Understanding the Plott-Wit-Yang Paradox

FINAL REPORT

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Non-technical summary:

The primary purpose of this research project was to understand the paradoxical results of betting market experiment reported in Plott et al. (2003) through analyzing the process of information aggregation on such markets. In Plott et al., the authors address experimentally two fundamental questions: first, is information aggregated on betting markets? Noting that there is no clear theoretical reason why betting markets should aggregate information at all, the authors report that the implicit prices on their experimental markets are very close to the prices that would exist if all agents pooled their information and made decisions on the basis of the pooled data. This observation suggests that the information in their markets does aggregate. Second, which model explains best how information is aggregated? The theoretical model which seems to fit their data best (the Decision Theory Private Information, or DTPI, model) does not rely on information aggregation whatsoever. The authors call this paradoxical. We refer to their result below as the Plott-Wit-Yang (PWY) paradox.

We replicate their experiment with minor changes because the original data is no longer available. We programmed software for this experiment using z-Tree and conducted the experiment in 9 sessions employing 109 participants in total. We find, first and like Plott et al., the paradoxical result that information is aggregated while the data seem to be explained best by a theoretical model that does not require information aggregation. We show that market odds are indeed very close to odds that would exist if traders behaved according to the DTPI model. However, our individual level data analysis suggests that, apart from the private information, traders extract significant additional information from observing the market odds. The PWY paradox seems due to aggregate rather than individual level data analysis.

In particular: first, we find that traders invest on average one third of their overall investment into events that they should ignore according to DTPI model. Second, we compare the observed individual distribution of bets to the distribution of bets implied by private signals (the DTPI model) and the distribution of bets implied by market odds (bets are in proportions to their probabilities implied by market odds). For this comparison we use again the Würtz measure (Würtz criterion, WC). Our hypothesis that traders do take into account information contained in their private signals and in market odds implies that the of distance between observed individual behavior and private signal is approximately the same or larger than the WC of distance between observed individual behavior and behavior induced by the market odds (note that the smaller WC, the lower the distance between two distributions). We find support for the fact that traders rely on the signal contained in market odds more than they rely on their private information.

Apart from this main result we also analyzed the effect of risk aversion on the level of investment. We do not find support for our hypothesis that risk averse traders bet on average less money than risk lovers. Further, our betting market exhibits a weak statistical efficiency (market probabilities correspond to actual frequencies of winning) and we find a long-shot bias similarly to Plott et al.

Finally, we conducted an experimental prediction market at CERGE-EI, Prague, to forecast the number of applications received for the 2009/2010 Ph.D. program. Traders were students and faculty members who could have insider information about the interest in this program. For example, some students participated in recruiting activities; faculty members helped in recruiting and knew about extensive financial support for new students, etc. The hope was to establish the prediction market as a leading indicator of the recruitment process that potentially could affect activities in the weeks leading up to the deadline and the ensuing selection process. While the prediction market did not show the capacity to provide valuable forecasts we do draw certain conclusions concerning the optimal design of small scale internal prediction markets (payment scheme, timing, using real vs experimental money, etc).

References:

Fischbacher, U. (2007): z-Tree: Zurich Toolbox for Ready-made Economic Experiments, *Experimental Economics* 10(2). pp. 171-178.

Plott, C. R., Wit, J. & Yang, W. C. (2003). Parimutuel Betting Markets as Information Aggregation Devices: Experimental Results. *Economic Theory* 22(2). pp 311-351.