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Pricing Competition: A New Laboratory Measure of Gender Differences in the Willingness to Compete

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A New Laboratory Measure of Gender Differences in the Willingness to Compete

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Abstract

Experiments have demonstrated that men are more willing to compete than women. We develop a new instrument to "price" willingness to compete. We find that men value a $2.00 winner-take-all payment significantly more (about $0.28 more) than women; and that women require a premium (about 40 percent) to compete. Our new instrument is more sensitive than the traditional binary-choice instrument, and thus, enables us to identify relationships that are not identifiable using the traditional binary-choice instrument. We find that subjects who are the most willing to compete have high ability, higher GPA's (men), and take more STEM courses (women).

1. Introduction

Laboratory experiments have demonstrated that men are significantly more willing to compete than women in stereotypically-male tasks (Niederle & Vesterlund (NV), 2011). This gender difference is ascribed to gender-variant beliefs about relative performance and preferences for competition;[1] and is believed to have a profound impact on the labor market, especially in the market for the most competitive jobs where women are underrepresented. For example, Bertrand and Hallock (2001) find that women held 2.5 percent of the five highest paid jobs at U.S. firms between 1992 and 1997. This disparity persists even in the face of female educational gains and greater government guarantees against gender discrimination (Goldin, Katz, & Kuziemko, 2006). While other factors—like childbirth, maternity leave, and the consequent beliefs about labor-force attachment—surely play a role, it has also been argued that gender-variant willingness to compete helps explain the disparity. Importantly, this is costly not only for women who may not advance in lucrative, male-dominated fields, but also for society as the best job candidate may not be matched with the corresponding job.

Two important questions follow (NV, 2011). First, what institutional changes could encourage more women to compete? Second, are preferences for competition changeable—that is, are they the result of nature or nurture? Of course, the generalized version of the latter question—what is responsible for observed gender differences?—is and has been the focus of research from a vast array of disciplines. Economists have begun to examine the former question. For example, Niederle, Segal, and Vesterlund (2013) investigate the impact of affirmative action in the NV (2007) setting. They find that having a quota for women increases women's willingness to compete, especially among high-ability women. Balafoutas and Sutter (2012) find that providing women with a handicap also increases women's willingness to compete (they also replicate NV's quota finding). Competing in teams has also been shown to reduce the gender difference in willingness to compete (Dargnies, 2009; Healy & Pate, 2011). Finally, Gupta, Poulsen and Villeval (2013) show that women are more willing to compete against women than against men.

In this paper we develop a new instrument that enables us to "price" each subject's willingness to compete. Specifically, we identify the minimum Piece-Rate (PR) payment that each subject prefers to a Winner-Take-All (WTA) payment by offering

[1] NV (2007) inspired a series of laboratory experiments to test the robustness and limits of their seminal finding. For example, researchers have (a) manipulated subjects' beliefs by providing subjects with feedback regarding their relative performance (e.g., Cason, Masters, & Sheremeta, 2010; Wozniak, Harbaugh & Mayr, 2014); (b) used tasks that are not stereotypically-male (e.g., Grosse & Riener, 2010; Kamas & Preston, 2009; Wozniak et al., 2014); (c) explicitly controlled for risk preferences (e.g., Cason et. al., 2010; Wozniak et al., 2014); and (d) employed proportional winner-take-all payments (e.g., Cason et. al., 2010). While this body of research has illustrated circumstances under which NV (2007) does not hold, the main finding (that men are significantly more willing than women to compete in stereotypically-male tasks) has been replicated repeatedly (see NV (2011) for a thorough review of the literature).

a series of choices between a $2.00 WTA payment and PR payments ranging from 0 to 100 percent of the WTA payment. In contrast, the traditional binary-choice instrument offers each subject a single choice, for example, between a $2.00 WTA payment and $0.50 PR, and consequently, generates a single data point regarding the subject's willingness to compete. Using our new instrument, we are able to demonstrate that men are more willing to compete than women for PR payments between 5 and 70 percent of the WTA payment, and that men value a $2.00 WTA payment significantly more than women, about $0.28 more. In a working paper, Gneezy and Pietrasz (2013) also develop a continuous measure of competition to investigate gender differences in competitiveness. In their experiment, subjects choose the percentage of their payoff to be determined by WTA-competition versus PR-payment. They find that this percentage is two times higher for men than women on average (63.8% versus 31.6%).

The second contribution of this paper is to consider whether financial incentives can be used to reduce gender differences in willingness to compete. Specifically, we calculate the "relative payoff"—WTA payment to PR payment—that is necessary for each subject to choose the WTA payment. We find that women require a significantly greater relative payoff—about 40 percent greater on average—to compete than do men. In the U.S., in contrast, women are paid less than men for similar jobs (Bertrand & Hallock, 2001). This suggests one reason that women are underrepresented in the most competitive, male-dominated jobs. They are not paid enough to compete for such jobs. Moreover, our research suggests that if women were offered a salary premium their underrepresentation in such jobs might be reduced. While readers may have inferred that women need greater incentives to compete than men from NV's results, the effect of incentives on willingness to compete has only been explicitly examined once in the literature, to our knowledge. In a robustness check, Gupta et al. (2013) increased the WTA-payment (relative to the PR-payment) and found that, while both men and women competed more, the gender gap in willingness to compete persisted. Our finding supports that women can be financially incentivized to compete, and our contribution is to measure the necessary level of financial incentives.

The third contribution of our paper is to explore the relationship between willingness to compete and performance in the experimental task. We are able to identify relationships that are not identifiable using the traditional binary-choice instrument, because our instrument is more sensitive and measures willingness to compete along a continuum. We find that subjects who are the most willing to compete also have high ability in the experimental task on average, a novel result in the literature.

Finally, we explore the relationship between willingness to compete and potential correlates of competitiveness from outside the lab: GPA, enrollment in Science, Technology, Engineering, and Mathematics (STEM) courses, and participation in varsity athletics. We find that there is a positive relationship between willingness to compete and GPA for men, but not for women; and a positive relationship between willingness to compete and taking STEM courses for women, but not for men. Kamas and Preston (2012) find no gender difference in willingness to compete between male and female STEM majors; our finding may help explain Kamas and Preston's finding. Finally, we find that female varsity college athletes are more willing to compete than women who are not varsity college athletes.

The STEM-result is interesting, as it has been suggested that the underrepresentation of women in STEM fields may help explain the gender wage gap. For example, McDonald and Thornton (2007) find that up to 95 percent of the gender gap in starting-salary offers is explained by the choice of major. One interpretation of our finding is that women who are less willing to compete are less likely to take STEM courses, and presumably enter STEM fields. This interpretation is in line with the findings of Buser et al. (2014). There, more competitive behavior in the NV experiment predicts more prestigious real career-track choices among secondary school students, with prestigious tracks more likely to be STEM. It is important to note, however, that our analysis is unable to demonstrate a causal link. Thus, this evidence is merely suggestive; and our result might, in contrast, imply that women who take more STEM courses become more willing to compete. This latter interpretation is interesting as well, as it addresses NV's second question: Are preferences for competition changeable? The GPA and varsity sports results could also be interpreted as suggesting that the preference for competition is changeable if causation runs from GPA and varsity sports participation to willingness to compete.

2. Experimental Design

In brief, our experimental procedure was as follows (additional details provided below). (1) Subjects read and signed the informed consent form. (2) Subjects completed four tasks in which they added five two-digit numbers for five minutes. Each task was incentivized with either a PR or WTA payment. In two tasks subjects chose the payment scheme. (3) Subjects completed a fifth task, in which they chose a payment scheme for task 1 retrospectively. (4) Subjects evaluated their performance on tasks 1-4. (5) Subjects completed five additional tasks that are part of a separate study and discussed in Ifcher and Zarghamee (2015). (6) Subjects completed a risk preference task. (7) Subjects answered questions regarding demographic and other characteristics. (8) Subjects received their payment and exited the session. Experimental sessions lasted approximately 90 minutes. Subjects received a minimum payment of $18 and an average of $30. The experiment was conducted using z-Tree (Fischbacher, 2007); NV graciously provided their z-Tree program, which we modified. All instructions were read aloud by the experimenter and are included in Appendix A, which is available upon request from the authors.[2]

[2] We ran three pilot sessions with 36 subjects in the summer of 2012. The pilot sessions did not include the five additional tasks that are described in item (5) above. The pilot data is not included in the analysis.

2.1. Subjects

The laboratory experiment was conducted at Santa Clara University in the fall of 2012. 108 undergraduate students (58 male, 50 female) were recruited from courses that all undergraduate students are required to take. These courses were chosen in an attempt to ensure that the sample was representative of the undergraduate student body. Prospective subjects were told that participation in the study would take about 90 minutes and that they would be paid for their participation, with a minimum and average payment of $16 and $32, respectively.

2.2. Tasks 1-3

This experiment builds upon NV (2007) and the first three tasks replicate those in NV (2007). Subjects had five minutes to perform summations; each summation was of five randomly chosen, two-digit numbers displayed horizontally across a computer screen. Subjects were given a pen and scrap paper to use during the session and were not allowed to use calculators. Immediately after subjects submitted an answer, the program informed them if their answer was correct, displayed the number of correct and incorrect answers submitted during the task, and presented a new summation problem. After five minutes, the task ended and subjects could not submit additional answers. Subjects received no feedback from the program or experimenter regarding the performance of other subjects.

The payment scheme for the first three tasks varied. Before completing each task, subjects received detailed instructions regarding the task and payment scheme. The task-1 payment scheme was a $0.50 PR payment per correct answer.

The task-2 payment scheme was a $2.00 WTA payment. Specifically, the subject who submitted the most correct answers within each group of four subjects received $2.00 per correct answer; the other group members received no payment. The computer settled ties randomly. The instructions explicitly stated that a subject's group included the three other subjects sitting in the same (front-to-back) row as the subject. When subjects arrived for the study, the experimenter assigned subjects to seats by simply stating, for example, "Please sit in seat 10." The order in which seats were assigned was not systematic except that the experimenter attempted to seat two female and two male subjects in each row. There was no explicit mention of the groups' gender balance; however, subjects could observe the other subjects in their group and session. Of 27 groups in the experiment, 24 had two male and two female subjects, two had three male and one female subject, and one had four male subjects. Reported results are robust to dropping the three groups that have an unequal number of male and female subjects.[3]

[3] The only exception is Column 3 of Table 1: when these three groups are dropped, there is no significant difference in the task-1-to-2 performance-improvement of women who choose WTA versus PR payment in task 3.

The task-3 payment scheme was determined by the subject's choice between the $0.50 PR and $2.00 WTA payment used in tasks 1 and 2, respectively. The instructions explicitly stated that if subjects choose the $2.00 WTA payment, then their task-3 performance would be compared to their group-mates' task-2 performance. The computer settled ties randomly.

2.3. Tasks 4-5

Task 4 used the same summation task as tasks 1-3 but had a different payment scheme. In an attempt to more fully understand subjects' preferences between PR and WTA payments, we offered subjects a series of choices between various PR payments, ranging from $0.00 to $2.00, and a $2.00 WTA payment. All choices were presented vertically on a single screen. The first choice was between a $0.00 PR and $2.00 WTA payment. The next was between a $0.10 PR and $2.00 WTA payment. Thereafter, the PR payment increased in $0.10 increments until it reached $2.00 (see Figure 1 for a screenshot). We expect subjects to choose the $2.00 WTA payment ($2.00 PR payment) when the alternative is a $0.00 PR payment ($2.00 WTA payment). We identify the strength of each subject's preference for a PR payment relative to a WTA payment by observing her switch point: the minimum PR payment the subject preferred to a $2.00 WTA payment.

In task 5 subjects chose retrospectively the payment scheme (using the task-4 payment scheme) they wanted to apply to their task-1 performance. Subjects were reminded how many questions they answered correctly in task 1, but received no information regarding other subjects' performance. As in NV (2007), task 5 is included in an attempt to rule out risk and feedback aversion as explanations for gender differences in the preference for PR payments.

2.4. Beliefs regarding rank in tasks 1-4

Subjects were asked to rank themselves relative to their group-mates in terms of the number of questions they answered correctly in tasks 1-4: 1st best, 2nd best, 3rd best, or 4th best (that is, worst). Subjects were informed that they would be paid an additional $1 for each task in which they ranked themselves correctly. Then subjects completed five additional tasks, 6-10, which used the same payment schemes as tasks 1-5, respectively, but used a task without agency instead of the summation task. Tasks 6-10 are not considered in the study and are part of a separate study discussed in Ifcher and Zarghamee (2015).[4]

2.5. Task 11

[4] In Ifcher and Zarghamee (2015) we explore subjects' willingness to compete in a task without agency. 100 subjects completed tasks 6-10 first and tasks 1-5 second. Generally, gender differences are not as stark in tasks 6-10 as in tasks 1-5. As we are primarily focused on the new instrument in this paper, we do not include the 100 subjects who completed the task without agency first and the summation task second in the analysis in this paper.

Task 11 was a standard risk-preference measure (Holt & Laury, 2002). Subjects chose between a series of fixed payments, ranging from $0.00 to $10.00, and a lottery with a 50% (50%) chance of a $10 ($0) payment. All choices were presented vertically on a single screen. The first choice was between a $0.00 fixed payment and the lottery. The next was between a $1.00 fixed payment and the lottery. Thereafter, the fixed payment increased in $1.00 increments until it reached $10.00.

2.6. Questionnaire

Subjects completed a questionnaire that included questions regarding their demographic and other characteristics, for example, date of birth, gender, race, family background, and subjective well-being. In addition, the questionnaire included questions regarding subjects' participation in competitive sports, which enabled us to examine whether such participation is correlated with willingness to compete. We also asked for subjects' permission to download their transcript and incorporate their choice of major, courses taken, and GPA into our analytical database; all subjects gave us permission to do so. This was done to examine whether the likelihood of enrolling in STEM courses is correlated with the preference for a PR payment.

2.7. Payments

Subjects were given detailed instructions regarding the calculation of their payment; again, all instructions were read aloud by the experimenter. Subject-payments included: a $5 show-up fee; $11 for completing the 11 tasks; a $1 payment for correctly indicating their rank in tasks 1-4 (and tasks 6-9); and a payment based on two of the 11 tasks. To determine which two tasks would be paid two numbers between one and 11 were randomly chosen (without replacement) after all subjects completed the questionnaire. If tasks 4 or 5 (or 9 or 10) were chosen, then one of the 21 PR payments was randomly chosen. If task 11 was chosen, then one of the 11 fixed payments was randomly chosen and the lottery was implemented. All randomization was implemented using a bingo spinner. Subjects were paid in cash. The payment was placed in an envelope with only the subjects' identification number on it. Subjects received their payment as they exited the session.

3. Results

3.1. Replication of main NV (2007) findings

We begin by replicating NV's main results. First, there is no gender difference in performance in tasks 1-4. For example, in task 1 men and women correctly answer 9.6 and 8.8 questions, respectively, on average ($p = 0.40$); all p-values reported in the paper are two-sided. One male subject correctly answered 49 questions per task on average; the second best performing subject correctly answered 20 questions per task. If the best performing subject is dropped, then men and women correctly answer 9.0 and 8.8 questions, respectively, on average (p = 0.81).[5] Subjects' performance is correlated across the tasks for both genders (Spearman rank correlations range from a low of 0.52 for women between tasks 1 and 2 to a high of 0.84 for men between tasks 3 and 4). Finally, performance improves significantly between tasks 1 and 2; marginally between tasks 2 and 3; and insignificantly between tasks 3 and 4 for both genders (men: 9.6, 10.6, 11.4, and 11.6; women: 8.8, 10.5, 11.0, and 11.1, respectively).

Second, compared to women, men are significantly more likely to choose the $2.00 WTA payment when offered a choice between it and the $0.50 PR payment in task 3 (0.57 versus 0.34, p = 0.02). Examining the relationship between the task-3 choice and performance on tasks 1 and 2, one finds that, for both men and women, those who choose the WTA payment do not perform significantly better in tasks 1 and 2 than do those who choose the PR payment (p ≥ 0.14 for all measures) (see Table 1). For men, the improvement in performance between tasks 1 and 2 is not significantly different for those who choose the WTA versus PR payment in task 3 (1.2 versus 1.0, p = 0.83). For women, however, those who choose the WTA payment improve significantly more between tasks 1 and 2 than those who choose the PR payment (2.9 versus 1.0, p = 0.03). This result diverges from NV (2007). Lastly, a probit regression shows that women are significantly less likely than men (marginal effect = 24 percentage points) to choose the WTA payment, controlling for task-2 performance and improvement in performance between tasks 1 and 2.

3.2. Measuring willingness to compete using PR-equivalents

We identify the strength of each subject's preference for a PR payment by observing the PR-payment equivalent of the WTA payment (hereafter denoted "PR-equivalent"): the minimum PR payment the subject chooses over a $2.00 WTA payment. PR payments increase in $0.10 increments so a subject who switches at the $0.60 PR payment might have switched at a PR payment between $0.51 and $0.59 as well. The greater the PR-equivalent, the greater the PR payment needs to be (relative to the $2.00 WTA payment) for a subject to choose the PR payment. We interpret a greater PR-equivalent as indicating a greater willingness to compete.

Of the 108 subjects, 100 have identifiable PR-equivalents. Specifically, 96 choose the WTA payment when the PR payment is $0.00, continue to choose the WTA payment until a unique PR payment at which they choose the PR payment, and thereafter choose the PR payment for all remaining PR payments. Two subjects always choose the WTA payment for all PR payments, including the $2.00 PR payment; these subjects are coded as having a $2.10 PR-equivalent. Conversely, two subjects always

[5] During task 2 one female subject raised her hand and reported that she could not enter an answer to a summation question into the computer. The experimenter walked over to her computer and entered the answer for her without a problem. After that she did not report any problems entering answers into the computer. The experimenter told her that if task 2 was selected as the payment task her payment would be adjusted. Task 2 was not selected as a payment task for the session.

choose the PR payment, even when it is $0.00; they are coded as having a $0.00 PR-equivalent. Finally, eight subjects' PR-equivalent cannot be identified, as their choices do not follow any of the preceding patterns. For example, some switch between the WTA and PR payments more than once. These eight subjects are dropped from all further analyses.

The mean PR-equivalent is $0.81, illustrating that on average subjects require a $0.81 PR payment to switch from the $2.00 WTA payment to the PR payment. The median and modal PR-equivalents are $0.60 and $0.50, respectively. Figure 2 illustrates the Cumulative Distribution Function (CDF) of the PR-equivalents by gender. One observes a clear distinction between the CDFs (Fisher's exact test: p = 0.04). The mean and median PR-equivalents are significantly greater for men than women, $0.94 versus $0.66 (p = 0.01), and $0.85 versus $0.60, respectively. Further, the female CDF is everywhere to the left of the male CDF, indicating that a greater percentage of women choose the PR payment over the WTA payment at all PR payments. Thus, NV's seminal finding is not dependent on the relative payoff being four ($2.00 WTA to $0.50 PA payment). The vertical distance between the male and female CDFs (the difference in the percent of men and women that choose the PR payment at a given PR payment) is smaller at PR payments near $0.00 and $2.00. Estimating this vertical distance, we regress subjects' choices (1 = WTA payment and 0 = PR payment) for all PR payments on gender; we cluster the observations by subject, as subjects' 21 choices are not independent. Women are 13.5 percentage points less likely to choose the WTA payment than men (p = 0.01); limiting the analysis to PR payments between $0.50 and $1.50, women are 17.5 percentage points less likely than men to choose the WTA payment (p = 0.01).

One can compare subjects' choices between a $0.50 PR and $2.00 WTA payment in task 3, where the choice is presented as in NV (2007), and in task 4, where it is presented as the sixth of 21 choices. The framing appears to have an impact on subjects' choices. In the former setting, 59 percent of men and 35 percent of women choose the WTA payment (these results are slightly different than those presented previously, as the eight subjects with unidentifiable task-4 PR-equivalents are not included). In the latter setting, the percent of men (women) who choose the WTA payment increases by 10 (19) percentage points (p = 0.17 (p = 0.01)) to 69 (54) percent. That women's choices are more affected is perhaps not surprising given that Croson and Gneezy (2009) find that women are more context-sensitive than men. Examining each PR payment separately, women are significantly less likely to choose the WTA payment than men for all PR payments between $0.10 and $1.30 (p < 0.10 for each) except the $0.50 PR payment. The lack of a significant gender difference at the $0.50 PR payment appears to be idiosyncratic as there is a significant gender difference for neighboring PR payments. Lastly, subjects' task-3 choice of payment scheme (1 = WTA payment and 0 = PR payment) is highly correlated with their task-4 PR-equivalent (Spearman rank correlation = 0.61, p = 0.00), suggesting that both instruments are measuring a similar parameter.

3.3. Using PR-equivalents to calculate the "relative payoff"

It has been argued that gender differences such as those observed in this and other papers are important as they may explain the paucity of women in some highly competitive jobs (NV, 2011). In other words, women shy away from positions that include compensation schemes that mimic, in some respects, WTA payments. PR-equivalents enable us to examine how much greater a WTA payment has to be than a PR payment so that a subject chooses the WTA payment. Specifically, the "relative payoff" is the WTA payment divided by the PR-equivalent. For example, if a subject's PR-equivalent is $0.80, then the relative payoff is 2.5 (= $2.00 WTA payment ÷ $0.80 PR-equivalent). That is, the subject will choose the WTA payment as long as the relative payoff is weakly greater than 2.5; otherwise she will choose the PR payment. Relative payoffs can range from one ($2.00 PR-equivalent) to infinity ($0.00 PR-equivalent). We interpret requiring a greater relative payoff as indicating a lower willingness to compete.

Next we repeat the analysis above using relative payoffs. Women, on average, choose the WTA payment as long as the relative payoff is weakly greater than 3.0 (= $2.00 WTA payment ÷ $0.66 mean PR-equivalent). In contrast, men, choose the WTA payment as long as the relative payoff is weakly greater than 2.1 (= $2.00 WTA payment ÷ $0.94 mean PR-equivalent). Thus, compared to men, women require a 43 percent "premium," on average, to choose the WTA payment. Using the median PR-equivalent the result is similar (women: 3.3; men: 2.4; and 37 percent premium). These results suggest that, all else equal, women require a larger payoff to compete.

In their seminal work, NV offer subjects a single, carefully chosen relative payoff: four (= $2.00 WTA ÷ $0.50 PR payment). NV choose this relative payoff as it ensures that the expected payoff is the same for PR and WTA payments if a subject's chance of winning the WTA tournament is 25 percent. Using NV's instrument, one cannot determine the relative payoff required for a subject chooses the WTA payment.

3.4. PR-equivalents and performance

Regressing task-4 PR-equivalents on gender and task-3 performance, the coefficient on female is negative and significant (b = -0.27, p = 0.01), indicating that after controlling for performance women's mean PR-equivalent is $0.27 less than men's (see Column 1 of Table 2). If one does not control for task-3 performance, the coefficient on female is virtually unchanged, b = -0.28 (p = 0.01) (see Column 2 of Table 2); thus, performance does not appear to explain the gender difference in willingness to compete.

The coefficient on task-3 performance is positive and significant (b = 0.03, p = 0.00), indicating that for each additional summation question a subject answers correctly her PR-equivalent increases by $0.03, on average.[6] Controlling for improvements in

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[6] We control for task-3 performance, as subjects choose their task-4 PR-equivalent before completing task 4, and thus, could not be influenced by their task-4 performance. The coefficients on female and

performance (between tasks 1 and 2, and 2 and 3) does not affect the results (see Column 3 of Table 2). Our performance-result diverges from NV (2007); NV find an insignificant relationship. This raises the question: do our results diverge because of different instruments or samples? To examine this question we perform a probit regression of task-3 choice (1 = WTA payment and 0 = PR payment) on task-2 performance and improvement in performance between tasks 1 and 2. The coefficient on task-2 performance is insignificant (see Column 4 of Table 2). This replicates the NV's result. Thus, our instrument appears to be more sensitive than the traditional binary-choice instrument.

3.5. PR-equivalents, beliefs about performance, and risk preferences

Male college students are believed to be more overconfident than female college students, especially in stereotypically male tasks (Croson & Gneezy, 2009; Ifcher & Zarghamee 2014; NV, 2007). In our sample, men's mean task-3 self-rank (where 1 = 1^{st} best, …, 4 = 4^{th} best) is significantly higher than women's (1.7 versus 2.3, p = 0.00), even though men's mean task-3 performance is not significantly better than women's (11.4 versus 11.0, p = 0.71). Men's greater willingness to compete could simply be the result of their greater overconfidence. Regressing task-4 PR-equivalents on gender and task-3 self-rank, the coefficient on female is negative and significant (b = -0.20, p = 0.04), indicating that after controlling for overconfidence men have a greater willingness to compete, as measured by PR-equivalents, than women (see Column 5 of Table 2). The coefficient on task-3 self-rank is negative and significant (b = -0.14, p = 0.02), indicating that willingness to compete is increasing with self-rank. These results mirror NV (2007).

Another potential explanation for the observed gender difference in willingness to compete is variant risk preferences. Men are believed to be less risk averse than women (Croson & Gneezy, 2009; Eckel & Grossman, 2002). In our study, we measure risk preferences using a Holt-Laury lottery (task 11). We identify subjects' task-11 certainty equivalent using the same procedure as we use to determine subjects' PR-equivalent. Of 100 subjects with identifiable task-4 PR-equivalents, 99 have identifiable task-11 certainty equivalents. The greater the task-11 certainty equivalent, the greater the fixed payment is when the subject switches from the lottery to the fixed payment, indicating the subject is less risk averse. In our sample, the mean task-11 certainty equivalent is marginally greater for men than women ($5.20 versus $4.70, p = 0.09), suggesting that men in our study are less risk averse than women. Regressing task-4 PR-equivalents on gender and task-11 certainty equivalents, the coefficient on female is negative and significant (b = -0.21, p = 0.03), indicating that after controlling for risk preferences, as measured by task-11 certainty equivalents, men have a greater willingness to compete, as measured by

performance are similar if we control for task-2 or -4 performance. Also, the relationship between task-4 PR-equivalents and task-3 performance is similar if we topcode the task-3 performance of the outlier who submitted 49 correct summations per task to the next-best performance, 20 correct summations; this suggests the performance-result is not driven by the outlier.

task-4 PR-equivalents, than women (see Column 6 of Table 2). The coefficient on task-11 certainty equivalents is positive and significant (b = 0.14, p = 0.00), indicating that willingness to compete increases as risk aversion decreases.

Controlling for task-3 performance, task-3 self-rank, and task-11 certainty equivalents in the same regression, the coefficient on female remains negative and significant (b = -0.18, p = 0.04), indicating that, after controlling for performance, self-rank, and risk preferences, men have a greater willingness to compete than women (see Column 7 of Table 2). Gneezy and Pietrasz (2013) also use a Holt-Laury measure to control for risk preferences in the relationship between gender and their continuous measure of competitive preferences; they also find that the gender gap in competitiveness persists when controlling for risk preferences. Controlling for self-rank and risk preferences does not diminish the relationship between willingness to compete and performance. The coefficient on task-3 performance is positive and significant (b = 0.03, p = 0.01), indicating that the positive relationship between performance and willingness to compete is not explained by self-rank and risk preferences.

Finally, repeating the analysis from Column 7 of Table 2 for men and women separately, we find that the relationship between willingness to compete and performance and self-rank hold for men but for not women (see Columns 8 and 9 of Table 2). For men, the coefficient on task-3 performance and on task-3 self-rank are 0.03 (p = 0.00) and -0.14 (p = 0.06), respectively. The relationship between willingness to compete and risk preferences is similar for men and women (men: b = 0.11, p = 0.00, and women: b = 0.13, p = 0.01).

3.6. Expected payments

To examine the impact of subjects' choices on their payments, we calculate each subject's expected payment based on her choices for each of the 21 offered PR payments in task 4. For example, if a subject chose the $0.50 PR payment over the $2.00 WTA payment, then her expected payment would be the product of $0.50 and her task-4 performance. In contrast, if a subject chose the $2.00 WTA payment over the $0.50 PR payment, then her expected payment would be the product of the $2.00, her task-4 performance, and the probability of winning the WTA tournament, where the probability of winning is imputed using the distribution of winners' task-2 performance. For each subject we also calculate the subject's maximum possible expected payment for each of the 21 offered PR payments. Specifically, we calculate a subject's expected payment from choosing the PR and WTA payment (as described above), and select the larger of the two.

The expected payments of subjects' choices are, on average, 88 percent of their maximum possible expected payments. As a percentage of the maximum possible expected payment, the expected payment from subjects' choices is greatest when the PR payment is $0.00 or $2.00, as almost all subjects chose the WTA and PR payment, respectively. Figure 3 presents the percent of the maximum possible expected payment represented by the expected payment of subjects' choices. As a percentage of the maximum possible expected payment, the expected payment from subjects' choices is lowest—74 percent— at the $0.50 PR payment. Interestingly, the analogous calculation for task 3 (when $0.50 is the only PR payment offered) is 69 percent, which is not significantly different (p-value of difference = 0.23).

Next, we examine whether the percent of the maximum possible expected payments is related to task-3 performance using both linear and quadratic regressions controlling for task-3 self-rank and task-11 certainty equivalent. No significant pattern emerges. We use the same specification to examine whether the percent of the maximum possible expected payments is related to task-4 PR-equivalents and find a marginally significant quadratic relationship (see Column 1 of Table 3 and Figure 4). This suggests that both low and high willingness to compete are associated with lower payments relative to the maximum possible expected payments.

Dividing the sample into low- and high-performing subgroups—subjects who perform worse than and better than the task-3 median (11 summations)—reveals a relationship between the percent of the maximum possible expected payment and risk preferences. The coefficient on the task-11 certainty equivalent is negative and significant ($b = -6.45$, $p = 0.04$) for the low-performing subgroup, and positive and significant ($b = 2.65$, $p = 0.01$) for the high-performing subgroup (see Columns 2-4 of Table 3). This indicates that, for low-performing (high-performing) subjects, the percent of the maximum possible expected payment is increasing (decreasing) with risk aversion. In other words, for low-performing subjects, risk aversion is positively related to the percent of the maximum possible expected payment represented by the expected payment of subjects' choices. The magnitude of the coefficient is large: requiring an extra dollar to switch from the lottery to the fixed payment is associated with a loss of 6.45 percentage points of the maximum possible expected payment. The relationship is the opposite for the high-performing subjects, but the coefficient is smaller. This indicates that reduced risk aversion is positively related to the percent of the maximum possible expected payment for high-performing subjects. It is also interesting that the coefficient on female is negative and marginally significant ($b = -6.86$, $p = 0.09$) for the high-performing subjects but not for the low-performing subjects, suggesting that high-performing females earn a lower percentage of their maximum possible expected payment than do their male counterparts. This gender difference is not observed for the low-performing subjects. This result is in line with the NV (2007) result that high-performing women under-compete.

3.7. PR-equivalents, STEM courses, GPA, and varsity sports

It has been suggested that gender differences in willingness to compete may explain the paucity of women in STEM fields. To explore whether this is the case, we regress task-4 PR-equivalents on the number of STEM courses subjects have taken.[7] We do not investigate the relationship between willingness to compete and STEM majors as 46 of 100 subjects had not declared a major at the time of the study. The coefficient on the number of STEM courses taken is insignificant. The results change markedly, however, when the analysis is repeated separately for men and women. The coefficient on STEM courses is positive and significant for women (b = 0.03, p = 0.01) and insignificant for men (see Columns 1-3 of Table 4). This indicates that women who take more STEM courses have a greater willingness to compete, as measured by their PR-equivalents, than do women who take fewer STEM courses.

Examining the relationship between willingness to compete and cumulative GPA one finds the opposite pattern: a positive and significant relationship for men (b = 0.27, p = 0.01) and an insignificant one for women (see Columns 4-6 of Table 4). This indicates that men with higher GPAs have a higher willingness to compete than men with lower GPAs. As a specification check, we include STEM courses and GPA as independent variables in the same regression, and the results are unchanged. The juxtaposition of these two results can lead to some interesting speculation. For example, for men (but not women) doing well academically is associated with willingness to compete; and for women (but not men) taking STEM courses is associated with willingness to compete. It must be noted that the relationships identified above are correlational, not causal.

In an attempt to explore whether preferences for competition are changeable we ask subjects about their participation in varsity sports. We first consider participation in college varsity sports. Regressing task-4 PR-equivalents on participation in college varsity sports, we find that the coefficient on participation is positive and significant for women (b = 0.85, p = 0.05) but insignificant for men (see Columns 7-9 of Table 4). This indicates that for women, participating in college varsity sports is positively related to willingness to compete. The magnitude of the effect is noteworthy, implying that participation is associated with a $0.85 increase in task-4 PR-equivalent. Caution must be used when interpreting this result as it is based on two female and three male college varsity athletes. Further, whether more competitive women participate in college varsity sports or whether women learn to be more competitive through college varsity sports is not identifiable in this study.[8]

[7] We control for task-3 performance, task-3 self-rank, and task-11 certainty equivalents in all subsequent regressions.

[8] Examining the relationship between willingness to compete and participation in high school varsity sports, we regress task-4 PR-equivalents on participation in high school varsity sports. We find that the relationship is negative and insignificant for both men and women (men: b = -0.23, p = 0.21, and women: b = -0.05, p = 0.66). One possible explanation for the negative relationship might be that high school varsity athletes learn to be less overconfident through competing and inevitably losing—an effect that may be especially strong for low-performing men, since they can be the most overconfident. In our sample we find support for this explanation: high school varsity athletes rank themselves lower than non-athletes, a difference that is larger for men (1.9 versus 1.2, p = 0.01) than for women (2.4 versus 2.2, p = 0.35), and is largest for men whose task-3 performance is below the median (2.3 versus 1.4, p = 0.05). Restricting the regression to men with task-3 performance below the median, we find that the coefficient on high school varsity participation is negative and

Lastly, the relationships identified between willingness to compete and STEM courses, GPA, and college varsity sports participation are not identifiable using task-3 choices. Specifically, we conduct the analogous analyses except with a probit regression using task-3 choices (1 = WTA payment and 0 = PR payment) as the dependent variable and controlling for task-2 performance and self-rank. All coefficients of interest are insignificant.

3.8. Task 5

Subjects retrospectively chose the payment scheme they wanted to apply to their task-1 performance. In NV (2007), an analogous task is used to rule out potential explanations for the observed gender difference in willingness to compete. NV find no significant gender difference in retrospective choices, controlling for task-1 performance and self-rank. They argue that the salient difference between the two results is that subjects complete the task *after* making their choice only in the main result. They interpret this finding as demonstrating that the observed gender difference in the main result is explained by a variant preference for competition and not by other factors, for example, overconfidence and feedback and risk aversion. Replicating NV's exercise, we regress task-5 PR-equivalents on gender, task-1 performance, and task-1 self-rank. The coefficient on female is negative and marginally significant (b = -0.14, p = 0.07) (see Column 1 of Table 5). Thus, there is some evidence that there is a gender difference when using retrospective choices. However, the coefficient becomes insignificant (b = -0.10, p = 0.18) if one adds task-11 certainty equivalents (risk aversion) to the regression (see Column 2 of Table 5). NV did not measure subjects' risk preferences directly, so they could not conduct an analogous regression.

4. Conclusion

We develop a new instrument to "price" willingness to compete. We find that men value a $2.00 WTA payment significantly more than women, about $0.28 more. Our instrument allows us to calculate the premium women require (relative to men) in order to compete, about 40 percent. While surely just coincidental, a 2009 Bloomberg report indicated that the 16 female CEOs of S&P 500 companies were paid 40 percent more than their male counterparts. Clearly, this pattern does not hold generally, as women are usually paid less than men for similar top corporate jobs. Our findings suggest an extra channel through which the gender wage differential may impede the promotion of women to highly competitive jobs.

Further, our new instrument is more sensitive than the traditional binary-choice instrument, as it measures willingness to compete along a continuum. For example,

marginally significant (b = -0.47, p = 0.08): participation in high school varsity athletics is associated with a $0.47 decrease in task-4 PR-equivalent for low-performing men.

we identify significant relationships between willingness to compete and performance, cumulative GPA, enrollment in STEM courses, and varsity sports participation. The traditional binary-choice instrument failed to identify these relationships. Lastly, the gender-specificity of some of these relationships bears note. We find that STEM courses and college-varsity sports participation are positively correlated with willingness to compete for women but not men, and that GPA and willingness to compete are related for men but not women. Indeed, this last result—the lack of a relationship between GPA and willingness to compete for women—mirrors and may in part explain a real world phenomenon, namely the persistence of gender gaps in labor market outcomes despite, albeit small, reverse gaps in schooling.

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Table 1: Task-1 and -2 performance by gender and choice of task-3 payment scheme

Gender	Choice of payment scheme in task 3	Average performance			Observations
		Task 1 (1)	Task 2 (2)	Task 2 - Task 1 (3)	
Women	PR payment	8.94 (0.45)	9.94 (0.56)	1.00 (0.42)	33
	WTA payment	8.65 (0.71)	11.53 (1.00)	2.88 (0.85)	17
	p-value	0.72	0.14	0.03	
Men	PR payment	8.56 (0.62)	9.68 (0.59)	1.12 (0.39)	25
	WTA payment	10.39 (1.25)	11.36 (1.34)	0.97 (0.53)	33
	p-value	0.24	0.30	0.83	

Note: Standard errors reported in parentheses. The p-values correspond to two-tailed tests of equal performance for those who chose PR versus WTA payment in Task 3.

Table 2: Estimates from regressing task-4 PR-equivalents on gender, performance, self-rank, and certainty equivalents

	(1)	(2)	(3)	Task 3 WTA (4)	(5)	(6)	(7)	Male Only (8)	Female Only (9)
Female	-0.268***	-0.284***	-0.276***	-0.258***	-0.197**	-0.212**	-0.183**		
	(0.097)	(0.101)	(0.097)	(0.098)	(0.096)	(0.093)	(0.088)		
Task-3 performance	0.031***		0.032***				0.025***	0.025***	0.015
	(0.008)		(0.009)				(0.009)	(0.006)	(0.038)
Task-2 performance				0.016					
				(0.012)					
Improvement between tasks 1 and 2			0.010	0.013					
			(0.020)	(0.022)					
Improvement between tasks 2 and 3			-0.013						
			(0.021)						
Task-3 self-rank					-0.136**		-0.037	-0.137*	0.038
					(0.059)		(0.060)	(0.071)	(0.106)
Task-11 (lottery) certanty equivalent						0.136***	0.123***	0.107***	0.126***
						(0.027)	(0.029)	(0.029)	(0.046)
Task-2 self-rank									
Observations	100	100	100	100	100	99	99	53	46

Note: All columns but 4 report OLS estimates; the dependent variable is the task-4 PR-equivalent. Columns 4 report marginal effects from a probit regression; the dependent variable is an indicator variable that equals one if the subject choose the WTA payment in task 3 and zero otherwise. Standard errors reported in parentheses. ***, **, * indicate statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 3: Estimates from regressions with the percent of maximum possible expected payment as the dependent variable

Dependent variable: percent of maximum possible expected payment	All (1)	All (2)	Task-3 worse than median (3)	Task-3 better than median (4)
Female	-1.216	-1.806	-0.539	-6.863*
	(2.889)	(2.832)	(5.818)	(3.910)
Task-4 PR-equivalent	3.172**			
	(1.531)			
Task-4 PR-equivalent squared	-0.163*			
	(0.084)			
Task-3 performance	0.448	0.079	1.923	0.057
	(0.438)	(0.322)	(1.420)	(0.336)
Task-3 self-rank	1.794	0.613	3.114	1.095
	(2.531)	(2.771)	(3.982)	(3.256)
Task-11 (lottery) certainty equivalent	-1.607	-1.597	-6.447**	2.648***
	(1.239)	(1.624)	(2.955)	(0.955)
Observations	99	99	43	44

Note: All columns report OLS estimates. Columns 3 and 4 restrict the sample to those who performed worse and better than the median in task 3, respectively. Standard errors reported in parentheses. ***, **, * indicate statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 4: Estimates from regressing task-4 PR-equivalents on gender, STEM courses, GPA, performance, self-rank, and certainty equivalents

Dependent variable: Task-4 PR-equivalent	All (1)	Men (2)	Women (3)	All (4)	Men (5)	Women (6)	All (7)	Men (8)	Women (9)
Female	-0.168*			-0.222**			-0.172*		
	(0.088)			(0.088)			(0.087)		
STEM courses	0.010	-0.003	0.027***						
	(0.008)	(0.007)	(0.009)						
Cumulative GPA				0.248***	0.266***	0.147			
				(0.091)	(0.094)	(0.246)			
Varsity college sports							0.315	0.071	0.851**
							(0.256)	(0.246)	(0.416)
Task-3 performance	0.026***	0.025***	0.015	0.022**	0.023***	0.015	0.023**	0.025***	-0.001
	(0.008)	(0.006)	(0.036)	(0.009)	(0.007)	(0.039)	(0.009)	(0.006)	(0.037)
Task-3 self-rank	-0.038	-0.138*	0.021	-0.027	-0.113	0.040	-0.045	-0.139*	0.020
	(0.058)	(0.070)	(0.107)	(0.060)	(0.073)	(0.109)	(0.060)	(0.071)	(0.110)
Task-11 (lottery) certainty equivalent	0.124***	0.106***	0.118***	0.115***	0.104***	0.119**	0.128***	0.109***	0.1298**
	(0.029)	(0.031)	(0.044)	(0.029)	(0.027)	(0.051)	(0.029)	(0.030)	(0.049)
Observations	99	53	46	99	53	46	99	53	46

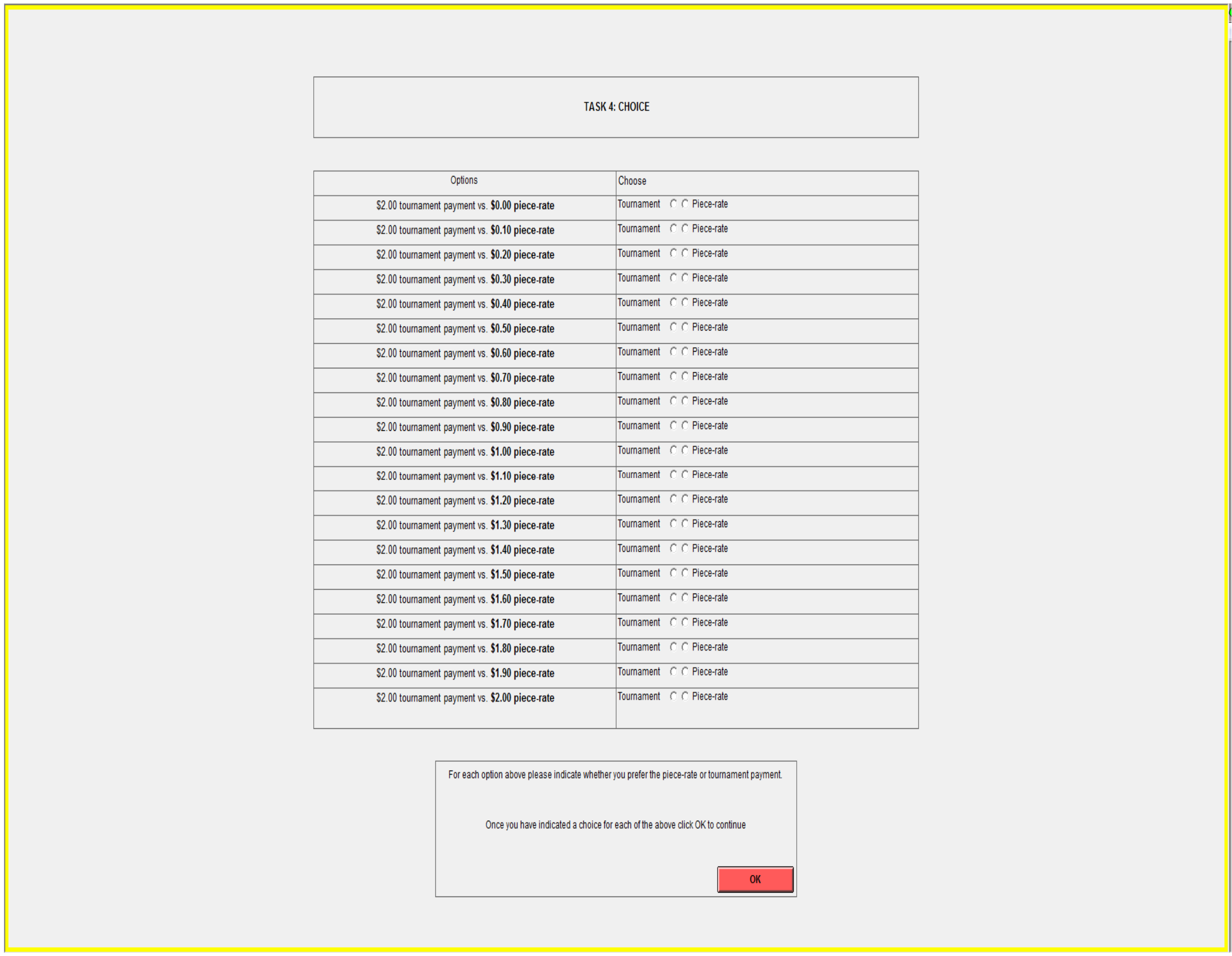
Note: OLS estimates reported. Standard errors reported in parentheses. ***, **, * indicate statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 5: Estimates from regressing task-5 PR-equivalents on gender, performance, self-rank, and certainty equivalents

Dependent variable: Task-5 PR-equivalent	(1)	(2)
Female	-0.139*	-0.096
	(0.077)	(0.072)
Task-1 performance	0.031***	0.030***
	(0.008)	(0.008)
Task-1 self-rank	-0.209***	-0.209***
	(0.048)	(0.045)
Task-11 (lottery) certainty equivalent		0.076***
		(0.026)
Observations	96	96

Note: OLS estimates reported. Standard errors reported in parentheses. ***, **, * indicate statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

Figure 1: Screen shot of choices between various PR payments, ranging from $0.00 to $2.00, and a $2.00 WTA payment



TASK 4: CHOICE

Options	Choose
$2.00 tournament payment vs. **$0.00 piece-rate**	Tournament ◯ ◯ Piece-rate
$2.00 tournament payment vs. **$0.10 piece-rate**	Tournament ◯ ◯ Piece-rate
$2.00 tournament payment vs. **$0.20 piece-rate**	Tournament ◯ ◯ Piece-rate
$2.00 tournament payment vs. **$0.30 piece-rate**	Tournament ◯ ◯ Piece-rate
$2.00 tournament payment vs. **$0.40 piece-rate**	Tournament ◯ ◯ Piece-rate
$2.00 tournament payment vs. **$0.50 piece-rate**	Tournament ◯ ◯ Piece-rate
$2.00 tournament payment vs. **$0.60 piece-rate**	Tournament ◯ ◯ Piece-rate
$2.00 tournament payment vs. **$0.70 piece-rate**	Tournament ◯ ◯ Piece-rate
$2.00 tournament payment vs. **$0.80 piece-rate**	Tournament ◯ ◯ Piece-rate
$2.00 tournament payment vs. **$0.90 piece-rate**	Tournament ◯ ◯ Piece-rate
$2.00 tournament payment vs. **$1.00 piece-rate**	Tournament ◯ ◯ Piece-rate
$2.00 tournament payment vs. **$1.10 piece-rate**	Tournament ◯ ◯ Piece-rate
$2.00 tournament payment vs. **$1.20 piece-rate**	Tournament ◯ ◯ Piece-rate
$2.00 tournament payment vs. **$1.30 piece-rate**	Tournament ◯ ◯ Piece-rate
$2.00 tournament payment vs. **$1.40 piece-rate**	Tournament ◯ ◯ Piece-rate
$2.00 tournament payment vs. **$1.50 piece-rate**	Tournament ◯ ◯ Piece-rate
$2.00 tournament payment vs. **$1.60 piece-rate**	Tournament ◯ ◯ Piece-rate
$2.00 tournament payment vs. **$1.70 piece-rate**	Tournament ◯ ◯ Piece-rate
$2.00 tournament payment vs. **$1.80 piece-rate**	Tournament ◯ ◯ Piece-rate
$2.00 tournament payment vs. **$1.90 piece-rate**	Tournament ◯ ◯ Piece-rate
$2.00 tournament payment vs. **$2.00 piece-rate**	Tournament ◯ ◯ Piece-rate

For each option above please indicate whether you prefer the piece-rate or tournament payment.

Once you have indicated a choice for each of the above click OK to continue

OK

Figure 2: CDF of PR-equivalents by gender

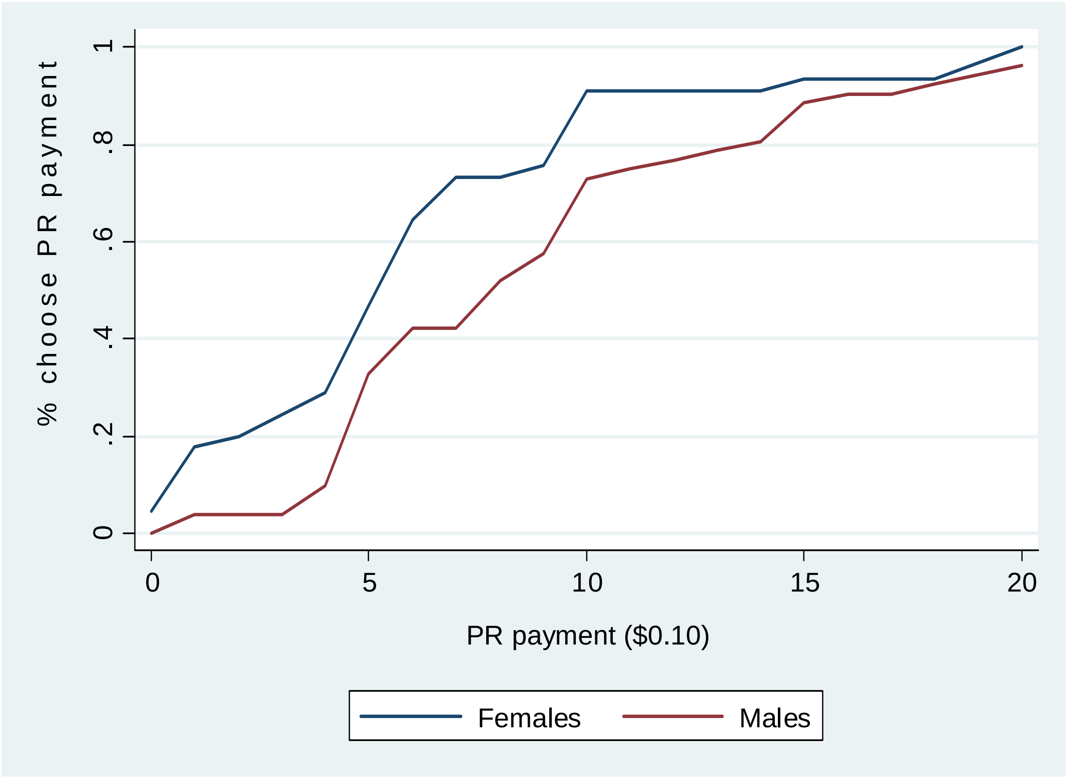


Figure 3: Average percent of the maximum possible expected payment represented by the expected payment of subjects' choices by PR payment

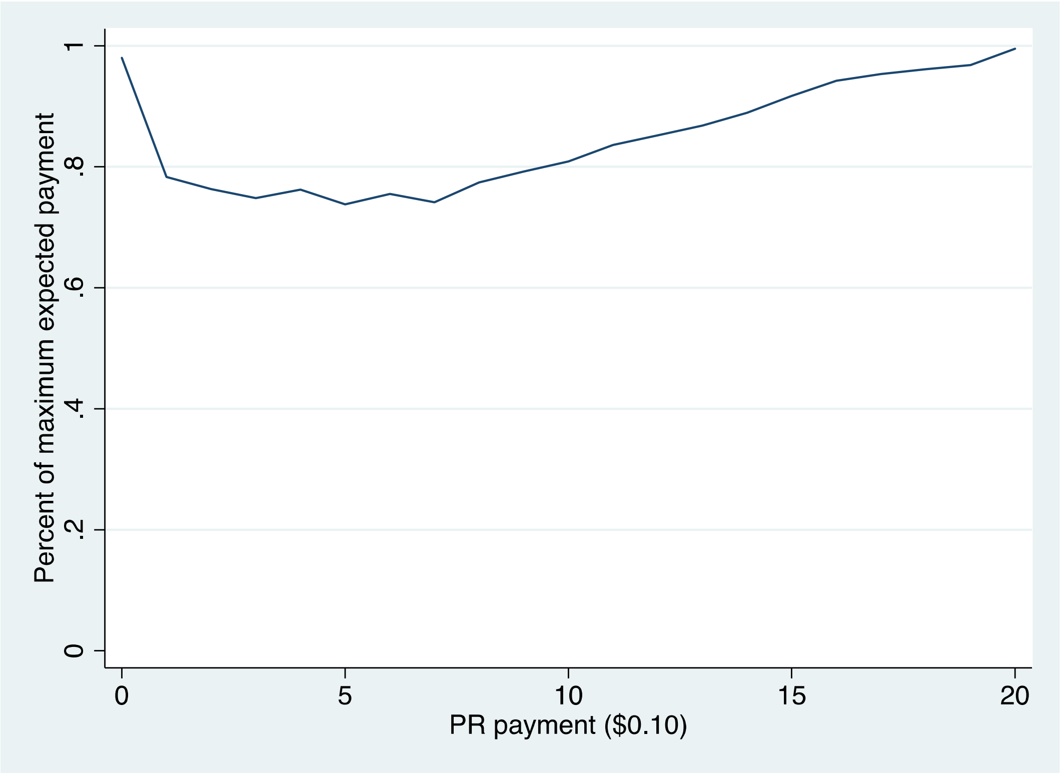


Figure 4: Relationship between the percent of the maximum possible expected payments and task-4 PR-equivalents