

Abstract of “Usefulness and feasibility of market maker in a thin market”

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Market maker is an important player who provides liquidity and stability to financial markets. There must be many potential markets that low cost market maker can elicit. Many elegant models have been proposed, but they tend to be under the assumption of foresightness or computability of rationality. We propose a simple model of market maker to develop autonomous market maker system for practical use. For this purpose, we try to estimate usefulness and feasibility of the market maker by artificial market, named U-Mart system.

At first, the market maker offers bid at lower price than latest price and ask at higher than that. Bid price at time t denoted by $bp(t)$ is obtained by upper spread ($up(t)$) and latest price $p(t-1)$, $bp(t)=(us(t)+1)*p(t-1)$, and $op(t)=(1-ls(t))*p(t-1)$, where $op(t)$ is offer price of the market maker and $ls(t)$ is lower spread from latest price. In upward trend, because price going up, market maker tend to have long position and in downward trend, market maker holds long position. Market makers exert to keep his position neutral. When the market maker holds long position, he hardly buys additionally and wishes to sell. Then, the market maker widens upper spread and shortens lower spread. This can be simply formalized as following. According to his position (x), $us(t)=-a_1*x^3+b$ and $ls(t)=a_2*x^3+b$ where b is constant and indicates default spread. Furthermore, when market maker holds a large long position, he stress to stop buying more over to sell, that is, $a1=a+c*(x/abs(x))$, $b1=a-c*(x/abs(x))$, where $abs(x)$ means “absolute value of x ” and a and b is constant. Our model of market maker is summarized as follows.

$$(0.1) \quad ls(x) = c |x^3| + ax^3 + b$$

$$(0.2) \quad us(x) = c |x^3| - ax^3 + b$$

$$(0.3) \quad ap(t) = (1 + us(x))p(t-1)$$

$$(0.4) \quad bp(t) = (1 - ls(x))p(t-1)$$

To check the usefulness and feasibility of market maker, we design “thin market” as following artificial futures market using U-Mart system developed by U-Mart Project. There are 10 random traders, who orders selling or buying randomly with probability 0.05. Limited prices of the order also are given randomly around last spot price. To estimate the usefulness and feasibility of market maker by comparison with other situation, we conduct following three kinds of experiments.

Ex1) Market with 10 random agents and market maker proposed above.

Ex2) Market with 10 random agents and an agent who always order selling and buying simultaneously, but limited prices of orders are given randomly.

Ex3) Market with 11 random agents.

The below Table shows the result of simulation. Parenthetic numbers are standard deviation. The market with the market maker realized high level of liquidity, that is, contract rate raise to 34.8%. By the result of Ex3 without market maker, contract rate is only 10.5%. In Ex2, we entry the agent who always offers bid and ask but limited prices are given randomly to estimate the performance of our model. Now we call the agent in Ex2 “naïve market maker”. The naïve market maker provide liquidity but contact rate is worse than that of the market maker appeared in Ex3. Moreover, second column of the table shows the performance of the market maker in Ex1, the naïve market maker in Ex2 and the randomly selected agent among 11 in Ex3. Average profit rate of the naïve market maker is higher than 100%, so he is expected to get profit, but standard deviation of performance is 4.1 so more than the probability of 8% he should suffer a loss. In contrast, the market maker almost always ensures a profit. This means that the market maker should be useful because both the market keeps liquidity and the market maker can afford to be business.

The following figures shows the position and profit of the market maker. The horizontal axis shows time and vertical axis is position and profit. In the above figure, if the vertical value is positive, market maker has long position and negative value means amount of short position. The market maker adjusts his position, and then the curve is seemed like that of trigonometrical function. With both figures, we can see that the market maker accumulates profit constantly by short and finicky trade.

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| Average (SD) | Contract Rate | Market Maker's asset at last day | Market Maker's position at last day |
|--------------|---------------|----------------------------------|-------------------------------------|
| Ex1 | 34.8%(0.4%) | 107.9%(2.4%) | 2(3) |
| Ex2 | 30.3%(0.7%) | 105.6%(4.1%) | -37(21) |
| Ex3 | 10.5% (0.3%) | 98.6%(3.7%) | 0 |

Table

