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An experimental analysis of information acquisition in prediction markets ☆

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ABSTRACT

We study which factors in terms of trading environment and trader characteristics determine individual information acquisition in experimental asset markets. Traders with larger endowments, existing inconclusive information, lower risk aversion, and less experience in financial markets tend to acquire more information. Overall, we find that traders overacquire information, so that informed traders on average obtain negative profits net of information costs. Information acquisition and the associated losses do not diminish over time. This overacquisition phenomenon is inconsistent with predictions of rational expectations equilibrium, and we argue it resembles the overdissipation results from the contest literature. We find that more acquired information in the market leads to smaller differences between fundamental asset values and prices. Thus, the overacquisition phenomenon is a novel explanation for the high forecasting accuracy of prediction markets.

1. Introduction

> *There is a fundamental conflict between the efficiency with which markets spread information and the incentives to acquire information.*
>
> Grossman and Stiglitz (1980)

Besides their role as allocation mechanisms, economists have long argued that markets can aggregate and convey information via prices. As part of his research in mechanism design, John Ledyard has made key contributions to the theory and the empirical study of the use of markets to extract and aggregate private information in a way which can help organizations and policy makers to make decisions. Of particular interest are prediction markets (also called information markets), which are financial markets with assets whose values depend on the occurrence of events such as election outcomes, sports outcomes, or the default of a bank. For example, a typical election market asset pays $1 if and only if the incumbent wins,

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and $0 otherwise, while the complementary asset pays $1 if and only if the challenger wins. Thus, the prices of these assets can be interpreted as a market probability forecast of the respective candidate winning the election.

From 2001 to 2003, John Ledyard took part in the design of information markets which could help predict economic and political stability in the Middle East (Polk et al., 2003). The complexity of such markets led him and co-authors to study the ability of information markets to aggregate information about complex intertwined real world events (Ledyard et al., 2009) and their ability to do so when the number of traders is small (Healy et al., 2010). Because information of individual traders is typically not observable in field data, he contributed to the study of the capacity of markets to aggregate information using laboratory experiments (e.g., Bossaerts et al., 2013).

In his Nancy Schwartz Memorial Lecture, Ledyard (2005) stressed the paradox of information markets. In theory there should be hampered by the no trade theorem (Milgrom and Stokey, 1982), but in practice they have proven to be very successful at aggregating information and predicting the underlying events (e.g., Wolfers and Zitzewitz, 2004; Berg et al., 2008; Page and Clemen, 2013). These potential benefits of information markets led him to take a public stance for the removal of regulatory barriers in the US preventing them to be used more widely (Arrow et al., 2008).

In the present paper we build on this interest in the ability of information markets to convey information through prices. As pointed out by Grossman and Stiglitz (1980), there is a fundamental conflict between the efficiency of market prices and the incentives for traders to acquire information. Until now, most research on prediction markets has been about their ability to aggregate existing knowledge. We take a step back and ask how much information traders have in the first place. The main question we address in this paper is if and when prediction markets promote information acquisition.

Our design and findings are novel in the following ways. First, we vary the trading environment in terms of endowments and initial information to identify factors that induce more information acquisition and lead to more accurate price forecasts. Second, we investigate trader characteristics that are associated with information acquisition and try to understand why these characteristics induce information acquisition. Third, beyond confirming the previous finding that acquiring information may lead to lower net profits, we also show that traders do not change the information acquisition behavior over many rounds of play. Fourth, we show that the overacquisition of information is a possible explanation why prediction markets provide accurate forecasts, because more information in the market typically leads to lower prediction errors of market prices. Finally, we suggest that the overacquisition phenomenon we observe is similar to rent overdissipation in the contest literature, and the contest nature of the market may explain the information acquisition behavior.

In our experiment, participants trade an asset whose value depends on the realization of the state of nature. Prior to trading, traders may acquire costly and imperfect signals about the state of nature. We use this experimental design to determine which factors—in terms of trading environment and individual trader characteristics—drive information acquisition on the individual level. Furthermore, we investigate whether these factors affect the market behavior, and in particular, whether increased information acquisition leads to lower prediction errors of market prices.

We find that traders invest a substantial amount of resources to collect information. In line with theoretical predictions, traders are more likely to acquire information if they have a larger endowment in cash and assets, if their existing information is inconclusive, and if they are more risk seeking. However, we find that most traders overinvest in information, so that traders obtain a negative average profit net of information costs. This finding persists even in the last rounds of the experiment, i.e., we find no evidence of reduced information acquisition over time to avoid these losses. This behavior is inconsistent with rational expectations theory and reminiscent of overdissipation in classical contest and tournament games (Anderson et al., 1998; Konrad, 2009; Sheremeta, 2010). Interestingly, while this overinvestment in information hurts net profits of traders, it improves the predictive accuracy of market prices. This phenomenon is a novel piece in the puzzle to explain why prediction markets work well in practice: Not only do they aggregate information, they also motivate a substantial amount of information acquisition. By varying the amount of initial information in the market, we also find that information acquisition is strongest if information in the market is weak. This finding helps to explain why prediction markets consistently produce good forecasts, even though initial information among traders is weaker in some markets than in others.

Our study contributes to the literature investigating the effect of information acquisition in financial markets, which is a surprisingly small subset of the large experimental asset market literature.[1] Early experimental studies by Sunder (1992) and Copeland and Friedman (1992) test rational expectations equilibrium (REE) predictions about aggregate market statistics such as market prices and extent of information acquisition. Their findings are roughly consistent with predictions of REE or noisy REE. In particular, Sunder (1992) and Copeland and Friedman (1992) found that, on average, informed traders obtain the same net profits as uninformed traders. Consistent with the original Grossman and Stiglitz (1980) article, these early studies consider perfect information signals, while later studies consider more realistic information structures with imperfect information. Ackert et al. (1997) focus on pricing and information aggregation by comparing asset prices to REE predictions in markets with few imperfect signals. They find that asset prices are consistent with the rational expectations prediction in roughly half of the markets, and that auction prices of information are typically positive, but sometimes converge toward zero. Huber (2007) and Huber et al. (2011) extend the early studies to allow for different levels of information. Contrary

[1] For an earlier study of markets with a similar types of Arrow–Debreu securities, see Plott and Sunder (1988). For reviews of the experimental asset market literature, see Sunder (1995) and Noussair and Tucker (2013). Deck and Porter (2013) provide a survey on laboratory studies on prediction markets, and Palan (2013) gives a survey on experimental studies devoted to bubbles and crashes.

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