Competition and Academic Performance: Evidence from a Classroom Experiment *

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July 21, 2017

Abstract

We examine the effect of relative evaluation on academic performance by implementing a classroom-level field experiment in which students are incentivized individually or in a tournament to take a microeconomics quiz. We focus on two aspects of competitive environments that may be particularly salient in academics: tournament size and one's perceived position in the ability distribution. At least in our setting, we find no evidence that effort responses to competition are sensitive to tournament size. However, in contrast to previous studies that examine effort responses to exogenously assigned competition, we find a large negative competition effect for students who believe they are relatively low in the ability distribution and no competition effect for those who believe they are relatively high ability. Using additional treatments, we further show that the divergence between our results and past results is driven by task type and not by differences in selection into participation between lab and field environments.

*We thank the office of Institutional Research, Planning and Assessment at UC Santa Barbara for access to administrative data. We also thank the UCSB economics and accounting instructors who donated class time to the experiment. This paper has benefited from helpful comments from Jenna Stearns, Gary Charness, Aric Shafran, Brian Duncan, Rey Hernandez-Julian, and seminar participants at the Federal Reserve Bank of New York and Claremont McKenna College. All errors are our own.

1 Introduction

Success in higher education often hinges on relative performance. Admission to selective colleges is in large part determined by class rank and relative scores on entrance exams. Undergraduate grades are often assigned using a curve. And, graduate and professional schools rely heavily on standardized tests to determine admission. This paper adds to the growing literature examining effort responses to competition by exploring student responses to competition in a classroom setting. More specifically, we administer a controlled experiment in university economics classes where students are incentivized to take a short introductory microeconomics quiz. We focus on two aspects of competitive environments that may be particularly salient in academics: one's perceived position in the ability distribution and tournament size.

Economic theory offers important insights into possible effort responses to competitive conditions. For example, Brown (2011) shows that ability gaps (or perceived gaps) between competitors can result in reduced effort for weaker contestants. She provides empirical support for her model using data from professional golf. More specifically, she shows that competitors perform worse when Tiger Woods plays in a tournament, at least back in his prime. In a different vein, Andreoni and Brownback (2014) model effort responses to competition when group size varies (holding the proportion of winners constant).[1] As class size shrinks, students become less certain about their rank. They show that this uncertainly leads low ability students to increase effort because working hard increases their chance of earning a high grade, but decreases the effort level of high ability students because there is still little risk of losing out on a top grade. Stated somewhat differently, as a class grows in size, it approaches the population and students know their exact percentile rank. In an infinitely large class, high types who are at or above the winning threshold will exert a positive amount of effort, those below the winning threshold will exert no effort. However, when Andreoni and Brownback (2014) take this to the lab, they find no real difference between individual's bids and the size of group at either end of the valuation distribution (or what translates into the ability

[1] Their model builds on work by Lazear and Rosen (1981), Becker and Rosen (1992) and Orrison et al. (2004).

distribution) in an all-pay auction.[2]

While models help build intuition, generally speaking, in environments outside the lab where there is less control over the parameters of the experiment, predicting effort responses is difficult. In other words, student effort responses to competition, and whether or not they vary systematically by ability and group size are in the end empirical questions. Our objective is to examine how effort changes in response to competition in a classroom setting, and to further ask whether responses differ across ability groups and/or the size of the tournament with which one is forced to compete. To do this, we run randomized experiments at the beginning of economics classes early in the academic quarter. Students are randomly assigned across a variety of tournament structures in which their earnings depend on their own quiz performance relative to their opponent's performance. To isolate the causal effect of competition, we also include a non-competitive piece rate treatment in which subjects are paid a flat rate for each correct answer. We find a large negative competition effect for students who believe they are a relatively low scoring student. In particular, students who believe they will earn less than an "A" grade in their current economics course score about 22 percent of a standard deviation lower when forced to compete compared to students assigned to the piece rate treatment.[3] We will refer to these students as low expectation students. In contrast, there is no statistically significant difference in quiz scores between tournament and piece rate subjects for those who believe they will earn an "A". We will refer to these students as high expectation students. Consistent with previous lab studies, e.g., Lima et al. (2014) and Andreoni and Brownback (2014), we find no evidence that these results vary across tournament size.

We are, of course, not the first to study effort responses to forced competition. In all cases, effort is either modeled as a cost chosen off a menu in a laboratory setting (Bull et al., 1987; Orrison et al., 2004) or as actual effort on a simple task such as solving mazes, running, adding

[2]Others have studied the effects of varying group size while maintaining the number of winners; e.g., Barut et al. (2002) and Lima et al. (2014). Lima et al. (2014) consider the effect of group size in a lab in an across-subjects design where subjects play a Tullock contest game. They find the average expenditure does not differ significantly across groups of two, four, or nine when there is a single winner.

[3]For context, approximately 60 percent of students believe that they will earn an A or an A- (what we refer to as an "A" grade), despite the fact that the actual number of such grades awarded is far below this level. We explore the difference between expected grades and actual earned grades in Section 5.1.

up numbers, or solving word and memory puzzles (Gneezy et al., 2003; Gneezy and Rustichini, 2004; Günther et al., 2010; Dreber et al., 2014). In contrast to our results, these studies generally find that individuals who are forced to compete, work at least as hard as those who are not; though there is some evidence suggesting the competition effect is sensitive to task type.[4]

There are two obvious candidate explanations for the divergence between our results and those reported in previous studies: task type and selection into participation. We explore these possibilities by running two additional treatments. In the first we replace the microeconomics quiz with a simple numeric task that is more similar to previous experiments. Interestingly, in these rounds we find *no* difference across competitive and piece rate payment schemes for either low or high expectation students – the weaker students exert less effort under competition result vanishes. In the second additional treatment we move the experiment (using the same microeconomics quiz) to the end of section and tell students that they are free to stay and participate or to leave. Approximately fifty percent of students choose to leave. The results for these rounds are similar to the rounds that are run at the beginning of section. In other words, we find no evidence that our competition results are driven by selection into participation.

The findings in this study offer at least two new insights. First, in our classroom context where students are asked to complete a real-effort and ability-specific task, we show that responses to competition depend on perceived ability. When forced to compete, low expectation students work less hard and high expectation students do not change their effort level. If it is the goal of the instructor or policymaker is to improve effort and thus academic outcomes, our results suggest that competition may not be the optimal mechanism, at least for those who perceive themselves as relatively low ability. Second, the fact that results from rounds of the experiment where a more general skill task is used – one similar to those used in previous studies – differ from the results for the microeconomics quiz, arguably a more specialized skill task, suggests that one should be

[4]There is a closely related experimental literature examining the propensity of individuals to compete when offered the choice. This literature finds that women are less likely to choose competition over a piece rate option compared to men (Niederle and Vesterlund, 2007; Gneezy et al., 2009; Sutter and Rutzler, 2015; Booth and Nolen, 2012a; Villeval, 2012; Datta Gupta et al., 2013; Garratt et al., 2013). There also exists an extensive theoretical literature focused on understanding effort response to relative performance incentive schemes, examples include Lazear and Rosen (1981), Green and Stokey (1983), and Prendergast (1999). See List et al. (2014) for a review.

cautious generalizing about effort responses to competition across task type.

2 Experimental Design

2.1 Microeconomics Quiz with No Selection into Participation

We administered the primary treatments to 2,415 students in 70 economics sections/classes at the University of California, Santa Barbara (UCSB) from fall 2013 through summer 2015. All sessions were held during the first two weeks of the relevant quarter. Before students entered the classroom sealed envelopes containing an entry survey and a microeconomics quiz were distributed across seats such that treatment groups were seated together. As students entered the section, they were randomly assigned to a treatment group by receiving a ticket from a shuffled deck that assigned them to a particular seat. Students who arrived late were asked to wait outside until the experiment ended. In all cases this was a very small number of students as we waited several minutes after the usual start time to close the door.

Once entry into the room had ceased, students completed an entry survey. This was a short questionnaire asking about their age, race, gender, year in school, intended major, and the grade they expect to earn in the course in which the quiz was being administered (the survey is in Appendix A). Importantly, we classify students into two groups based on how they respond to the entry survey question, "What grade do you expect to earn in this class?". We define those who believe they are going to earn an "A" as high expectation students, and those who indicate they expect to earn a grade less than an "A" as low expectation students. This allows us to separately analyze effort responses to competition across perceived ability and and tournament size. For context, approximately 66 percent of students expect to earn an "A" in the current course. We will explore differences between perceived ability and actual ability in Section 5.1.

Next we explained that we were administering a microeconomics quiz in a large number of sections across both lower and upper division economics courses. We also informed participants that we would be coming around to explain how they could earn money for correctly answering

quiz questions and that they would be entered into a $25 drawing at the end of the quiz to thank them for participating. At least in part because the quiz was administered at the beginning of classes and sections, participation was essentially 100 percent; less than five students left during the instruction phase and did not fill out a survey or participate in the quiz.

Students were given fifteen minutes to complete a ten question microeconomics quiz. They were not permitted to use a calculator or any other materials. We used six quiz forms to guard against cheating. The questions on each form were randomly drawn within subject category from the Test of Understanding in College Economics (TUCE) exam. The TUCE is a 30 question introductory microeconomics exam given to college economics students across the United States. An example of the quiz is in Appendix A. Students were incentivized for each correct quiz answer based on their randomly assigned treatment group. The treatment groups were as follows:

1. Piece Rate: Subjects earned $0.50 for each correct answer.

2. Group of Two: The subject with the highest score in each pair earned $1 for each correct answer.

3. Group of Six, Top Half Paid: The three highest scoring subjects in each group earned $1 for each correct answer.

4. Group of Ten, Top Half Paid: The five highest scoring subjects in each group earned $1 for each correct answer.

5. Group of Six, Winner Take All: The subject with the highest score in each group earned $3 for each correct answer.

6. Group of Ten, Winner Take All: The subject with the highest score in each group earned $5 for each correct answer.

The baseline treatment incentivizes students using a non-competitive piece rate payment scheme. Treatments two through four maintain the proportion of winners but vary group size. One can think

of this type of design as grading on a curve, where the same share of the class (e.g., 20%) always earns an "A" grade. In contrast, treatment groups five and six vary group size but have a single winner. Note that the ex ante expected value would be the same across all treatments if quiz scores were randomly assigned. Using a wide range of tournament sizes and payout structures is intended to allow for the detection of any or all possible group size effects.

Ties were broken by random draw. Given the number of groups, not all treatments were administered in every section, but more than one group was administered in every section. This is important because it allows for the inclusion of section fixed effects.

2.2 Task Type

As it is possible that responses to competition depend on the type of task, in summer 2015 we also compared performance on the microeconomics quiz – a specialized skill task – to a relatively more general skill based quiz. This general skill quiz more closely resembles the tasks used in much of the previous experimental literature on competition; it required students to add and multiple two digit numbers without a calculator. To examine whether the effects of competition depend on task type, we randomly assigned 180 students in 11 sections into one of four treatment groups: piece rate and a TUCE quiz, piece rate and an adding/multiplying quiz, group of two and a TUCE quiz, or group of two and an adding/multiplying quiz. For tractability, we limit group size to two in this round. The incentive structure is the same as above: $0.50 per correct answer in piece rate and $1 for each correct answer for the highest scoring student in the group of two tournament. Because the adding/multiplying and TUCE quizzes were administered simultaneously in all 11 sections, the former was formatted to look like a microeconomics quiz; calculating rent, minimum cost, average return, and so on. An example of the adding/multiplying quiz is included in Appendix A.

2.3 The Role of Selection into Participation

In contrast to most lab experiments, our environment features very different selection. In our setting, conditional on attending the chosen section, we have essentially 100 percent participation.

This occurs by design because all experiments were run at the beginning of section. On the other hand, in a typical lab setting, students are recruited through a web based application and must show up to the lab at a designated time solely for the purpose of participating in the experiment.

In an effort to understand how our sample compares to a group that is relatively more selected, we ran 11 sessions in summer 2015 during the last 15 minutes of sections. On these occasions, students could choose to stay and participate in the quiz or to leave. They were told that they could earn money for correctly answering quiz questions and that they would be eligible to win a $25 raffle for their participation. Roughly half of students in these sections chose to stay and participate in the experiment. Those who stayed were randomly assigned to a piece rate or group of two treatment. As in all other sessions, those in the piece rate group earned $0.50 for each correct answer and the top scorer in the group of two earned $1.00 for each correct answer. 137 students participated in these rounds.

3 Subjects and Data

All data come from two sources. The main source is the data collected directly from the survey and experiment. The experiments were conducted in four rounds: fall quarter 2013, spring quarter 2015, and summer sessions A and B 2015. We ran experiments in 81 sections with 2,732 total participants at UCSB. These data include quiz scores, treatment assignments, race, gender, major, academic year standing, age, and the grade they expect to earn in the course in which the quiz is administered. All tables are restricted to participants who responded to all questions on the survey and for whom we can standardize their test score.[5] These restrictions eliminate 143 participants, leaving an estimating sample of 2,589. Table 1 reports summary statistics for quiz scores, standardized quiz scores, and expected grade disaggregated by the six main treatments (Panel A), by gender (Panel B), and class standing (Panel C). The sample in Table 1 is restricted to the 2,298 participants who took the TUCE quiz at the beginning of a section. We provide similar information

[5] All scores are standardized by quiz form within each course in a given quarter. By bad luck, 21 students received a test form that no one else in their class received, making it impossible to calculate a standardized score.

for those who took the more general skill task and the rounds that were run at the end of sections in Section 6. While column 1 reports raw TUCE quiz scores to give the reader some context, column 2, and all columns in all subsequent tables use scores that are standardized to mean zero and standard deviation one by course, year, and quiz form.

It is worth highlighting a few features of Table 1. The average TUCE quiz score is approximately 5 out of 10, the average male undergraduate outscores the average female undergraduate, and students in upper division courses outscore students in lower division courses. While the average score is also highest for the piece rate group, it is important to remember that there are no controls and not all treatments were assigned in every section. Roughly two-thirds of the participants have high expectations (expect to earn an "A" grade) in the current course and on average women are somewhat less likely to have high expectations.

Panel A of Table 2 reports descriptive statistics for the pre-treatment characteristics collected on the entry survey for low expectation participants. Column 1 reports the mean and standard deviation for each characteristic for participants assigned to the group of two treatment. Columns 2-6 report the differences in mean characteristics between the group of two and each of the other treatment groups. Each entry in these columns comes from a separate regression. There is little evidence of systematic differences in gender, race, major, class standing, or age across treatment groups. Panel B replicates this exercise for high expectation participants. Again, there is little evidence of imbalance across treatment groups, at least based on observable characteristics.

The experiment and survey data are also linked to administrative records that include information about parental education, transfer status, language spoken in the home, citizenship status, socioeconomic status, SAT scores, and grades earned in core economics courses at UCSB. Unfortunately, there are many non-random missing values for all variables in the administrative data. For instance, administrative records do not contain SAT scores for transfer students. As such, our preferred specifications use the measures drawn from the survey, but not the variables collected from administrative records. The primary deviation from this will be a heterogeneity analysis that explores the relationship between expected grades and actual grades. These issues will be discussed

in more detail in Section 5.1.

4 Empirical Specification

Our primary objective is to ask whether there are consistent patterns in participant effort when assigned to compete versus being assigned to a piece rate treatment that depend on perceived ability and tournament size. More concretely: (1) Do low expectation participants change their effort level when assigned to compete in ways that are similar or different from high expectation participants? And, (2) Do these responses depend on tournament size? We use the following simple specification to examine these questions.

$$Y_{iags} = \alpha + \theta_{ag} + \gamma_s + X_{iags}\beta + \varepsilon_{iags} \tag{1}$$

Where Y_{iags} is the standardized quiz score (mean 0 and standard deviation 1 by course, quarter, and quiz form) for student i, of perceived ability a (low and high expectation students), in treatment group g (piece rate, group of two, group of six winner take all, group of six top half paid, group of ten winner take all, and group of ten top half paid), in section s. θ is a vector of eleven indicator variables for expected grade specific treatment groups. Low expectation students assigned to the piece rate treatment is the omitted category. γ_s is a vector of section fixed effects. Note that section indicators absorb time because sections (or classes) are quarter and academic year specific. X is a vector of student background characteristics, including race, gender, major, and year in school. Because treatment is randomly assigned within sections, all results are similar regardless of which controls are included. Section 5.1 discusses this issue in more detail. ε is the usual error term and all standard errors are clustered at the section level.

5 Results

5.1 Economics Quiz at the Beginning of Section

The results for equation 1 are reported in Table 3. Unless otherwise specified, all point estimates in each table come from a single regression. Column 1 reports the difference in quiz score between the piece rate treatment and each of the five tournament treatment groups for low expectation participants. P-values for the difference in competition effect between the specified larger tournament size and the group of two for low expectation students are reported in square brackets under the standard errors. Column 2 reports the same set of results for high expectation students. In other words, each entry tells you the average difference in scores between the specified group and the piece rate group for individuals who expect a high grade. Similarly, the p-values reported in square brackets are for the difference in competition effect between the group of two and the specified larger group for high expectation students. Column 3 reports the difference between the low and high expectation student groups within each tournament size.

Column 1 reveals that low expectation students reduce their effort when forced to compete. More specifically, the average group of two score is 19.9 percent of a standard deviation lower than the average piece rate score; for context, 25 percent of a standard deviation is approximately half a point on the ten-point TUCE quiz. Further, there is no evidence that the size of the tournament or the pay structure matters; we fail to reject the null hypothesis that the point estimate for any tournament group larger than two is the same as for the group of two.[6] In contrast, there are no precisely estimated competition effects for high expectation students at any tournament size. Column 3 shows that the competition effects for the two ability groups are statistically different from one another, and that is the case for all but one of the tournament group sizes. Appendix Table B1 reports the results for the main specification with varying levels of controls. The first panel includes only section fixed effects, the second panel adds survey reported controls (the specification reported in Table 3), and the third panel further adds the available administrative controls. As

[6] In an unreported analysis, we check for "giving-up" behavior. There is no evidence suggesting students answer more correct questions in the first half of the quiz relative to the last part.

expected, the results are similar across all specifications.

As there is no evidence that tournament size or payment structure matters, we simplify all subsequent analysis by collapsing all tournament treatments into a single "compete" category and report all results relative to the piece rate treatment. To facilitate comparison across tables, Table 4 repeats the Table 3 analysis using this averaged specification. Column 1 of Table 4 shows that the average score in a competitive treatment is 22.3 percent of a standard deviation lower than the average piece rate score for low expectation students. Column 2 similarly shows that the average score for high expectation students is 5.9 percent of a standard deviation higher compared to those in the piece rate treatment, but this point estimate is not statistically significant at conventional levels.[7]

These results naturally lead one to wonder whether expected grades reflect actual ability/skill or over/under confidence of some type for some subgroups. Our administrative data on grades in core economics courses allow us to probe this issue. Table 5 interacts expected grade with earned grade, where earned grade is defined as the participant's first intermediate microeconomics grade. If no intermediate theory grade is available, we use their principles grade. The sample size is slightly smaller for this table because we have no grades for foreign exchange students and a small number of students who enrolled as junior college transfers before the first intermediate theory course was moved into the pre-major. We divide students into two groups: those who earn less than an "A" (non-A students) and those who earn an "A" (A students).

Not surprisingly, as we sub-sample or interact to greater degrees, many estimates become quite noisy. What is clear, is that the subset of subjects who are non-A students who also have low expectations put forth less effort when assigned to competitive treatments (column 1), and this competition effect is statistically different from the competition effect for high expectation non-A students (compare columns 1 and 3). In summary, we can rule out large negative effects for non-A students with high expectation suggesting that optimism or overconfidence shields this group from the negative competition effect. And, while the other comparisons are noisy (i.e, comparing

[7] Appendix Table B2 reports the results for this specification with varying levels of controls. The results are similar across all specifications.

columns 1 and 2), what we can say with some confidence is that reduced effort when confronted with competition seems to be driven by weaker students who realize that they are weaker students, a result that is more consistent with honest self-reflection than under confidence.

At least part of the reason that the low expectation non-A student group is driving the results is because this is where the discrepancy between earned and expected grades exists. Table 6 shows that among A students, about 81 percent expect to earn an "A" in the current course. On the other hand, among non-A students, 42 percent expect less than an "A" and 58 percent expect an "A".[8]

Many previous studies identify important differences in effort response to competition by gender. In a variety of field and lab settings, it has been shown that men tend to increase their effort when forced to compete, while women's performance is unchanged (Gneezy et al., 2003; Gneezy and Rustichini, 2004). Table 7 replicates Table 5 but instead of earned grade, we interact expected grade with gender. Columns 1 and 2 (3 and 4) report the competition effect for low (high) expectation men and women. In contrast to previous studies, in our setting the negative competition effect point estimate is most negative for low expectation men, but due to imprecision, we cannot reject that the male and female effects are the same for students within expectation groups. Overall, these findings are consistent, but not definitive, evidence that the competition effects are driven by less able men exerting less effort when forced to compete.[9]

5.2 Task Type

In contrast to many previous studies, in our setting we find that competition reduces effort, at least for an important subset of participants. In this section we investigate two possible features of our experiment that might explain the divergence of our results from past findings that show performance improves, at least among some sub-groups, when subjects are forced to compete. First, we explore the potential role of task type. In our design, subjects take a microeconomics quiz. Relative to the tasks that are often implemented, such as solving mazes or adding up two-

[8] Appendix Table B3 disaggregates Table 6 by gender.

[9] In an unreported analysis, we find no evidence of gender differences in the response to the sex composition of the group.

digit numbers, the task in this experiment draws on a more specialized skill. Second, our sample is selected on major or course enrollment (largely economics and accounting students), but has almost no selection on the showing up or signing up margin since all quizzes took place at the start of sections and essentially 100 percent of students attending section participated. We examine each of these in turn.

To test whether a specialized skill task in a competitive environment has a different effect on performance than a more general skill task, we implement an additional treatment. In this treatment students were asked to multiply and add sequences of numbers without a calculator. These simple calculations were formatted to look like microeconomics questions because this treatment was administered in the same sections as the microeconomics quiz task. For example, questions from the more general skill task included calculating rent, minimum cost, and average return. For simplicity, we only included one competitive incentive scheme, group of two (we call this compete), and the piece rate treatment. Table 8 reports summary statistics for these additional rounds. For comparative purposes, column 1 reports the average raw quiz score, the average standardized score, the percent of the sample with high expectations, and the percent female for participants assigned to the piece rate and group of two standard microeconomics quiz treatments. Column 2 reports the same summary measures for participants assigned to the general skill task, again including both piece rate and groups of two. It is important to note that you cannot compare the average raw scores across columns 1 and 2 because the tests are very different.

We use an empirical specification similar to equation 1. The primary differences are as follows. First, there are only two compensation schemes: compete and piece rate (piece rate for low expectation students continues to be the omitted category). Second, the model now includes an indicator variable for the general skill task and this indicator is interacted with the three treatment group indicators (low expectation compete, high expectation piece rate, and high expectation compete). Column 1 of Table 9 reports the results. As in the main results reported in Table 4, low expectation participants exert less effort on the microeconomics quiz when forced to compete, while the effort of high expectation students does not change (see Panel B). Low expectation students

score 22.0 percent of a standard deviation lower in the group of two treatment compared to the piece rate treatment. In contrast, low expectation students assigned to the adding/multiplying task score higher when assigned to the competitive treatment, although the point estimate is noisy. The difference-in-difference estimate shows that the competition effect for the general skill task is 37.0 of a standard deviation higher than the competition effect for the specialized skill task. Even if the competition effect for the general skill task is indistinguishable from zero, we can reject that it is as negative as the competition effect for the specialized skill task for the low expectation group. Taken together, these results suggest that effort in competitive environments depends importantly on the nature of the task. And if the task involves a specialized skill, it also depends on ability. Unsurprising, our general skill treatment yields results similar to what has previously been found in the experimental literature, as those studies implement tasks involving similar skills. Results for the microeconomics quiz task are quite different.

5.3 Selection into Participation

In order to explore the potential for at least some forms of selection to impact the results, we ran 11 additional sessions in which we allowed, even encouraged, more selection into participation. In contrast to all other sessions, these sessions were run at the end sections. Students were invited to stay and take the microeconomics quiz under the same set of incentives as before. On average, approximately half of the students present chose to participate (compared to essentially 100 percent in the beginning of section sessions). Summary statistics for these additional end of section sessions are reported in last column of Table 8. There is some evidence of selection; stayers score slightly better on average and are somewhat more likely to be male. Of course, our primary question is whether this selection implies a different response for those who are randomly assigned to compete.

The results are reported in column 2 of Table 9. The specification is identical to that exploring the difference between the microeconomics quiz task and the general skill quiz in column 1, except that the indicator for the new treatment (the end of section treatment) cannot be identified

separately from section fixed effects. We can, however, identify this indicator interacted with the three included treatment group indicators (low expectation compete, high expectation piece rate, and high expectation compete). In contrast to the differential response to competition in specialized and general skill tasks, the response to competition in sessions run at the beginning of section and at the end of section (less and more selected participation cases) are both negative for low expectation students, and we cannot reject the null hypothesis that the point estimates are the same. And as in all other cases, there is no evidence of an effort response for high expectation students. The end of session results suggest that the reason our main findings differ from previous studies is not our use of a less selected sample, but rather stems from the difference in task type.

6 Conclusion

In a classroom setting where students are asked to complete a real-effort task, we show that individuals who believe they are lower scoring students reduce their effort when forced to compete, while there are few detectable effects for students who expect to earn higher grades. We find that students who believe they will earn less than an "A" grade in their current economics course score about 22 percent of a standard deviation lower when forced to compete compared to the piece rate treatment, and that this effect is driven by men and low expectation students who have realistic beliefs about their ability. In contrast, previous research has tended to find that men increase their effort level when forced to compete. Perhaps the biggest take away from this experiment is the evidence that our results diverge from past findings because of task type differences and not because of selection. The evidence clearly suggests that task type plays a critical role in one's response to competition. Stated more generally, responses to competition are likely to depend importantly on the environment and the individual's position in the skill distribution; people who might increase their effort when faced with competition in one environment might decrease or not change their effort in another environment. As such, one should be cautious, perhaps even skeptical, about generalizing results about the distribution of responses to competition from one context to another.

References

Andreoni, James and Andy Brownback, "Grading on a Curve, and Other Effects of Group Size on All-Pay Auctions," Technical Report, National Bureau of Economic Research 2014.

Barut, Yasar, Dan Kovenock, and Charles N Noussair, "A Comparison of Multiple-Unit All-Pay and Winner-Pay Auctions Under Incomplete Information," *International Economic Review*, 2002, *43* (3), 675–708.

Becker, William E and Sherwin Rosen, "The Learning Effect of Assessment and Evaluation in High School," *Economics of Education Review*, 1992, *11* (2), 107–118.

Beyer, Sylvia, "Gender Differences in the Accuracy of Self-evaluations of Performance.," *Journal of Personality and Social Psychology*, 1990, *59* (5), 960.

Booth, Alison and Patrick Nolen, "Choosing to Compete: How Different are Girls and Boys?," *Journal of Economic Behavior & Organization*, 2012, *81* (2), 542–555.

Booth, Alison L and Patrick Nolen, "Gender Differences in Risk Behaviour: Does Nurture Matter?," *The Economic Journal*, 2012, *122* (558), F56–F78.

Brown, Jennifer, "Quitters Never Win: The (Adverse) Incentive Effects of Competing with Superstars," *Journal of Political Economy*, 2011, *119* (5), 982–1013.

Bull, Clive, Andrew Schotter, and Keith Weigelt, "Tournaments and Piece Rates: An Experimental Study," *Journal of Political Economy*, 1987, *95* (1), 1–33.

Cárdenas, Juan-Camilo, Anna Dreber, Emma Von Essen, and Eva Ranehill, "Gender Differences in Competitiveness and Risk Taking: Comparing Children in Colombia and Sweden," *Journal of Economic Behavior & Organization*, 2012, *83* (1), 11–23.

Chemers, Martin M, Li tze Hu, and Ben F Garcia, "Academic Self-Efficacy and First Year College Student Performance and Adjustment.," *Journal of Educational Psychology*, 2001, *93* (1), 55.

Dohmen, Thomas and Armin Falk, "Performance Pay and Multidimensional Sorting: Productivity, Preferences, and Gender," *The American Economic Review*, 2011, pp. 556–590.

Dreber, Anna, Emma von Essen, and Eva Ranehill, "Gender and competition in adolescence: task matters," *Experimental Economics*, 2014, *17* (1), 154–172.

Eckel, Catherine C and Philip J Grossman, "Men, Women and Risk Aversion: Experimental Evidence," *Handbook of Experimental Economics Results*, 2008, *1*, 1061–1073.

Garratt, Rodney J, Catherine Weinberger, and Nick Johnson, "The State Street Mile: Age and Gender Differences in Competition Aversion in the Field," *Economic Inquiry*, 2013, *51* (1), 806–815.

Gillen, Ben, Erik Snowberg, and Leeat Yariv, "Experimenting with Measurement Error: Techniques with Applications to the Caltech Cohort Study," Technical Report, National Bureau of Economic Research 2015.

Gneezy, Uri and Aldo Rustichini, "Gender and Competition at a Young Age," *American Economic Review Papers and Proceedings*, 2004, pp. 377–381.

_ **, Kenneth L Leonard, and John A List**, "Gender Differences in Competition: Evidence from a Matrilineal and a Patriarchal Society," Technical Report 2009.

_ **, Muriel Niederle, and Aldo Rustichini**, "Performance in Competitive Environments: Gender Differences," *Quarterly Journal of Economics*, 2003, *118* (3), 1049–1074.

Green, Jerry R and Nancy L Stokey, "A Comparison of Tournaments and Contracts," *Journal of Political Economy*, 1983, pp. 349–364.

Günther, Christina, Neslihan Arslan Ekinci, Christiane Schwieren, and Martin Strobel, "Women Can't Jump? - An experiment on competitive attitudes and stereotype threat," *Journal of Economic Behavior & Organization*, 2010, *75* (3), 395–401.

Gupta, Nabanita Datta, Anders Poulsen, and Marie Claire Villeval, "Gender Matching and Competitiveness: Experimental Evidence," *Economic Inquiry*, 2013, *51* (1), 816–835.

Harbring, Christine and Bernd Irlenbusch, "An Experimental Study on Tournament Design," *Labour Economics*, 2003, *10* (4), 443–464.

Kagel, John H and Alvin E Roth, *The Handbook of Experimental Economics*, Princeton University Press Princeton, NJ, 1995.

Kuhn, Peter and Marie Claire Villeval, "Are Women More Attracted to Co-operation Than Men?," *The Economic Journal*, 2015, *125* (582), 115–140.

Lazear, Edward P and Sherwin Rosen, "Rank-Order Tournaments as Optimum Labor Contracts," 1981.

Lima, Wooyoung, Alexander Matros, and Theodore Turocy, "Bounded Rationality and Group Size in Tullock Contests: Experimental Evidence," *Journal of Economic Behavior & Organization*, 2014, *99*, 155–167.

List, John, Daan Van Soest, Jan Stoop, and Haiwen Zhou, "On the Role of Group Size in Tournaments: Theory and Evidence from Lab and Field Experiments," Technical Report, National Bureau of Economic Research 2014.

Moore, Don A and Deborah A Small, "Error and Bias in Comparative Judgment: On Being Both Better and Worse Than We Think We Are.," *Journal of Personality and Social Psychology*, 2007, *92* (6), 972.

Nalbantian, Haig R and Andrew Schotter, "Productivity Under Group Incentives: An Experimental Study," *American Economic Review*, 1997, pp. 314–341.

Niederle, Muriel and Alexandra H Yestrumskas, "Gender Differences in Seeking Challenges: The Role of Institutions," Technical Report, National Bureau of Economic Research 2008.

_ **and Lise Vesterlund**, "Do Women Shy Away from Competition? Do Men Compete Too Much?," *Quarterly Journal of Economics*, 2007, *122*, 1067–1101.

Orrison, Alannah, Andrew Schotter, and Keith Weigelt, "Multiperson Tournaments: An Experimental Examination," *Management Science*, 2004, *50* (2), 268–279.

Prendergast, Canice, "The Provision of Incentives in Firms," *Journal of Economic Literature*, 1999, *37* (1), 7–63.

Sutter, Matthias and Daniela Rutzler, "Gender Differences in Competition Emerge Early in Life," 2015.

Villeval, Marie Claire, "Ready, Steady, Compete," *Science*, 2012, *335* (3), 544–545.

Zizzo, Daniel John, "Experimenter Eemand Effects in Economic Experiments," *Experimental Economics*, 2010, *13* (1), 75–98.

Table 1: Summary Statistics - Test Scores (TUCE) and Expected Grades

	Score	Standardized Score	E(A)	Sample Size
	(1)	(2)	(3)	(4)
Panel A: Treatment Group				
Piece rate	5.49	0.01	0.57	417
	(2.03)	(0.98)	(0.50)	
Group of Two	5.14	0.02	0.60	641
	(2.06)	(0.99)	(0.49)	
Group of Six WTA	5.10	0.02	0.64	309
	(1.91)	(0.93)	(0.48)	
Group of Six THP	4.76	-0.04	0.64	311
	(1.90)	(0.92)	(0.48)	
Group of Ten WTA	4.81	0.03	0.65	321
	(1.99)	(1.01)	(0.48)	
Group of Ten THP	5.17	-0.01	0.64	299
	(2.06)	(1.05)	(0.48)	
Panel B: Gender				
Male	5.36	0.12	0.64	1,376
	(2.02)	(0.99)	(0.48)	
Female	4.73	-0.15	0.58	922
	(1.96)	(0.94)	(0.49)	
Panel C: Class Standing				
Lower Division	4.84	0.000	0.61	1,678
	(1.97)	(0.99)	(0.49)	
Upper Division	5.81	0.04	0.64	620
	(1.97)	(0.99)	(0.49)	

Notes: Mean scores and expected grades are reported by subgroups. Standard deviations are in parentheses. E(A) denotes students who expect to earn an A (high expectation) and E(NA) denotes students who do not expect to earn an A (low expectation). WTA are treatments where the top scorer is paid, THP are treatments where the top half of the group is paid.

Table 2: Pre-Treatment Characteristics - Sample Balance

		Differences Between Treatments				
	Group of 2 Mean (1)	Piece Rate (2)	Group of 6 WTA (3)	Group of 6 THP (4)	Group of 10 WTA (5)	Group of 10 THP (6)
Panel A: E(NA)						
Female	0.41	-0.04	0.14	0.11	0.20	0.04
	(0.49)	[0.50]	[0.06]	[0.17]	[0.03]	[0.65]
Hispanic	0.18	0.06	-0.09	0.04	0.08	-0.10
	(0.39)	[0.23]	[0.12]	[0.47]	[0.27]	[0.15]
Black	0.02	-0.01	0.04	0.00	0.00	0.04
	(0.12)	[0.60]	[0.06]	[0.96]	[0.94]	[0.12]
Asian	0.37	-0.09	0.02	-0.09	-0.05	0.03
	(0.48)	[0.18]	[0.78]	[0.25]	[0.57]	[0.71]
Other	0.07	-0.01	-0.03	-0.04	-0.06	-0.03
	(0.26)	[0.70]	[0.45]	[0.32]	[0.20]	[0.42]
Accounting Major	0.42	0.09	0.03	-0.05	-0.05	-0.15
	(0.49)	[0.14]	[0.70]	[0.50]	[0.55]	[0.06]
Other Major	0.30	-0.09	0.01	0.09	0.10	0.07
	(0.46)	[0.07]	[0.83]	[0.12]	[0.14]	[0.31]
Sophomore	0.30	0.11	-0.11	0.11	0.15	-0.04
	(0.46)	[0.03]	[0.06]	[0.10]	[0.06]	[0.57]
Junior	0.36	-0.07	0.11	0.06	0.01	0.06
	(0.48)	[0.22]	[0.06]	[0.38]	[0.88]	[0.39]
Senior	0.19	0.00	-0.09	-0.04	-0.05	-0.10
	(0.39)	[0.95]	[0.02]	[0.29]	[0.21]	[0.04]
Age 20-21	0.38	0.05	0.05	0.08	0.05	-0.04
	(0.49)	[0.45]	[0.47]	[0.24]	[0.49]	[0.58]
Age 22+	0.17	-0.04	-0.05	-0.05	-0.07	0.00
	(0.37)	[0.39]	[0.35]	[0.37]	[0.23]	[0.96]
Sample Size	256	437	367	369	367	364
Panel B: E(A)						
Female	0.39	-0.08	0.02	-0.08	0.03	0.02
	(0.49)	[0.13]	[0.69]	[0.15]	[0.63]	[0.77]
Hispanic	0.14	-0.02	0.06	-0.06	-0.04	0.03
	(0.35)	[0.52]	[0.14]	[0.13]	[0.32]	[0.52]
Black	0.02	0.00	0.00	0.01	0.00	-0.02
	(0.13)	[0.88]	[0.83]	[0.54]	[0.73]	[0.24]
Asian	0.45	0.00	0.00	0.04	0.01	-0.01
	(0.50)	[0.95]	[0.95]	[0.47]	[0.93]	[0.90]
Other	0.05	-0.03	0.01	0.01	0.02	0.02
	(0.21)	[0.20]	[0.64]	[0.66]	[0.51]	[0.63]
Accounting Major	0.42	-0.01	-0.07	0.04	0.00	0.08
	(0.50)	[0.84]	[0.21]	[0.45]	[0.99]	[0.17]
Other Major	0.29	0.08	0.06	-0.04	-0.06	-0.04
	(0.46)	[0.05]	[0.19]	[0.33]	[0.09]	[0.41]
Sophomore	0.27	-0.05	-0.05	-0.04	0.03	0.01
	(0.45)	[0.24]	[0.24]	[0.38]	[0.58]	[0.90]
Junior	0.39	0.04	0.03	0.02	-0.10	0.02
	(0.49)	[0.43]	[0.52]	[0.73]	[0.04]	[0.78]
Senior	0.19	0.03	-0.04	-0.02	0.04	-0.04
	(0.39)	[0.34]	[0.18]	[0.60]	[0.29]	[0.36]
Age 20-21	.39	0.06	0.11	-0.02	-0.11	0.06
	(0.49)	[0.29]	[0.04]	[0.68]	[0.05]	[0.36]
Age 22+	0.22	0.01	-0.11	-0.01	0.02	-0.10
	(0.42)	[0.84]	[0.01]	[0.72]	[0.69]	[0.06]
Sample Size	385	621	583	583	595	576

Notes: Column 1 reports means for the group of two treatment. Corresponding standard deviations are in parentheses. Differences in columns 2-6 are from OLS regressions that include section fixed effects. Sample sizes listed in columns 2-6 include the group of two and the group listed at the top of each column. P-values for differences are in square brackets. E(A) denotes students who expect to earn an A (high expectation) and E(NA) denotes students who do not expect to earn an A (low expectation). WTA are treatments where the top scorer is paid, THP are treatments where the top half of the group is paid.

Table 3: Score Differences by Incentive Structure Across Grade Expectation

	Difference Estimates		Effects Statistically Different?
	E(NA) (1)	E(A) (2)	(1)-(2) (3)
Group of 2 - Piece Rate Difference	-0.199**	0.049	-0.248**
	(0.085)	(0.085)	(0.099)
Group of 6 WTA - Piece Rate Difference	-0.338**	-0.052	-0.285
	(0.132)	(0.142)	(0.178)
	[0.18]	[0.41]	
Group of 6 THP - Piece Rate Difference	-0.309**	-0.065	-0.245*
	(0.125)	(0.122)	(0.137)
	[0.27]	[0.24]	
Group of 10 WTA - Piece Rate Difference	-0.246	0.053	-0.300*
	(0.158)	(0.118)	(0.154)
	[0.74]	[0.96]	
Group of 10 THP - Piece Rate Difference	-0.424**	-0.025	-0.400**
	(0.169)	(0.147)	(0.146)
	[0.12]	[0.56]	
Testing Equality of Tournament Coefficients	F = 0.39	F = 0.50	

Notes: Sample size is 2,298. All coefficients are from a single regression (equation 1) that includes indicators for race, gender, major, and year in school, as well as section fixed effects. E(A) denotes students who expect to earn an A (high expectation) and E(NA) denotes students who do not expect to earn an A (low expectation). WTA are treatments where the top scorer is paid and THP are treatments where the top half of the group is paid. Standard errors are clustered at the section level and are reported in parentheses. Square brackets report the p-value testing for the equivalence of the corresponding coefficient and the coefficient for the group of two. ** (*) indicates statistical significance at the 5 (10) percent level.

Table 4: Score Differences by Incentive Structure Across Grade Expectation

	Difference Estimates		Effects Statistically Different?
	E(NA) (1)	E(A) (2)	(1)-(2) (3)
Compete - Piece Rate Difference	-0.223**	0.059	-0.282**
	(0.086)	(0.083)	(0.098)

Notes: Sample size is 2,298. The five tournament treatments are collapsed into a single "compete" category. All coefficients are from a single regression (equation 1) that includes indicators for race, gender, major, and year in school, as well as section fixed effects. E(A) denotes students who expect to earn an A (high expectation) and E(NA) denotes students who do not expect to earn an A (low expectation). Standard errors are clustered at the section level and are reported in parentheses. ** (*) indicates statistical significance at the 5 (10) percent level.

Table 5: Score Differences by Incentive Structure Across Grade Expectations by Previous Microeconomics Grade

	E(NA)		E(A)	
	Non-A Student	A Student	Non-A Student	A Student
	(1)	(2)	(3)	(4)
Compete - Piece Rate Difference	-0.229**	-0.105	0.113	-0.105
	(0.086)	(0.274)	(0.090)	(0.178)

Notes: Sample size is 2,252. Non-A students earned less than an "A" and A students earned an "A" in microeconomics at UCSB. The five tournament treatments are collapsed into a single "compete" category. All coefficients are from a single regression (equation 1) that includes indicators for race, gender, major, and year in school, as well as section fixed effects. E(A) denotes students who expect to earn an A (high expectation) and E(NA) denotes students who do not expect to earn an A (low expectation). Standard errors are clustered at the section level and are reported in parentheses. ** (*) indicates statistical significance at the 5 (10) percent level.

Table 6: Earned Microeconomics Grade Versus Current Expected Grade

	Most Recent Earned Microeconomics Grade		
	Non-A Student	A Student	Number of Students
E(Grade) in Current Class			
E(NA)	42%	19%	860
E(A)	58%	81%	1,392
Number of Students	1,847	405	2,252

Notes: E(Grade) is the grade students expect to earn in the current course. E(A) denotes students who expect to earn an A (high expectation) and E(NA) denotes students who do not expect to earn an A (low expectation). Non-A students earned less than an "A" and A students earned an "A" in microeconomics at UCSB.

Table 7: Score Differences by Incentive Structure Across Grade Expectations by Gender

	E(NA)		E(A)	
	Male	Female	Male	Female
	(1)	(2)	(3)	(4)
Compete - Piece Rate Difference	-0.289**	-0.140	0.103	-0.011
	(0.102)	(0.138)	(0.098)	(0.123)

Notes: Sample size is 2,298. The five tournament treatments are collapsed into a single "compete" category. All coefficients are from a single regression (equation 1) that includes indicators for race, gender, major, and year in school, as well as section fixed effects. E(A) denotes students who expect to earn an A (high expectation) and E(NA) denotes students who do not expect to earn an A (low expectation). Standard errors are clustered at the section level and are reported in parentheses. ** (*) indicates statistically significance at the 5 (10) percent level.

Table 8: Summary Statistics for Mechanism Exploration Rounds

	Start of Section Task=TUCE (1)	Start of Section Task=Adding (2)	End of Section Task=TUCE (3)
Score	5.28	7.20	5.97
	(2.06)	(2.05)	(1.89)
Standardized Score	0.02	0.00	0.12
	(0.99)	(0.97)	(0.83)
E(A)	0.59	0.56	0.55
	(0.49)	(0.50)	(0.50)
Female	0.40	0.46	0.34
	(0.49)	(0.50)	(0.47)
Sample Size	1,058	172	119

Notes: Means are reported by subgroup. Standard deviations are in parentheses. "Start of Section" and "End of Section" refer to rounds of the experiment run at the beginning and end of the sections. "Adding" refers to the general skill task and "TUCE" to the introductory microeconomics quiz, the ability-specific task. E(A) denotes students who expect to earn an A (high expectation).

Table 9: Score Differences: TUCE Task Compared to Adding Task and Beginning of Section TUCE Compared to End of Section TUCE

	CT = Adding Task (1)	CT = End of Section (2)
Panel A: Coefficients		
E(NA) Group of Two	-0.220**	-0.225**
	(0.089)	(0.090)
E(A) Piece Rate	-0.017	0.026
	(0.087)	(0.089)
E(A) Group of Two	0.023	0.025
	(0.101)	(0.102)
Comparison Treatment (CT)	-0.176	–
	(0.186)	
CT E(NA) Group of Two	0.370*	0.140
	(0.204)	(0.251)
CT E(A) Piece Rate	0.390*	0.204
	(0.220)	(0.302)
CT E(A) Group of Two	0.361	0.201
	(0.210)	(0.308)
Panel B: Relevant D-in-D Estimates		
Competition Effect for E(NA) TUCE	-0.218**	-0.225**
	(0.089)	(0.09)
Competition Effect for E(NA) CT	0.152	-0.084
	(0.193)	(0.233)
D-in-D	0.370*	0.140
	(0.205)	(0.251)
Competition Effect for E(A) TUCE	0.040	0.050
	(0.086)	(0.087)
Competition Effect for E(A) CT	0.010	0.047
	(0.159)	(0.346)
D-in-D	-0.030	-0.004
	(0.181)	(0.357)
Sample Size	1,230	1,177

Notes: Each column is from a single regression. All models include indicators for race, gender, major, and year in school, as well as section fixed effects. "Start of Section" and "End of Section" refer to rounds of the experiment run at the beginning and end of the sections. "Adding" refers to the general skill task and "TUCE" to the introductory microeconomics quiz, the ability-specific task. E(A) denotes students who expect to earn an A (high expectation) and E(NA) denotes students who do not expect to earn an A (low expectation). Standard errors are clustered at the section level and are reported in parentheses. ** (*) indicates statistically significance at the 5 (10) percent level.

Appendix A

Entry Survey

You are being asked to participate in a study by Kelly Bedard, Stefanie Fischer, and Jon Sonstelie. For your participation today, we will enter you in a lottery in which one person in this class will receive $25 cash today (photo ID required). If you are younger than 18 you are not eligible for the lottery. While those under 18 years of age can participate in the tournament, your data will not be used for research purposes.

You have also been selected to receive the opportunity to compete against the person with the same color quiz sitting near you. The highest scoring person in your pair will win $1 for each of their correct answers. The microeconomics quiz includes 10 randomly selected questions. You have 15 minutes to complete the quiz. In the event of a tie, you will split the prize equally.

All participants will be notified by email when scores are posted on Gauchospace. Winners will also be notified by email about the date of payment. All payments will be made outside the classroom at the end of class on the specified date. Winners will be paid in approximately ten days.

We are conducting a study to assess proficiency in foundational microeconomics and analyze competition and test taking. By signing up for this experiment, you are acknowledging that the authors of this study will follow your academic records at UCSB from the beginning of your enrollment through summer 2014. This data will not be used for any other purpose nor will any information ever be made public. All identifying data will be held in confidence from all instructors until after this academic quarter. That being said, absolute confidentiality cannot be guaranteed, since research documents are not protected from subpoena.

Your participation is voluntary. There will be no repercussions should you decide not to participate. You may withdraw your participation at any time and remain eligible for the $25 lottery. If you have questions you may contact Kelly Bedard at kelly@econ.ucsb.edu or 805-893-5571 or the University of California Santa Barbara Human Subjects committee at 805-893-3807.

By signing below, you acknowledge the above information.

<u>We would like to ask you a few questions</u>:

What is your sex?	(A) Female	(B) Male			
How old are you?	(A) 17	(B) 18 or 19	(C) 20 or 21	(D) 22 or 23	(E) 24+
Are you Hispanic/Latino?	(A) Yes	(B) No			
What is your race?	(A) White	(B) Black	(C) Asian	(D) Other	
Academic Year?	(A) Freshman	(B) Sophomore	(C) Junior	(D) Senior	
Major/Intended Major?	(A) Economics	(B) Economics & Accounting	(C) Economics & Mathematics	(D) Other	(E) Undecided

_____ _____

Print name Signature

_____ _____

Date Perm #

_____ _____

Primary e-mail address Local phone number

Form 1 of the TUCE Quiz (Specialized Skill Task)

8. Suppose a city facing a shortage of rental apartments eliminates rent controls. Which of the following is most likely to occur?

   A. a decrease in rents and a decrease in the number of apartment units supplied
   B. an increase in rents and an increase in the number of apartment units supplied
   C. a decrease in the demand for apartments and an increase in the number of apartment units supplied
   D. an increase in the demand for apartments and a decrease in the number of apartment units supplied

9. If all of the firms in a competitive industry are legally required to meet new regulations that increase their cost of production:

   A. supply of the product will decrease.
   B. demand for the product will decrease.
   C. the long-run economic profits of individual firms in the industry will decrease.
   D. the short-run economic profits of individual firms in the industry will increase.

10. At the profit-maximizing level of output, a perfectly competitive firm will:

    A. produce the quantity of output at which marginal cost equals price.
    B. produce the quantity of output at which marginal cost is minimized.
    C. keep marginal cost lower than price, so profits will be greater than zero.
    D. try to sell all the output it can produce, to spread fixed costs across the largest possible number of units.

11. A state legislature increased the tax on gasoline sold in the state from $.20 to $.30 per gallon. A supporter said the tax would "make the distribution of after-tax income in the state more equal." This statement would be true only if it could be shown that, after the tax is increased:

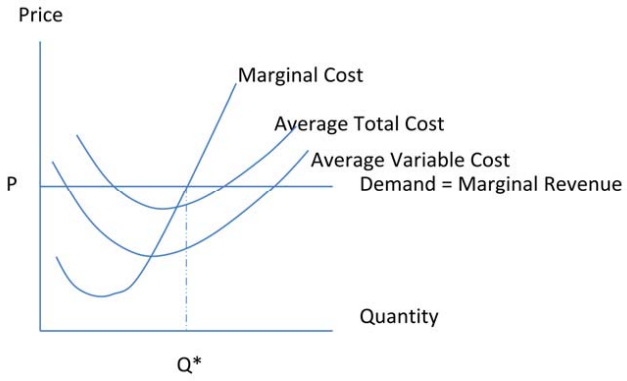
    A. people with low incomes buy more gasoline than people with high incomes.
    B. the quantity of gasoline purchased in the state is highly responsive to changes in price.
    C. people with high incomes tend to spend the same proportion of their incomes on gasoline as people with low incomes.
    D. people with high incomes tend to spend a larger proportion of their incomes on gasoline than people with low income.

12. The opportunity cost of being a full-time student at a university instead of working full-time at a job includes all of the following EXCEPT:

    A. payments for meals.
    B. payments for tuition.
    C. payments for books.
    D. income from the full-time job.

13. "Water is essential to life, but inexpensive to buy." Which of the following best explains this observation?

A. Water has a high total utility, but a low marginal utility.
B. Water has a low total utility, but a high marginal utility.
C. The quantity supplied of water is less than the quantity demanded at the market price.
D. The quantity supplied of water is greater than the quantity demanded at the market price.



14. Which of the following is true for this profit-maximizing firm at price P in the graph above?

A. It is not earning any economic profits.
B. It is currently earning short-run economic profits.
C. It should shut down to minimize its economic losses.
D. It will continue to earn economic profits in the long run.

15. If the exchange rate between dollars ($) and yen (¥) changes from $1 = ¥200 to $1 = ¥100, and domestic prices in both countries stay the same, has the dollar appreciated or depreciated, and would U.S. imports from Japan become less expensive or more expensive?

	Value of the dollar	U.S. imports from Japan
A.	Appreciated	Less expensive
B.	Appreciated	More expensive
C.	Depreciated	Less expensive
D.	Depreciated	More expensive

16. Suppose the only two cola companies (Acola and Bcola) in a nation are deciding whether to charge high or low prices for their colas. The companies' price strategies are shown in the table below. The four pairs of payoff values show what each company expects to earn or lose in millions of dollars, depending on what the other company does.

		Acola's Price Strategy	
		High Price	Low Price
Bcola's Price Strategy	High Price	Acola +$100 Bcola +$100	Acola +$250 Bcola -$50
	Low Price	Acola -$50 Bcola +$250	Acola +$50 Bcola +$50

If both companies believe that most consumers are soon going to quit drinking colas, and switch to other products, what is the equilibrium outcome?

A. Both Acola and Bcola will charge a low price.
B. Both Acola and Bcola will charge a high price.
C. Acola will charge a low price; Bcola will charge a high price.
D. Acola will charge a high price; Bcola will charge a low price.

17. In Sunshine City, one local ice cream company operates in a competitive labor market and product market. It can hire workers for $45 a day and sell ice cream cones for $1.00 each. The table below shows the relationship between the number of workers hired and the number of ice cream cones produced and sold.

Number of Workers Hired	Number of Ice Cream Cones Sold
4	340
5	400
6	450
7	490
8	520

As long as the company stays in business, how many workers will it hire to maximize profits or minimize losses?

A. 5
B. 6
C. 7
D. 8

Form 1 of the Adding/Multiplying Quiz (General Skill Task)

8. The owner of a company must choose between four money schemes. For each scheme, the owner of the firm gets the specified amount. Which scheme has the highest **average** payout? *Hint: to answer this question you'll need to calculate the average for each Scheme -- i.e. to find the average of Scheme 1 you would want to calculate (8+12+4+24)/4.*

Scheme 1	Scheme 2	Scheme 3	Scheme 4
8	4	12	16
12	40	20	16
4	4	4	6
24	12	20	18

   A. Scheme 1
   B. Scheme 2
   C. Scheme 3
   D. Scheme 4

9. A real estate developer has to choose between four apartment buildings. Each building has four types of apartments which charge specific levels of rent. Which building generates the highest revenue (total rent)?

Rent	Building 1	Building 2	Building 3	Building 4
1000	2	4	8	4
1500	4	2	4	6
2000	8	6	2	6
2500	2	4	4	2

   A. Building 1
   B. Building 2
   C. Building 3
   D. Building 4

10. A factory owner must upgrade his factory line. The factory line has five parts. He has bids from four machine shops. Each bid includes all five parts. If the factory owner wants to pay the lowest cost possible for the upgrade, which bid should he choose?

Part	Bid 1	Bid 2	Bid 3	Bid 4
Part 1	10,000	8,000	12,500	9,000
Part 2	12,000	14,000	8,000	11,000
Part 3	1,500	4,500	3,500	4,000
Part 4	2,000	3,000	3,000	4,000
Part 5	16,000	12,000	15,000	13,000

   A. Bid 1
   B. Bid 2
   C. Bid 3
   D. Bid 4

11. Your financial planner presents you with four possible stock portfolios. Each portfolio includes five different stocks, each with a different return. Each portfolio includes 1 of each stock (so there are 5 stocks in total in each portfolio). If you want the highest average return, which portfolio should you choose?

Stock	Portfolio A	Portfolio B	Portfolio C	Portfolio D
Stock 1	20%	25%	15%	10%
Stock 2	10%	10%	10%	12%
Stock 3	25%	20%	15%	20%
Stock 4	6%	9%	6%	12%
Stock 5	4%	6%	14%	6%

A. Portfolio A
B. Portfolio B
C. Portfolio C
D. Portfolio D

12. You have to play one of the four lotteries listed in the table below. If you want to choose the one with the highest average pay out, which lottery should you choose? *Hint: to answer this question you'll need to calculate the average pay-out for each Lottery – i.e. to find the average pay-out for Lottery A you would do the following calculation, (8+16+12+32)/4.*

Lottery A	Lottery B	Lottery C	Lottery D
8	16	24	8
16	20	16	24
12	8	14	14
32	28	22	26

A. Lottery A
B. Lottery B
C. Lottery C
D. Lottery D

13. The owner of a company must choose between four money schemes. For each scheme, the owner of the firm gets the specified amount. Which scheme has the highest **average** payout? *Hint: to answer this question you'll need to calculate the average for each Scheme -- i.e. to find the average of Scheme 1 you would want to calculate (24+24+8+32)/4.*

Scheme 1	Scheme 2	Scheme 3	Scheme 4
24	28	20	20
24	20	18	24
8	6	11	8
32	30	35	32

A. Scheme 1
B. Scheme 2
C. Scheme 3
D. Scheme 4

14. A real estate developer has to choose between four apartment buildings. Each building has four types of apartments which charge specific levels of rent. Which building generates the highest revenue (total rent)?

Rent	Building 1	Building 2	Building 3	Building 4
3000	8	3	5	2
2000	4	6	5	4
2500	6	4	5	8
1500	10	12	11	10

A. Building 1
B. Building 2
C. Building 3
D. Building 4

15. A factory owner must upgrade his factory line. The factory line has five parts. He has bids from four machine shops. Each bid includes all five parts. If the factory owner wants to pay the lowest cost possible for the upgrade, which bid should he choose?

Part	Bid 1	Bid 2	Bid 3	Bid 4
Part 1	30,000	32,000	28,500	29,000
Part 2	10,000	12,000	11,000	9,000
Part 3	22,000	20,000	21,000	20,000
Part 4	12,000	7,000	14,000	9,000
Part 5	4,000	6,000	5,000	11,000

A. Bid 1
B. Bid 2
C. Bid 3
D. Bid 4

16. Your financial planner presents you with four possible stock portfolios. Each portfolio includes five different stocks, each with a different return. Each portfolio includes 1 of each stock (so there are 5 stocks in total in each portfolio). If you want the highest average return, which portfolio should you choose?

Stock	Portfolio A	Portfolio B	Portfolio C	Portfolio D
Stock 1	3%	2%	6%	7%
Stock 2	18%	14%	15%	12%
Stock 3	22%	25%	20%	20%
Stock 4	8%	8%	10%	10%
Stock 5	4%	6%	9%	6%

A. Portfolio A
B. Portfolio B
C. Portfolio C
D. Portfolio D

17. You have to play one of the four lotteries listed in the table below. If you want to choose the one with the highest average pay out, which lottery should you choose? *Hint: to answer this question you'll need to calculate the average pay-out for each Lottery – i.e. to find the average pay-out for Lottery A you would do the following calculation, (150+350+650+350)/4.*

Lottery A	Lottery B	Lottery C	Lottery D
150	100	100	300
350	400	500	400
650	600	550	580
350	300	250	200

A. Lottery A
B. Lottery B
C. Lottery C
D. Lottery D

Appendix B

Table B1: Score Differences by Incentive Structure Across Grade Expectation with Various Controls

	Section Fixed Effects Only			Plus Survey Reported Controls			Plus Available SAT Scores		
	E(NA) (1)	E(A) (2)	E(NA)-E(A) (3)	E(NA) (4)	E(A) (5)	E(NA)-E(A) (6)	E(NA) (7)	E(A) (8)	E(NA)-E(A) (9)
Group of 2 - Piece Rate Difference	-0.231**	0.056	-0.287**	-0.199**	0.049	-0.248**	-0.187**	0.047	-0.234**
	(0.099)	(0.083)	(0.104)	(0.085)	(0.085)	(0.099)	(0.089)	(0.088)	(0.103)
Group of 6 WTA - Piece Rate Difference	-0.378**	-0.024	-0.354*	-0.338**	-0.052	-0.285	-0.377**	-0.046	-0.331*
	(0.152)	(0.139)	(0.190)	(0.132)	(0.142)	(0.178)	(0.136)	(0.151)	(0.181)
	[0.21]	[0.52]		[0.18]	[0.41]		[0.09]	[0.46]	
Group of 6 THP- Piece Rate Difference	-0.346**	-0.037	-0.309**	-0.309**	-0.065	-0.245*	-0.275**	-0.046	-0.229*
	(0.129)	(0.120)	(0.134)	(0.125)	(0.122)	(0.137)	(0.130)	(0.127)	(0.135)
	[0.23]	[0.34]		[0.27]	[0.24]		[0.38]	[0.33]	
Group of 10 WTA - Piece Rate Difference	-0.247	0.067	-0.314*	-0.246	0.053	-0.300*	-0.226	0.071	-0.297*
	(0.169)	(0.117)	(0.16)	(0.158)	(0.118)	(0.154)	(0.171)	(0.123)	(0.167)
	[0.91]	[0.90]		[0.74]	[0.96]		[0.79]	[0.78]	
Group of 10 THP - Piece Rate Difference	-0.395**	-0.011	-0.384**	-0.424**	-0.025	-0.400***	-0.401**	0.001	-0.402***
	(0.166)	(0.146)	(0.147)	(0.169)	(0.147)	(0.146)	(0.168)	(0.146)	(0.142)
	[0.23]	[0.60]		[0.12]	[0.56]		[0.15]	[0.71]	
Testing Equality of Tournament Coefficients	F = 0.50	F = 0.59		F = 0.39	F = 0.50		F = 0.41	F = 0.52	

Notes: Sample size is 2,298. Each vertical panel is from a single regression (equation 1). All models include section fixed effects. Survey reported controls include: race, sex, major, year in school, and age. Administrative controls include: high school GPA, grades in previous economics courses taken at UCSB, parent education, transfer status, SES, citizenship, and primary language spoken in home. SAT scores includes SAT math, SAT reading and SAT writing as well as dummy variables indicating if SAT scores are missing. E(A) denotes students who expect to earn an A (high expectation) and E(NA) denotes students who do not expect to earn an A (low expectation). Square brackets report the p-value testing for the equivalence of the corresponding coefficient and the coefficient for the group of two. Standard errors are clustered at the section level and are reported in parentheses. ** (*) indicates statistically significance at the 5 (10) percent level.

Table B2: Score Differences by Incentive Structure Across Grade Expectation with Various Controls

	Section Fixed Effects Only			Plus Survey Reported Controls			Plus Available SAT Scores		
	E(NA)	E(A)	E(NA)-E(A)	E(NA)	E(A)	E(NA)-E(A)	E(NA)	E(A)	E(NA)-E(A)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Compete - Piece Rate Difference	-0.254**	0.065	-0.319**	-0.223**	0.059	-0.282**	-0.220**	0.063	-0.282**
	(0.100)	(0.081)	(0.101)	(0.086)	(0.083)	(0.098)	(0.090)	(0.088)	(0.103)

Notes: Sample size is 2,298. All five tournament treatments have been collapsed into a single "compete" category. Each vertical panel is from a single regression (equation 1). All models include section fixed effects. Survey reported controls include: race, sex, major, year in school, and age. Administrative controls include: high school GPA, grades in previous economics courses taken at UCSB, parent education, transfer status, SES, citizenship, and primary language spoken in home. SAT scores includes SAT math, SAT reading and SAT writing as well as dummy variables indicating if SAT scores are missing. E(A) denotes students who expect to earn an A (high expectation) and E(NA) denotes students who do not expect to earn an A (low expectation). Standard errors are clustered at the section level and are reported in parentheses. ** (*) indicates statistically significance at the 5 (10) percent level.

Table B3: Earned Microeconomics Grade Versus Expected Grade by Gender

	Most Recent Earned Microeconomics Grade					
	Male			Female		
	Non-A Student	A Student	Number of Students	Non-A Student	A Student	Number of Students
E(Grade) in Current Class						
E(NA)	40%	20%	479	47%	18%	381
E(A)	60%	80%	867	53%	82%	525
Number of Students	1,093	253	1,346	754	152	906

Notes: E(Grade) is the grade students expect to earn in the current course. E(A) denotes students who expect to earn an A (high expectation) and E(NA) denotes students who do not expect to earn an A (low expectation). Non-A students earned less than an "A" and A students earned an "A" in microeconomics at UCSB.