Chapter 13

THE MATCHING MARKET INSTITUTION

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The matching market (MM) institution is a two-sided auction procedure that collects bids from buyers and asks from sellers, and iteratively matches the highest remaining bid with the highest remaining ask less than or equal to it. Each buyer pays his bid price and the seller receives the bid price. Rich and Friedman (1998) and Rich (1996) document recent use of the MM by the Chinese Environmental Protection Agency and occasional use in various financial markets.[1]

The MM institution maximizes the number of agreeable matches (i.e., transactions) in a given set of bids and asks, and gives the seller the best agreeable price in each transaction. However, buyers and sellers in the MM have strong incentives to bid and ask strategically so as to underreveal willingness to transact (Rich and Friedman, 1998). Actual performance, in terms of efficiency as well as transaction volume and seller's surplus, therefore is a question of theoretical and practical interest.

In this chapter we summarize a first laboratory experiment comparing the MM institution to the natural alternative, the uniform price (UP) or single call market. The procedures and results are reported more fully in Rich and Friedman (1998). We find that, compared with UP, MM has lower efficiency, has about the same average volume but greater variability, and gives sellers a *smaller* fraction of the surplus.

1. Experimental Procedures

The experiment consisted of ten sessions; five conducted by hand at Wuhan University (WU) in China and five conducted over a computer network at University of California, Santa Cruz (UCSC). Each session involved 16 or more trading periods, roughly half under MM and half under UP. Three sessions at each site used inexperienced subjects, four buyers and four sellers, and the other two sessions used experienced subjects, six buyers and four sellers. Figure 1 shows the induced value and cost parameters; note that experienced buyers received the higher value schedule B' in some periods. On average subjects earned about \$10 per hour at UCSC and 25 Yuan at WU, well in excess of average opportunity cost.

[1] A general definition is that a matching market is a mechanism for pairing individuals for mutual benefit. In one well-known special case, often referred to as the marriage market, utility is non-transferable and the value of a potential match depends nonlinearly on the characteristics of the two parties (Gale, 1968; Becker, 1973; Roth and Sotomayor, 1990; Shimer and Lones, 2000). Our MM is a polar case of transferable utility in which the value of a match is simply the difference between buyer's value and seller's cost.

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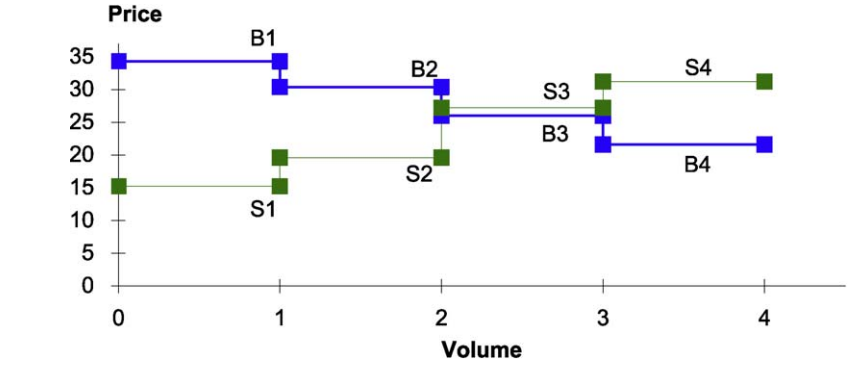

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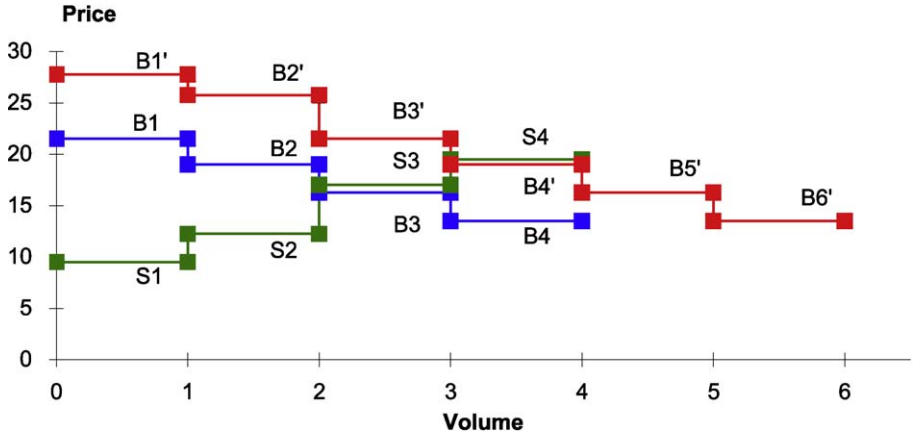

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Figure 1. (A) Induced values and costs in inexperienced sessions. In sessions with inexperienced subjects, supply is induced each period using cost schedule $S1$–$S4$. Demand is induced each period using value schedule $B1$–$B4$, producing the competitive equilibrium (CE) price = 27.2, the CE volume = 2, and the total CE profit = 30 each period. (B) Induced values and costs in experienced sessions. In sessions with experienced subjects, supply is induced each period using cost schedule $S1$–$S4$. Demand is induced in some periods using value schedule $B1$–$B4$, producing CE price = 17.0, CE volume = 2, and CE total profit = 18.75. In other periods demand is induced using $B1'$–$B6'$, producing CE price = 19.5, CE volume = 3, and CE total profit = 36.25.

To illustrate the two market institutions, suppose that the bids of the four buyers are 4.60, 3.75, 2.25, and 1.50, and that sellers' asks are 6.00, 4.00, 2.81, and 1.40. In the MM, the highest ask would be rejected since it is above the highest bid, and the other three asks would be matched respectively with the three highest bids. The outcome is three transactions at prices 4.60, 3.75, and 2.25 with revealed surplus $4.60 - 4.00 = 0.60$, $3.75 - 2.81 = 0.94$, and $2.25 - 1.40 = 0.85$. The actual surplus, of course,

depends on the three buyers' true values and the three sellers' true costs; presumably the actual surplus exceeds the total revealed surplus of $0.60 + 0.94 + 0.85 = 2.39$.

The same bids and asks lead to a different outcome in the UP institution. Here the two highest bids are matched with the two lowest asks at the highest market clearing price, 3.75. In this case the two transactions yield a revealed surplus of $4.60 - 1.40 = 3.20$ plus $4.00 - 3.75 = 0.25$ for a total of 3.45. See the Cason and Friedman chapter in this Handbook and the citations therein for a complete description of the UP institution, referred to there as the "$k = 1$ SCM."

In each period of the experiment, the trading institution, MM or UP, was announced (and typically held constant for 4–8 periods) and each trader privately submitted a bid or ask. The collected bids and asks and resulting transactions then were publicly displayed; true values and costs remained private information.

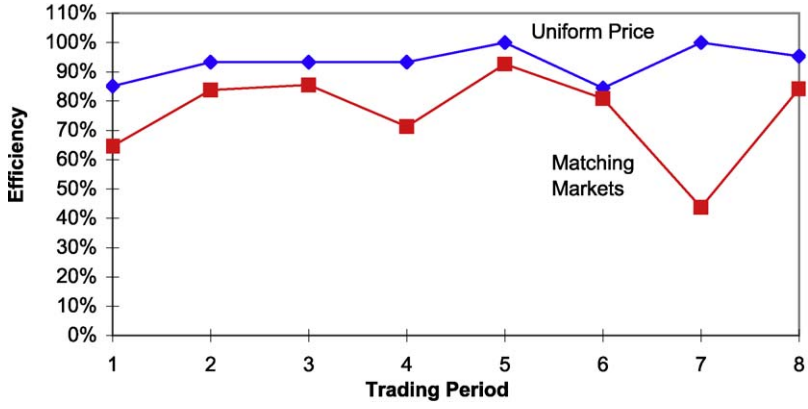
2. Results

We focus here on how the market institution (MM or UP) affects three performance variables: efficiency, trading volume, and surplus split. The variables are measured in 264 market periods in ten sessions, 133 MM periods and 131 UP periods. Efficiency is defined each period as the observed total profits as a fraction of the competitive equilibrium (CE) profit shown in Figure 1. The overall mean efficiency is 80 percent under the matching market compared to 92 percent under the uniform price market. Figure 2 shows the trends for the first eight periods averaged over all six inexperienced sessions in Panel A. In each of these periods the average efficiency is higher in UP than in MM. Panel B shows the corresponding averages over all four experienced sessions. Here the data are more erratic and in three periods the MM has higher efficiency, but overall UP is still clearly the more efficient market institution.

Volume deviation is defined in percentage terms each period as observed trading volume minus competitive equilibrium volume and then divided by CE volume. These values are quite small on average in both institutions: -0.6% in MM and -5% in UP. But volume is considerably more variable in MM, where the absolute value of volume deviation (VDVAB) averages 21% in MM and 5% in UP. That is, positive and negative deviations are both large in the MM but tend to offset each other, while positive deviations are extremely rare in UP and negative deviations are rather moderate. Figure 3 shows the trends in VDVAB. In each of the first eight periods the average absolute volume deviation in the six inexperienced sessions is larger in MM than in UP. Again the experienced data are more erratic – MM has smaller average absolute deviation in one period and equal in another. The overall conclusion is the same: the MM institution is less reliable than the UP in delivering the CE trading volume.

Why are the experienced session averages more erratic than the inexperienced?

Partly it is simply the difference in sample size, with four experienced versus six inexperienced sessions. The other part of the explanation is that both institutions perform erratically. In a stationary repetitive environment, traders in the UP institution tend to



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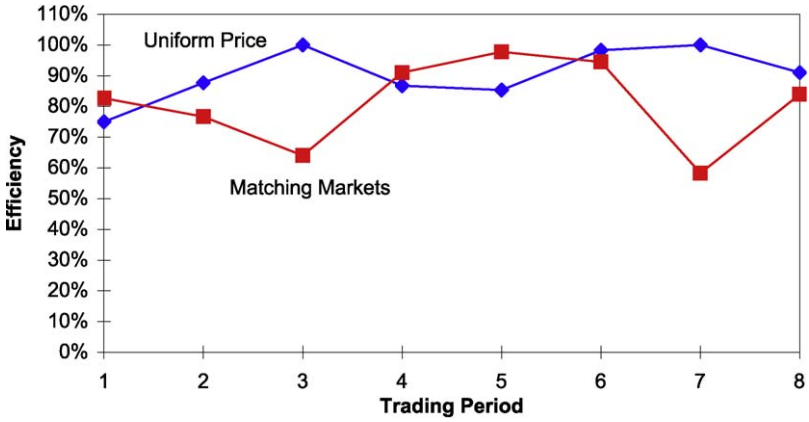

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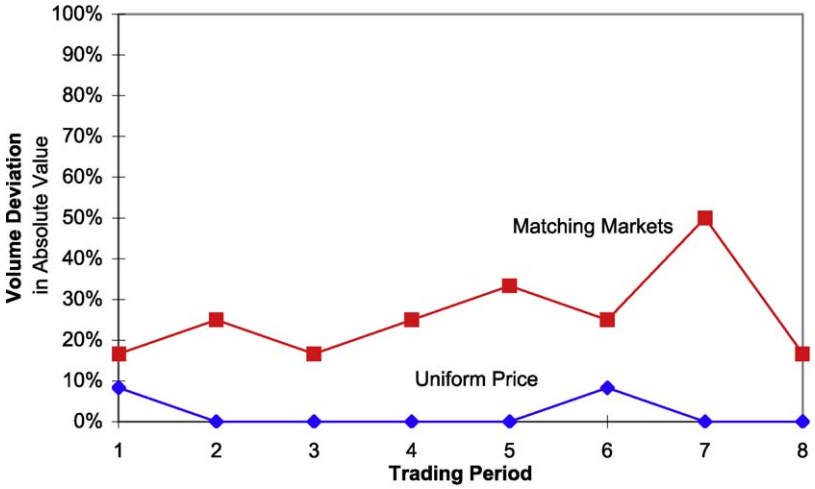
Figure 2. (A) Average efficiency in inexperienced sessions. The first eight periods are averaged over all six inexperienced sessions; see Figure 1 Panel A for induced values and costs. Note that average efficiency in every period is higher in the uniform price institution than in the matching institution. (B) Average efficiency in experienced sessions. The first eight periods are averaged over all four experienced sessions; see Figure 1 Panel B for induced values and costs. Note that overall UP is more efficient although the MM has slightly higher efficiency in three periods.

shade their bids and offers closer and closer to the anticipated clearing price, and occasionally they overshoot the price and fail to transact, with a drastic impact on efficiency and volume (Friedman and Ostroy, 1995; Smith et al., 1982). The UP data in Figures 2 and 3 reflect this strategic behavior, and also reflect the fact that the MM also encourages strategic behavior and produces even more erratic outcomes.

The final performance measure we consider is the surplus split. Define ratio of sellers' profit (RSP) as actual profits earned by all sellers in a given market period as a percent-



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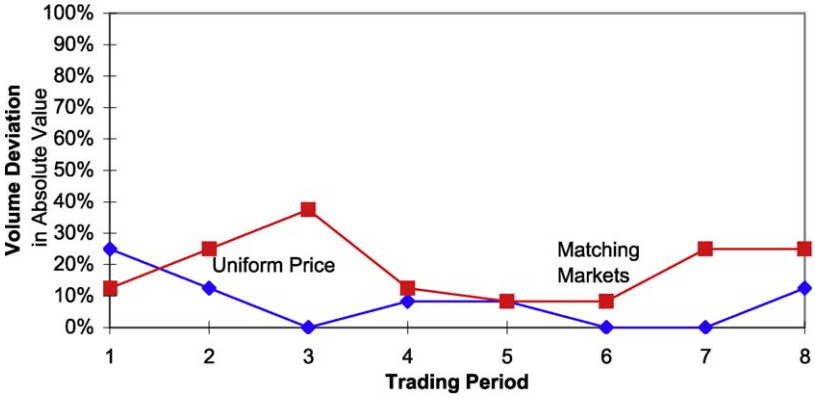

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Figure 3. (A) Average volume deviation in inexperienced sessions. The first eight periods are averaged over all six inexperienced sessions; see Figure 1 Panel A for induced values and costs. Note that volume is considerably more variable in MM compared to UP. (B) Average volume deviation in experienced sessions. The first eight periods are averaged over all four experienced sessions; see Figure 1 Panel B for induced values and costs. Note that the MM is again less reliable than the UP in delivering the CE volume.

age of profits that sellers would earn in competitive equilibrium. Likewise, define RBP as the ratio of buyers' actual profit to CE profit. Overall, average RBP is 91.2% in MM versus 99.9% in UP, while average RSP is 72.9% in MM versus 86.6% in UP. Thus the profits of both buyers and sellers are notably lower in MM than in UP. To assess the relative loss (or surplus split *per se*) we consider the ratio of average RSP to average RBP.

The ratio is 79.9% in MM and 86.7% in UP. Thus the MM impairs sellers' relative, as well as absolute, profitability.

3. Discussion

Our findings offer little encouragement to advocates of the MM in field markets. Compared either to the competitive equilibrium (CE) theoretical benchmark or to the actual performance of the uniform price (UP) market institution, the MM institution fails to deliver on its main selling point: that it will generate higher trading volume. It does generate considerably more variable volume but average trading volume is quite close to the CE benchmark and to the UP average. A secondary selling point is that the MM will offer sellers a larger share of the surplus. However, our data show that sellers in the MM get a smaller slice of a smaller pie than in UP.

Rich and Friedman (1998) show that prices were also more variable in MM, even after averaging across transactions within a period. The main problem with the MM in practice is that it is much less efficient; loss of potential gains from trade averaged about 8% in UP and about 20% in MM. Rich and Friedman (1998) argue that the reason for the poor showing is that buyers substantially understate their willingness to pay and sellers understate their willingness to accept in both institutions but especially in the MM institution. These results serve as a caution to those who contemplate field use of the MM, and serve as a challenge to theorists who wish to construct general models of price formation.

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