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## Abstract

*Prediction Markets are a relatively novel type of Group Decision Support System (GDSS) which use social collaboration via a market mechanism to elicit and aggregate information from large numbers of individuals. While the literature recognises their potential as decision support tools, it also notes several issues that give rise to concern regarding their utility in an organisational setting. One concern is the possibility that prediction markets may be subject to malicious manipulation. This paper presents a field experiment which examines the effect of such manipulations on prediction market performance.*

**Keywords:** Prediction Markets, GDSS, Business Intelligence

# 1. Introduction

A pre-eminent theme in information systems research is exploring how information systems and technology can improve decision making at both an individual and organisational level. Prediction markets are a relatively novel form of Group Decision Support System (GDDSS). They use social collaboration via a market mechanism to elicit and aggregate information from large numbers of individuals. Their potential as organisational decision making tools is acknowledged in the literature, which has led to calls to move beyond assessments of predictive accuracy and focus on other issues that may affect their utility in organisational settings. One such issue is the possibility that prediction markets may be subject to malicious manipulations. This paper presents an empirical investigation of the effect of such manipulations on prediction market performance.

The remainder of this paper is structured as follows. Section 2 introduces prediction markets and identifies the issue of manipulation as an open research question. This research question is defined in Section 3. Section 4 briefly describes the methodology used to investigate this issue. The results of this study and emergent conclusions will be presented at the conference.

# 2. Literature Review

Prediction markets are "*markets that are designed and run for the primary purpose of mining and aggregating information scattered among traders and subsequently using this information in the form of market values in order to make predictions about specific future events*" (Tziralis & Tatsiopoulos 2007, p.75). The defining characteristic of a prediction market is that its primary purpose is the elicitation and aggregation of information from a large number of individual participants (Bell 2009). This distinguishes them from other markets, such as those whose primary purpose is investment, the hedging of risk or enjoyment (Wolfers & Zitzewitz 2004). In modern incarnations, prediction markets are deployed using information technology. Participants reveal information through buying and selling contracts on a website, which uses some form of algorithm to match buyers with sellers.

Prediction markets are ascribed a number of benefits over comparable information aggregation mechanisms such as polls or expert groups (Servan-Schreiber et al. 2004). First, prediction markets incentivize information revelation (Hall 2010; Hahn &

Tetlock 2006b). Second, they encourage participants to search out relevant information (Berg & Rietz 2003; Sunstein 2006; Hahn & Tetlock 2006a). Third, the market mechanism they use automatically communicates and aggregates participant's information (Hahn & Tetlock 2006c). Fourth, prediction markets implicitly weight the information provided. If participants are more confident of their beliefs in a particular topic, they will be willing to buy more of the relevant contracts, and vice versa (Berg & Rietz 2006; Graefe & Weinhardt 2008; Hahn & Tetlock 2006b). Fifth, the nature of prediction markets is such that they can scale to very large groups (Hahn & Tetlock 2006c). Prediction markets operate in real-time over extended periods of time, an advantage over comparable methods such as polls (Hall 2010; Polgreen et al. 2006). Finally, prediction markets can be configured to operate in a manner that maintains the anonymity of participants (Remidez & Joslin 2007). This can be useful where there is a concern that power relationships and social interactions may affect the truthful revelation of information (Ellis & Fisher 1994).

Organizations are interested in using prediction markets to tap the valuable private information and tacit knowledge held by employees and other stakeholders (Gruca & Berg 2007). This has led to steady growth in academic and practitioner interest (Tziralis & Tatsiopoulos 2007). There are numerous examples of organizational deployments of prediction markets discussed in the literature. Ortner (1997) discusses how prediction markets are used to support project management processes in Siemens, with other project management case studies offered by Remidez and Joslin (2007). A number of papers describe their use as sales forecasting tools (Chen et al. 2003; Chen & Plott 2002; Waitz & Mild 2009). Hopman (2007) describes the use of prediction markets for demand forecasting in Intel, with other authors offering examples from the public health sector (Rajakovich & Vladimirov 2009; Polgreen et al. 2006).

Much of the academic work on prediction markets to date has focused on assessing their accuracy, both absolutely and relative to comparable methods. At this point, the literature suggests that prediction markets "*can provide more accurate forecasting and effective aggregation than other predictive technologies*" (Hall 2010, p.45). Other authors caution against drawing definitive conclusions but summarize the existing empirical evidence as cautiously optimistic (Gruca et al. 2008; Ledyard 2006; Wolfers & Zitzewitz 2006).

The establishment of the basic credibility of prediction markets as information aggregation tools has to led to calls for studies which move beyond assessing predictive accuracy (Gruca et al. 2005). One major concern noted in the literature is the theoretical possibility that prediction markets can be adversely affected by manipulation (Hall 2010; Wolfers & Zitzewitz 2006). In this context, manipulation is an attempt by a trader or group of traders to affect the outcome of the prediction market for their own ends. In other words they trade, regardless of gains or losses, with a view to dictating a certain forecast. Many authors suggest that prediction markets should not be vulnerable to such manipulations (Berg & Rietz 2003). If an individual attempts to move the price of a contract in a particular direction, others will see an opportunity to profit, trade accordingly and counter balance the attempted manipulation. Some authors go so far as to suggest that manipulation attempts will improve the accuracy of prediction markets, as they will provide more arbitrage opportunities for rational traders.

## 3. Research Question

This study investigates the following research question: Is there a difference in the accuracy of prediction markets which are subjected to a manipulation versus those which are not. The theoretical work in the literature suggests that manipulations should be quickly arbitraged away. This research project aims to confirm this empirically.

## 4. Methodology

The research methodology used in this study was a field experiment in the form of a post test randomised control trial. A number of prediction markets were run as part of this study.

In order to collect relevant data, prediction markets were created asking participants to forecast the price of financial assets. Examples of such assets would be the Dow Jones Industrial Average or a barrel of Crude Oil. Each asset had an individual market, which would open at 9 am on Monday morning. The initial price of the asset was set to the actual price of the asset on the previous Friday. Participants in the market were asked to forecast what the actual price of the asset would be on the following Friday. Participants were allowed to trade freely until Wednesday evening at 5 pm. On the Friday evening, the actual closing prices of the financial assets being traded would be

compared to the forecasts generated by the prediction market. At this point, participants in the market would be rewarded with an allocation of virtual cash based upon the accuracy of their predictions. The study ran for a period of 10 weeks. Each week, 8 markets were created. At the end of each week, participants' performance would be evaluated.

The participants in the prediction markets were 67 undergraduate students studying a 4th year Finance module. As part of this module, students were expected to develop skills in pricing and trading financial assets. Each week, 1% of the marks for the module were available to students. Students earned 0.5% marks overall for making at least 5 trades in a given week. The additional 0.5% was allocated on the basis of performance. The participant who performed best in a particular week as calculated by virtual cash was allocated 0.5%, while the weakest participant received 0. Other participants received a scaled mark between these two extremes. This approach mimicked incentives structures used in organisational prediction markets and incentivises both participation and performance.

The purpose of this study is to investigate the effect of malicious manipulations on prediction market accuracy. In this context, a malicious manipulation can take one of two closely related forms (Hall 2010). The first type of manipulation can occur when a trader or group of traders has the ability to affect the outcome of the event being forecast. In this case, traders may forecast a particular outcome and then bring it about.

The organisational utilization of prediction market implies that policy and operational decision will be informed by the forecasts derived from prediction markets. An obvious concern is that when policy decisions are informed by prediction market forecasts, individuals with a stake in those decisions make "*take losses in these markets in order to deceive decision makers.*" (Hanson & Oprea 2009, p.312). This is the second form of manipulation that is raised as a concern in the literature.

In either case, the utility of driving the prediction market to a specific outcome outweighs the utility associated with gaining rewards through participating in the market accurately. The behaviour of a malicious trader in this situation will be the same. They will trade, without regards for the market price, or possible losses with a view to determining a particular forecast.

In order to simulate this behaviour in a market, the following procedure was adopted. For an individual market, four fake traders would expend all their allocation of virtual dollars selling the asset, thus reducing the forecast price by 6%. Given the nature of the forecasting problem, this represented a highly significant manipulation. Each week, 4 of the 8 active markets were subjected to the manipulation. The participants in the market were not informed that any such manipulation occurred.

The sample used in this study is the 72 prediction markets for which data was collected. This sample was divided into a control group and a treatment group by the independent variable MANIP, which is a binary variable indicating whether or not a market was subjected to manipulation. This produced 36 units in the control group and 36 units in the treatment group. The dependent variable is the accuracy of the prediction market. This is calculated as being the absolute normalised difference between the prediction markets forecast of the asset price and the actual value of the asset price. This research design was submitted to the University Research Ethics committee for approval, which was granted on the 9th of February 2012.

## 5. Results and Conclusions

Data collection for this project has been completed and analysis is underway. Results and conclusions will be presented at the conference.

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