The Journal of Prediction Markets (2009) **3**, 1 *61-63*

ON MARKET MAKER FUNCTIONS

Robin Hanson[1]

Since market scoring rules have become popular as a form of market maker, it seems worth reviewing just what such mechanisms are intended to do.

The main function performed by most market makers is to serve as an intermediary between people who prefer to trade at different times. Traders who have the same favorite times to trade can show up together to an ordinary continuous double auction, and then make and accept offers to trade. But when traders have different favorite times, a market maker can help them by first making offers that some of them will accept, and then later making opposite offers which others will accept. By adjusting prices in his favor, a market maker can even profit from providing this service.

By making offers, however, a market maker opens himself up to the risk of losing to informed traders who know more than he about asset values. It is a complex and difficult task to choose the price and duration of offers in order to profit the most from intermediary trades while suffering the least from informed trades. This task requires subtle judgments about the relative fraction of informed and intermediary trades at different times, prices, quantities, and trading histories. No simple algorithm could reasonably claim to do this task optimally.

Very active markets have little need for market makers, as anyone can trade at anytime. In markets with large but sporadic trades, a human will likely find it profitable to apply their considerable intelligence to the complex task of market making. The question is what to do for smaller less-active markets, which cannot afford such human attention. Trading may simply not happen there if no intermediary can be found to make such markets.

A computer program with less than human intelligence that attempts to make markets runs the risk of being out-smarted by human traders. Humans might even figure out how to turn that program into a money pump, giving up cash each time it is run through some cycle of trades. Of course a program could be set to shut down once it had lost more than some amount, but then it would no longer be making markets.

In this difficult situation it is somewhat comforting to know that we can at least describe a simple program that is guaranteed to always intermediate

[1] Research Associate, Future of Humanity Institute at Oxford University, Associate Professor of Economics, George Mason University, MSN 1D3, Carow Hall, Fairfax VA 22030-4444, rhanson@gmu.edu

trades by offering substantial buy and a sell offers close to each other in price, and that can do so forever while bounding the amount of money that it could ever lose. While such a program will rarely do an optimal job of trade intermediation, it will at least support some trading.

This simple automated market maker is inventory-based. That is, it always sets its current buy price to be some monotonic function of its asset holdings, and always offset from its sell price so as to prevent becoming a money pump. I was not the first to realize this result (Savage 1971; Black 1971). If I made an original contribution it was to describe combinatorial versions of such market makers (Hanson 2003; 2007). Given some set of base events, a combinatorial market maker can support trades between any combination of event-contingent assets defined in terms of events expressible as any combination of these base events.

This sort of market maker, one that can both guarantee perpetual trade intermediation and yet bound its losses, is the sort that a neutral exchange could reasonably support directly. More ambitious market maker programs must take more risks, and so need to be monitored more closely to ensure that they are sustainable and do not covertly favor some traders over others. Fortunately multiple market-makers can coexist within a continuous double auction market; one can support both a safe inventory-based version and also more ambitious but risky versions.

In addition to firms like Microsoft that have constructed their own simple inventory-based market makers, several firms, such as Consensus Point, Xpree, and Inkling, now sell software that support such markets. Software engineer Ken Kittlitz of Conensus Point writes about their experience:

> "Having run markets both with and without Hanson's automated-market maker, we say with confidence that it makes a huge difference to the success of a market. Because it maintains buy and sell orders at a wide range of prices, it provides a steady source of liquidity that would otherwise be lacking. This allows traders to interact with the system in an easy, intuitive manner rather than having to worry about placing booked orders at certain prices and waiting for other traders to match those orders. The number of trades in a market using the market-maker is at least an order of magnitude higher than in one not using it."

A few firms, such as YooNew, have even implemented combinatorial versions of inventory-based market makers, and Consensus Point will soon sell combinatorial software.

There are two obvious ways that an inventory based market maker can fail to optimally intermediate trades: it can trade too much or too little, via offering too much or too little liquidity. If it offers to trade too much, it may end up trading mostly with only one side of the market (e.g., buyers), as the price might not move enough to engage trades on the other side. If it offers to trade too little, then those who want to trade more will have to wait, either for others to accept direct trader-to-trader offers, or for the market maker to return to their price range. Of these two errors, trading too little is the cheaper risk.

One can modify a simple inventory based market maker to use different price-inventory relations in different circumstances, and in this way adapt its liquidity to apparent demand. But this approach risks unbounded losses to clever traders who anticipate and exploit such changes. For example, if a clever trader can anticipate that low liquidity will be followed by high liquidity, he might suffer small losses while moving the price far away, but then be rewarded with large gains for returning the price back to its starting point.

While trade intermediation is usually the main function market makers are created to perform, it is worth mentioning that market makers can perform other functions. In particular, market makers can encourage trading activity. Losses of a market maker are gains to its traders, and the prospect of such gains should entice more trading. The details of the added trader incentives match details of the market maker's loss tendencies.

A nice feature of inventory-based market makers is that they only directly reward traders for acquiring more information about asset value. No other trading activity is rewarded directly, though other activity can be rewarded indirectly via the combination of the market maker and other traders. For example, traders are rewarded for acquiring information before other traders, traders can have incentives to trade to mislead other traders about their information, and traders may want to wait for trades with complementary information before making their own trades.

REFERENCES

Black, Fischer (1971) "Towards a fully automated exchange", Financial Analyst Journal, July and November.

Hanson, Robin (2003) Combinatorial Information Market Design. Information Systems Frontiers 5(1):105-119, January.

Hanson, Robin (2007) Logarithmic Market Scoring Rules for Modular Combinatorial Information Aggregation, Journal of Prediction Markets 1(1):3-15, February.

Savage, Leonard (1971) Elicitation of personal probabilities and expectations. Journal of the American Statistical Association 66(336):783801.