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Risk and Risk Aversion Effects in Contests with Contingent Payments

Contests and the influence of their design reach much further than just the sporting world. Firms seeking new products, investors backing competitors, and government agencies in search of design solutions are all examples of different models of contest design found in the marketplace. Those seeking new technology, innovation, design, and investment must select a winner from many participants. The participants expend resources to increase their chances of winning, knowing all the while that in the end, they may not be chosen.

In the existing research on contests, it is commonly assumed that contest investments are paid up front by each contestant, regardless of whether the contestant wins the contest. In PERC's working paper 1707, *Risk and Risk Aversion Effects in Contests with Contingent Payments,* authors Liqun Liu, Jack Meyer, Andrew J. Rettenmaier, and Thomas R. Saving analyze contests with contingent payment of costs where only the winner pays for the resources used in the contest,

Contests by their very nature involve risk, winning and losing are both possible, and the gain from winning can, itself, be uncertain. The participants in a contest know that they can win or lose and use resources to better their chances of winning. Although many contest models exist, prior research has focused mainly on one type: where "the payment for the cost of these resources is paid up-front by the contestant. Using the symmetric Nash equilibria, previous research shows that risk-averse and prudent contestants choose to devote less resources to winning when the gain from winning is random, rather than certain. This group of contestants also devote less resources than risk-neutral contestants.

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The authors' analysis here adds to these findings by comparing the equilibria reached by two groups of risk-averse and prudent (i.e., downside risk averse) contestants, with one group being both more risk averse and more downside risk averse than the other.

In this paper, findings show that more risk aversion combined with more downside risk aversion implies a smaller equilibrium contest investment. Also, risk-averse and prudent contestants invest less when the prize is uncertain.

The second model used, and the main focus of this paper, describes a contest where only the winning contestant pays for the cost of resources used in the competition. In this model, where the payment for the resources used to improve the chance of winning is contingent

upon winning, the contestant chooses the quantity of resources to employ to enhance the chance of winning, but pays for these resources after the contest is resolved, and only pays when a winner.

Under this model, three different payment arrangements are examined. In each arrangement, the winner pays a share of the prize, the prize share depends on the resources expended, and the winner pays some portion of the cost of the resources used to compete.

The first example is one found in professional golf where a contestant contracts with an investor and the investor pays for all of the resources used to compete. If the contestant wins, the investor receives a share of the prize. A risk averse contestant would choose to participate in such a contract in order to reduce his own risk by transferring it to the investor. The investor would require her share of the prize to be greater than the cost of the resources used in order to accept the increased risk.

In the second payment arrangement, the winner pays all of the contest expenses for all of the contestants. In this example, a venture capital firm has a fixed budget to complete the research and development for a new product. Part of the budget is offered to contestants as seed money to use as resources for product development.

The remaining budget amount is promised to the winner to be used for the production costs of implementing the design. After the winner is selected, they incur all of the production costs and, indirectly, all of the expenses of all the contestants. Findings show that more risk averse contestants use more resources to increase their chance of winning, even though this decreases the size of the net prize. Risk is not shared or transferred.

A design-build competition serves as an example of the last payment arrangement, where the cost of resources are only incurred by the winner. In this type of contract, firms bid on a design-build contract for a local government's construction project.

Resources are not a sunk cost and are only a promise to expend resources if the contract is won in the form of the amenities included in the design. Interestingly, even when resources are not a sunk cost, risk averse contestants are willing to expend more resources to reduce risk and increase the probability of winning.

Findings indicate that, where the cost of participation in a contest is made only by the winning contestant, not paying when losing a contest reduces or eliminates many of the anomalies that arise in the basic self-protection decision model. Paying only when winning also significantly alters the effects of risk and risk aversion on the outcome of the contest.

In comparing different payment structures where the winner pays costs and the losers do not, more risk-averse contestants use a greater amount of resources to compete, rather than less, even when those resources are not a sunk cost, but only a promise to pay if the contest is won.

This study opens the door to some additional issues for further research including identifying which payment method leads to a larger or smaller equilibrium contest investment and which is most efficient under the contest rules.

Persistent Effects of Teacher-Student Gender Matches

In many areas of study previously dominated by men, the representation of women has seen a marked increase over time. Yet, this is not so in the fields of science, technology, engineering and mathematics (STEM). The absence of same gender role models in these fields has been shown to discourage female student participation in STEM fields of study.

One possible cause may be the interaction of students and teacher gender, in which female students are treated differently by or react differently to female and male teachers. In PERC Working Paper 1706, Persistent Effects of Teacher-Student Gender Matches, PERC professor Jonathan Meer and co-author Jaegeum Lim study the long term effects of teacher-student gender matches at the secondary school level.

Earlier research has focused mainly on short term effects, such as how students' current-year outcomes are affected by the gender of their current teacher(s); research outcomes are currently mixed. However, further study on current effects is of limited relevance if these effects are proven to fade over time. Long-term impact studies have been limited due to non-random classroom assignments that lead to potential confounds, such as

that female teachers are assigned to only lower or higher achieving students. Also, little evidence exists on whether the teacher-student gender match has a long-run impact when taking place at more formative ages.

In this paper, the authors study whether the effects of teacher-student gender matches change over time by tracking 7th through 11th grade student data from Korean middle and secondary schools. The South Korean educational system implements several policies that differ from those found in the United States public school system. Rather than segment low-performing, average, and high-achieving students into separate classrooms, the goal of South Korean schools is to produce homogeneous classrooms with similar student abilities.

Although a student's middle school placement begins randomly, the next series of school placements from high school and beyond are based on previous academic performance in specific subjects, teacher and administrative perceptions of the student, and student choice. Student data, including standardized test scores by subject, high school course taking, and academic track choice is collected and allows the authors to track how the effects change outcomes over this four year period.

In elementary school, students are assigned to a local middle school (grades 7 through 9) by lottery. Once in middle school, students are randomly assigned to a physical homeroom classroom and subject teachers rotate through to give lessons. This provides the basis for a truly randomized sample for the study and avoids non-random sorting confounds.

After ninth grade, students apply to attend various public and private high schools, where admission is based on standardized examination scores and recommendations from principals and teachers. In the second year of high school, students choose among academic tracks, regardless of which school they attend. Most schools provide both a math-science track and a humanities-social science track and students are free to choose their academic track. In twelfth grade, students apply to post-secondary institutions, which also take the previously chosen academic track and performance into account.

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The authors' findings explore both contemporary and longer-term effects. In examining 7th grade student standardized test score data for female students taught by female teachers in that same year, the performance gap between female and male students increases by 13.3 % of a standard deviation when the teacher is female rather than male. A smaller decrease in boys' performance when the teacher is female was also observed.

The long-term impacts are of even greater significance in both academic performance and student behavior. Findings show that the presence of a female teacher substantially increases student's test scores compared to male test scores and this effect persists at least through 11th grade. Gender gap effects persist even four years after the initial teacher-student gender match, proving long-lasting effects.

By tracking individual academic tracks in high school, female students who had a female teacher were 8 percent more likely to take an advanced course in that same subject four years later. In relation to STEM fields, girls who had a 7th grade math teacher are 15.1 % more likely to choose the math-science track in high school when taught by a female math teacher verses a male math teacher. Also, female students are 15.7%more likely to take at least one advanced math course when they were taught by a female math teacher in 7th grade versus a male teacher.

This research highlights the fact that female middle school students who are taught by female teachers in STEM-related subjects display greater success in those subjects through higher test scores. Also, positive interactions with same-gender teachers can later increase the likelihood that female students will choose a STEM field of study at post-secondary institutions.

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Winter 2018

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