Usefulness and feasibility of market maker in a thin market

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Abstract

To develop autonomous market maker for practical use, we propose simple model. In this model, the market maker decides ask and bid prices by his position. By using virtual futures market system (U-Mart system), effects of the market maker were estimated. As the result, the market maker provides liquidity to the market and market maker himself obtains profit constantly. This suggests feasibility of autonomous market maker system.

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Introduction

Market maker is an important player who provides liquidity and stability to financial markets. Market maker has been investigated theoretically, and many models were proposed. These models can be dividing into 3 types. One is the model, in which market maker decide bid-ask spread to minimize inventory cost and transaction cost. Stall[1], Ho and Stoll[2], O'Hara and Oldfield[3] proposed this kind of model. The other type is to focus information of traders. In this kind of investigation, it is assumed that market consist of informed traders and noise traders. Optimum bid-ask spread can be calculated by the component ratio of informed and noise trader. Copeland and Galai [4] proposed this kind of model, and then Kyle [5] develops this idea. Both kinds of models under the assumption of foresightness or computability of rationality. Last type of model is the market makers who have learning method. Beltratti et al. proposed market maker model with neural net [6].

Many open markets, for example NYSE, NASDAQ in USA and Jasdaq in Japan, adopt market makers. These actual market maker should use these theory and models but it is closed how they calculate bid-ask indicative price. By private interview with a person who had done, they accessorily use information calculated by these models but finally a market maker personally decide by his experience. Especially, it is expected that there are no autonomous market maker system, because any program should have counterplot.

There are many thin markets, for example Osaka securities exchange is a local stock market. Almost all days, pricing ratio is less than a half. There must be many potential markets that low cost market maker can elicit. As mentioned above many elegant models have been proposed. Though, we propose 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.

Model of Market Maker for Thin Market

At first, the market maker offers bit at lower price than latest price and ask at higher than that. Bit 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 $ls(t)=a_2x^3+b$ 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.

$$ls(x) = c \mid x^3 \mid + ax^3 + b \tag{1.1}$$

$$us(x) = c \mid x^3 \mid - ax^3 + b \tag{1.2}$$

$$ap(t) = (1 + us(x))\, p(t-1) \tag{1.3}$$

$$bp(t) = (1 - ls(x))\, p(t-1) \tag{1.4}$$

Fig. 1 shows upper and lower spread, its x-axis represent market maker's position. Fig. 2 shows bid and ask price the market maker offers. X-axis of fig.2 represent market maker's position and Y-axis represent price when the latest price was 1.

Usefulness and feasibility of market maker

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 [U-Mart, 2002, U-Mart, 2003, U-Mart URL]. The market is the futures market of stock index. Pricing is done once a day. Agents make contract futures during 3000 days, and then contracts are settled at spot price of 3001st day. Market maker proposed here always orders selling and buying simultaneously. Limited prices of orders are given by (1.3) and (1.4).

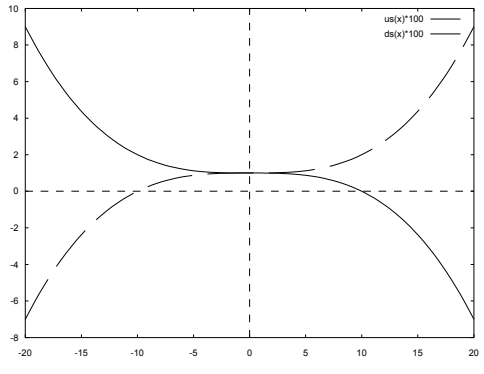


Fig. 1: upper and lower spread with position x.

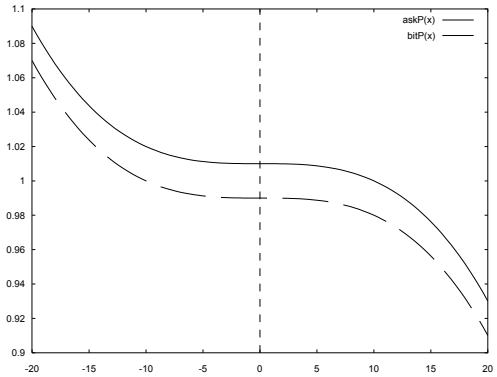


Fig. 2: Bid and Ask Price offered by market maker.

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.

To give simulation parameter, we check all price of stock given by market maker in JASDAQ[1] at 3/3/2004. Table 1 represents the result. By this, we decide a=0.0001, b=0.01, c=a/2. Time series of spot prices are given as geometric Brownian motion process. Time series of spot price are 14 and execute 20 times for one spot price by changing random seed, totally 280 trials are done.

	Upper Spread	Lower Spread	Bit Ask Spread
MAX	8.9%	15.2%	14.3%
MIN	-0.9%	-3.4%	0.2%
Average	1.4%	1.1%	2.5%
SD	1.5%	1.5%	2.0%

Table 1: Actual data of JASDAQ

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

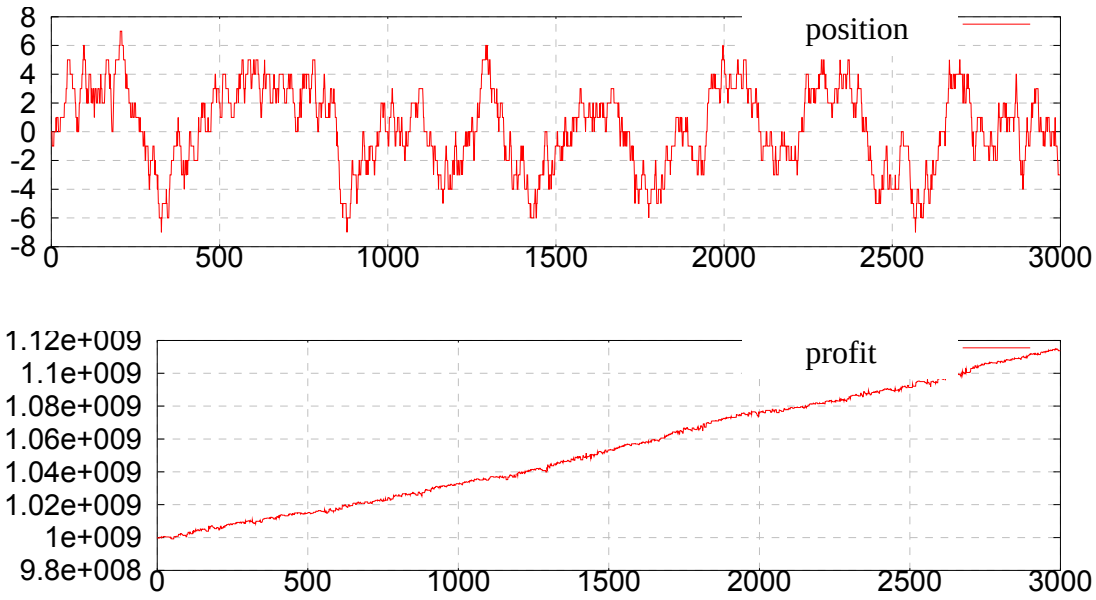
Table 2: Results of Simulation.

Table 2 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 bit 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 table 2 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

[1] Jasdaq is one of the "over-the-counter markets" where is most famous market adopting market make system in Japan. See http://www.jasdaq.co.jp/index_en.jsp. At that time, 276

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.

Fig.3 shows the position of the market maker. The horizontal axis shows time and vertical axis is position, if 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. Fig. 4 represents profit of the market maker. By short and finicky trade, the market maker accumulates profit constantly.



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