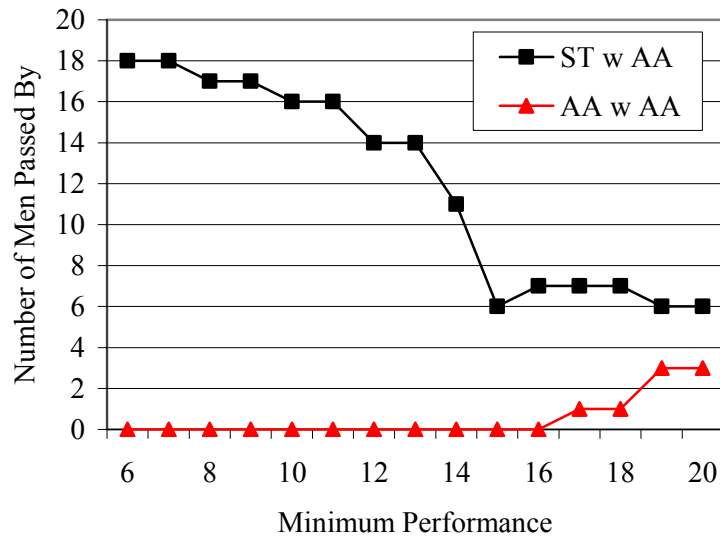


FIGURE VI: Number of Better Performing Men Passed by to Secure Equal Representation of Women Given the Entrants to the Standard Tournament (ST w AA) and the Entrants to the AA Tournament (AA w AA)

Based on tournament entry prior to the introduction of affirmative action we anticipate substantial reverse discrimination. Returning to the case with a minimum performance requirement of 15, we saw that entry in the standard tournament would enable us to hire 12 people under the equal representation requirement. As shown by the ST w AA line in Figure VI this would cause us to pass by 6 men who have a performance in excess of the required minimum for women, in this case 15. The introduction of affirmative action however cause women to be better represented among the set of entrants, and we would instead be able to hire an equally representative pool of 22 people with a minimum performance of 15. As demonstrated by Figure VI, entry in the AA tournament implies that the requirement of equal representation does not cause better performing men to be passed by. Thus accounting for the changes in tournament entry the experienced degree of reverse discrimination is smaller than anticipated.

The substantial difference between ex-post and ex-ante 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 imply that there are circumstances where it need not be costly to secure a more diverse set of winners, certainly it may be much cheaper than suggested by entrants in the standard tournament.

## VII. CONCLUSION

This paper contributes to the literature that tries to understand why women are underrepresented in many high-profile jobs and across whole professions. While discrimination and gender differences in preferences and ability help explain this gender gap, another explanation may be that men and women respond differently to competitive environments. Our study examines how and at what cost one can alter institutions to entice more women to compete. Specifically, we investigate a quota-like affirmative action environment where we require that women be at least equally represented among those hired. Our analysis provides a deeper understanding of why women shy away from competition, and helps us understand which mechanisms we may use to change this behavior. Furthermore, we are able to examine the performance costs and reverse discrimination that may be associated with such an institutional change.

While affirmative action is expected to affect tournament entry through changes in the probability of winning, other factors could influence entry as well. Decisions may change because we mention affirmative action, and because the competition becomes more gender specific (e.g., a woman wins as long as she is the best performing woman). 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.

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 is not fully accounted for by changes in the probability in winning, rather the factors listed above all help explain why the gender gap in tournament entry differs under affirmative action.

Our experimental design allows us to characterize how the composition of the applicant pool changes with affirmative action. Replicating the finding that women shy away from competition, we find that prior to affirmative action only few high-performing women choose

to compete. As a result, only rarely does a woman succeed in winning the tournament.<sup>41</sup> Using this initial applicant pool the requirement that at least one woman must be hired for every man implies that very few participants can be hired when a specific minimum standard of performance has to be reached. This implies that to hire the same number of people the minimum performance standard has to be lowered substantially. Based on entry in the standard tournament the under representation of women causes affirmative action to be very costly as many more qualified men 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.

Research on affirmative action has primarily focused on examining the consequences of changing the demand side of the market (see e.g., Coate and Loury, 1993, Fryer and Loury, 2005, and 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. We show that in assessing the costs of affirmative action we need to also account for the indirect effects that occur through self selection into competitions.<sup>42</sup> Specifically, we demonstrate that the effects of affirmative action on the set of applicants may be very large when entry decisions are not payoff maximizing. If we do not account for such changes in behavior we will exaggerate the costs of affirmative action.

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<sup>41</sup>Note that this gender difference arises in the absence of any discrimination.

<sup>42</sup> While most affirmative action studies examine the direct effect on those admitted under the program, a few studies also account for the indirect effects on applicants. Long (2004) and Card and Krueger (2005) examine how the elimination of affirmative action 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 vs. 10 percent 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.

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