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Risk aversion in prediction markets: A framed-field experiment☆

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ABSTRACT

To make better decisions today, companies and other economic agents are interested in getting accurate predictions of future events. Prediction markets can, at least potentially, give those accurate forecasts for the probability of the event by aggregating information from traders. However, formal studies highlight that the risk attitudes of market participants may bias the market equilibrium prices, and consequently make the prediction unreliable. This research examines the effect of participants' risk attitudes on prediction market prices, through a framed field experiment on the two semifinals at the 2015 NCAA Men's Division Basketball Tournament. The results of the experiment show a significant price difference between the risk-averse group and the less risk-averse group. The large price discrepancy between markets with participants with varying risk aversion suggests that risk aversion deserves a critical consideration in future prediction-market research and implementation.

1. Introduction

What product will dominate the market in the coming season? Who will win the next election? What movie will win a competition? Companies, policy makers, and decision-makers in general may be interested in getting accurate predictions of future events to make better decisions today. Prediction markets aim to give those accurate forecasts in probabilistic terms (see Wolfers and Zitzewitz (2004) for a survey on prediction markets' types and accuracy).

Prediction markets are exchange-traded future markets that allow traders to buy and sell real-money contracts according to their beliefs in a future outcome. These contracts, which trade between 0 and 100%, offer a binary option that expires at the price of 100% or 0 depending on the outcome happening or not happening, respectively. As the traded asset is the outcome of an event, and markets aggregate the information or opinions from traders, market prices would possibly reveal the traders' beliefs about the probability of the event (the "wisdom of crowds").

Surveys on field evidence from a range of prediction contexts, as Wolfers and Zitzewitz's (2004), suggest that prediction-markets prices seem quite accurate predictors of probabilities. In the political domain, for example, Berg and Reitz (2003); Berg, Nelson, and Reitz (2008a), and Berg, Forsythe, Nelson, and Reitz (2008b) show evidence from the Iowa Electronic Markets and find that the market yields accurate predictions, outperforming large-scale opinion polls. Wolfers and Leigh (2002) show similar results for local elections in Australia. Berg, Neumann, and Reitz (2009) summarize the four advantages of prediction markets over simple surveys that give as a result "an efficient, dynamic mechanism for aggregating information" (p. 349): 1) trader's economic incentives; 2) traders can self-select and express their strength of confidence through their intensity in trading; 3) traders can incorporate into their own beliefs the forecasts of others, reflected in the observable market prices (see Motes and Woodside (2001) for an example of consumers' reinforcements over additional trials); 4) markets can respond quickly to new information.

Therefore, an increasing number of companies experiment with internal prediction markets to forecast important events to the firm. Plott and Chen (2002) arrange a number of internal prediction markets at Hewlett–Packard Corporation to forecast sales. Google uses large-scale prediction markets with its employees since 2005 to forecast new office openings, product launch dates, and other strategic events (Cowgill, Wolfers, and Zitzewitz, 2009). In the public domain, Intrade.com is a large prediction market that offers contracts on current events, the economy, or scientific discoveries, among others.

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However, while many studies find prediction markets rather accurate, the support is not universal. Jacobsen, Potters, Schram, Van Winden, and Wit (2000); Brüggelambert (2004); Huber and Hauser (2005); Rietz (2005), and Sonneman, Camerer, Fox, and Langer (2008) show some examples where prediction markets fail to forecast the outcomes. Laboratory experiments as Deck, Lin, and Porter (2012) and Jian and Sami's (2012), for example, study manipulations that can destroy the prediction markets' ability to aggregate information and mislead those who forecast according to market predictions (see Deck and Porter (2013) for a survey on economic experiments on prediction markets that discusses the prediction markets' accuracy depending on various design features). In addition, some theoretical models highlight features that may undermine the efficacy of the prediction markets' forecasts (see Section 2). These formal models agree with the important effect that market participants' risk attitudes have on the market's equilibrium prices, and therefore on the potential to make a prediction market unreliable as a predictor of uncertain future events.

As prediction markets become of more widespread use, the importance of measuring its reliability and underlying mechanisms grows. This research presents a framed field experiment on the effect of participants risk attitudes on prediction market prices. Framed field experiments combine the power of laboratory experiments with the real-world link of field studies. The results of the experiment on two prediction markets for the two semifinals at the 2015 NCAA Tournament show a significant difference in price between participants with varying risk aversion. Formal analyses that derive equilibrium prices in prediction markets support this result.

Following this introduction, Section 2 reviews some results from formal related literature. Section 3 presents the details of the experimental design and field implementation. Section 4 reports the results. Finally, Section 5 discusses the results and offers some conclusions.

2. Related literature

Despite the recent popularity of prediction markets and its increasing use, only a limited amount of theoretical analysis in this area exists.

Manski (2006), adapting Ali's (1977) example, presents the first formal analysis to derive the equilibrium price in prediction markets. His work considers the case of risk-neutral price-takers traders with heterogeneous beliefs and concludes that other forms of risk aversion imply different relationships between market price and the distribution of trader beliefs. His formal analysis stimulated other researchers to study price formation when replacing the assumption of risk neutrality with other assumptions of risk attitudes.

Wolfers and Zitzewitz (2006) provide a formal model that includes Manski's (2006) as a special case. They show that while prediction market prices typically aggregate participants' information into useful forecasts, several features may undermine the efficacy of these forecasts: 1) Prices close to 0 or 100%; 2) distributions of beliefs specially disperse; 3) constrained trading volumes; and finally, 4) degrees of risk aversion.

The theoretical models of Gjerstad (2005); Ottaviani and Sørensen (2005), and Ottaviani and Sørensen (2007) also support that the participant's degree of risk aversion and beliefs are key parameters driving the equilibrium price in prediction markets.

As these findings indicate that interpretation of prices in prediction markets requires knowledge on participants' risk preferences, this study designs and implements a framed field experiment on the relationship between participants' risk attitudes and prediction market prices.

3. Experimental design and field implementation

To analyze the effect of participants' risk attitudes on prediction market prices, this research runs an experiment on predictions of a mayor sport competition. This research chooses the two semifinals at the 2015 National Collegiate Athletic Association (NCAA) Men's Division Basketball Tournament, the well-known March Madness of the US College Basketball Tournament.

On April 4, 2015, two games take place: Game 1 opposes Michigan State University and Duke University (Team A and B, respectively), and Game 2 opposes Wisconsin University and Kentucky University (Team C and D, respectively). This research chooses this moment of the competition to guarantee some interest from the participants. In addition, the timing of the games (both on the same day and with a few hours interval) helps ensuring that uncontrollable factors do not affect the participation in the two markets.

After receiving IRB approval, the research recruits 75 undergraduate students using the subject pool under the management of Darden Business School, in the University of Virginia, United States.

The experiment consists in four stages. First, the participants complete a pre-experiment questionnaire on socio-demographics. In addition, the participants answer questions that gauge their knowledge about and interest in college basketball. The second task measures participants' attitudes toward risk with the Holt and Laury (2002) lottery choice experiment. Participants were then divided into two groups: the risk-averse and the less risk-averse, according to their scores in the Holt and Laury (2002) measure: those with a higher number of safe choices go in the risk-averse group and those with the lower number of safe choices go in the less risk-averse group. The average number of safe choices for the risk-averse group is 6.58 and the average number of safe choices for the less risk-averse group is 4.00. Drawing from the technique in Holt and Laury (2002), the normalized risk aversion of the risk-averse and less risk-averse group is 2.58 and 0.00, respectively. Interestingly, this means that the less risk-averse group is risk-neutral on average.

On the third stage, the participants enter the markets of the two semi-final games of the sport competition. In the fourth stage, the participants fill out a post-experiment questionnaire that further assesses knowledge and interest in the tournament.

A total of 75 people sign up to participate in the experiment, but only 66 participants complete the risk aversion task, the Holt and Laury (2002) lottery choice experiment. The 66 participants divide into two groups drawing solely on their risk-aversion preferences (Holt and Laury, 2002). As one participant withdraws from the experiment, the less risk-averse group remains with only 32 participants, whereas the risk-averse group has 33 participants. Participants in each group play together in two markets with an average payoff of $10 per market and participant. In addition, they receive earnings for their decisions in the Holt and Laury (2002) lottery choice experiment. The computerized laboratory experiment interface *Ve*conlab (http://veconlab.econ.virginia.edu/) runs both, the risk aversion task and the prediction markets.

The quarterfinals take place on March 28 and 29, which allow the markets to open up for the semifinal games at noon on March 30 and close at 12 pm on April 4. During these five days, a market call occurs every 12 h, resulting in a total of 10 trading periods in each market. To further boost participation, the participants receive an email after every market call with instructions on how to log back into their account, how to create an account if they did not already do so, and a timeline of future market calls. Students entering the market can place bids and ask for an outcome, which pays $1 when occurrence but 0 otherwise.

The pre and post experiment questionnaires contain five questions on participant's interest in college basketball and three questions on participants' knowledge about college basketball. To create dummy variables indicating whether a participant has high interest or high knowledge, the study standardizes the responses. For each question, the study modifies and transforms participant responses into the standard deviation of their responses from the group average in that particular question. For example, the study transforms the answer of a participant who indicates very low interest in one question into a negative number, representing how much her/his answer deviates below the group

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