Available online at www.sciencedirect.com
SCIENCE DIRECT®
Economics Letters 83 (2004) 89–97
economics letters
www.elsevier.com/locate/econbase

Does the option to cancel an order in a double auction market matter?

Steve Crowley[a,1], Orly Sade[b,*]

[a] College of Business, Montana State University, P.O. Box 173040, Bozeman, MT 59717-3040, USA
[b] Finance Department, Jerusalem School of Business, Hebrew University of Jerusalem, Mount Scopus, Jerusalem 91905, Israel

Received 8 February 2002; received in revised form 10 July 2003; accepted 25 September 2003

Abstract

Given the non-standardized use of the cancellation rule in the experimental markets literature, this paper investigates whether the ability to cancel orders in a double auction matters. We find that players use the option to cancel orders when it is available and that the option to cancel affects volume, but not price-associated variable.

Keywords: Experimental markets; Double auction; Order cancellation

JEL classification: C90; D40

1. Introduction

The double auction market is an institution in which buyers and sellers may continually make public bid/ask offers. This institution has long been favored in major financial markets[2], and experimental markets, because of its efficiency and simplicity (Friedman, 1991). Beginning with Smith's (1962) work, the double auction trading environment has become one of the most experimentally-investigated trading environments. Many researchers have used different manipulations to test its level of efficiency under various conditions. A major concern of any researcher is the ability to compare his or her results to the results obtained by others that used related, but different, manipulations.

* Corresponding author. Tel.: +972-2-588-3227; fax: +972-2-588-1341.
E-mail addresses: scrowley@montana.edu (S. Crowley), orlysade@mscc.huji.ac.il (O. Sade).
[1] Tel.: +1-406-994-4301; fax: +1-406-994-6206.
[2] For instance, stock markets, money markets for US funds, commodities markets, and foreign exchanges.

0165-1765/$ - see front matter
doi:10.1016/j.econlet.2003.09.027

Although in practice major stock exchanges allow participants to cancel limit orders submitted to continuous trading systems (double auction environment) before execution, not all researchers in the experimental markets literature allow that option. The vast majority do not report whether they allowed the option or not. Examples demonstrating the various uses and reporting practices of the cancellation option include the following: Smith et al. (1982) specifically indicates that a player can cancel orders. Mestelman and Welland (1995) do not report whether players can cancel orders although in practice they allow it[3]. Van Boening and Wilcox (1996) do not allow cancellation although their program allows that option[4]. Jamison and Plott (1997) do not allow cancellation of orders that meet the price improvement rule[5]. Kachelmeier et al. (1991) put participants on the honor system whereby they were not allowed to cancel intentional bids and asks, but they were allowed to cancel inadvertent errors[6]. To the best of our knowledge, there is no documentation either theoretically or experimentally regarding the effect of the option to cancel orders in a dual auction environment[7]. Because of the non-standardized use of the cancellation rule, presenting evidence on the possible effect of the cancellation option should be of interest to those conducting research in an experimental market context.

Our evidence indicates that cancellation affects trading volume more than price-associated variables. We find that players use the option to cancel if the option is given to them. We also find that the number of submitted orders and the number of transactions is higher when we allow the players to cancel their orders. We do not find differences in the standard deviation (STD) of the limits of the standing submitted orders or in the price of the transactions[8]. The paper continues as follows: in Section 2 we describe the experimental design and procedure. Analysis and results are presented in Section 3. Section 4 concludes the paper.

2. Experimental design and procedures

The experimental design and procedures follow from Tuttle et al. (2002). The participants were engaged in a series of computerized, continuous double auction asset markets where stock for 12 companies was traded, one company per trading period. Traders were endowed with three shares of stock and 50 experimental dollars at the beginning of each of 12 trading periods. The principal investigator informed them that they could use these resources to buy and/or sell shares. Traders also received firm specific financial information (based on the actual financial statements, with modifications in some of the cases, of firms traded on the NYSE—as discussed in Tuttle et al., 2002) for the company they were about to trade. Traders could only post one bid and ask at a time. They were assigned to one of two conditions in a between-subjects design. In one condition traders were told that they could cancel their bid/ask orders and were given instructions for the cancellation

[3] Confirmed that with Stuart Mestelman.
[4] Confirmed with Mark Van Boeing.
[5] Confirmed with Charles Plott.
[6] Confirmed with Steven Kachelmeier.
[7] We refer to a dual auction environment, as an auction that involves multiple buyers and sellers where each player can be both a buyer and a seller.
[8] We refer to standing orders as to all the orders (not only best bids and asks) that were not canceled by the participants.

process. In the second condition traders were told that they could not cancel their bid/ask orders and the software features that allowed cancellation were disabled. Each trading period lasted 3 min. The market was then re-initialized, the information for the just-completed company was collected and new financial information regarding the next company's trading period was distributed.

Six traders participated in each of six market sessions (three in which cancellation was allowed and three in which cancellation was not allowed) which consisted of 12 separate 3 min trading periods. Yet, no trader participated in more than one session[9]. During the trading period, contract, bid, and ask queues were projected on a large screen at the front of the room. Bids (asks) were presented from high to low (low to high) so that the highest bid and lowest ask were shown side-by-side at the top of two queues. Trading occurred when one side of the market accepted the terms of trade presented by the other side, e.g. a buyer accepts the lowest available ask. As with real financial markets the book of orders did not clear after a trade. Trader's available dollars and shares were displayed on individual monitors. The traders' seating was arranged to that they could not view other screens.

The initial three trading periods of each sequence were practice and did not affect the traders' total earnings. Liquidating dividends were shown on individual trading screens at the end of each practice period. The dividends were set equal to the NYSE price for that company's stock for the year-end from which the financial information was drawn. Traders earned the dividend for units held at the end of the trading period and earned additional money (or lost some money) if they bought below (above) the NYSE price or sold above (below) that price. Beginning with the fourth period, the traders were informed that the remaining nine periods would affect their total earnings and that the specific values of the liquidating dividends would no longer be disclosed at the end of each of the remaining periods. While the value of the liquidating dividend was not disclosed at the end of each of the last nine trading periods, the total amount earned from trading and liquidating dividends for the period was disclosed at the end of each of them. Additionally, total earnings for all nine periods were disclosed at the end of the experiment.

The following example demonstrates how earnings for a single period were calculated. Assume a trader starts with three shares, \$50 in experimental money, and the liquidating dividend is P_{NYSE}=\$18. During one trading period the trader makes the following five trades: sell at \$20, sell at \$16, buy at \$17, buy at \$19, and sell at \$19. The trader holds two shares at the end of the trading period.

Therefore:

Capital gains = sum of selling prices − sum of buying prices=(\$20+\$16+\$19) − (\$17+\$19)=\$55 − \$36=\$19.

P_{NYSE}=\$18 on each of the two shares held at the end of the period = 2 × \$18=\$36. Capital gains + dividend earnings=\$19+\$36=\$55 in net cash flow.

Adding the \$50 endowment brings total earnings to \$105.

[9] Smith (1982) argues that convergence to competitive equilibrium occurs with six traders and that the double auction exhibits strong competitive equilibrium properties. Lundholm (1991) demonstrates that double auctions with six traders converge to the efficient price much more quickly than do markets with 12 traders. The number of periods was determined at 12 to allow sufficient practice.

The last nine (non-practice) cases were presented in one of the three sequences. Assignment to one of three sequences and the two experimental conditions was randomized to determine if there was an order effect. At the conclusion of each session, the traders were paid 5% of the experimental dollars they had earned in cash. Average earnings were 694 experimental dollars per subject and each session lasted approximately 90 min.

2.1. Subjects

Thirty-six undergraduate students (six sessions with six traders in each) were recruited from courses in the business school at a large state university. Prior to participating in the experiment, the subjects were instructed about financial statement analysis in security valuation. Instructions were scripted and standardized between experimental sessions. When all experiment sessions were completed, the experimenters conducted debriefing sessions. At the debriefing session, subjects indicated that they enjoyed the experiments and took trading seriously. Approximately 43% of the subjects indicated that they owned individual stocks or bonds. We believe that the participants achieved a fairly high level of sophistication as bid, ask, and contract prices generally reflected the actual closing prices given the financial statement information, i.e. stocks that actually closed $20 were traded at around $20, while those closing at $2 traded at around $2.

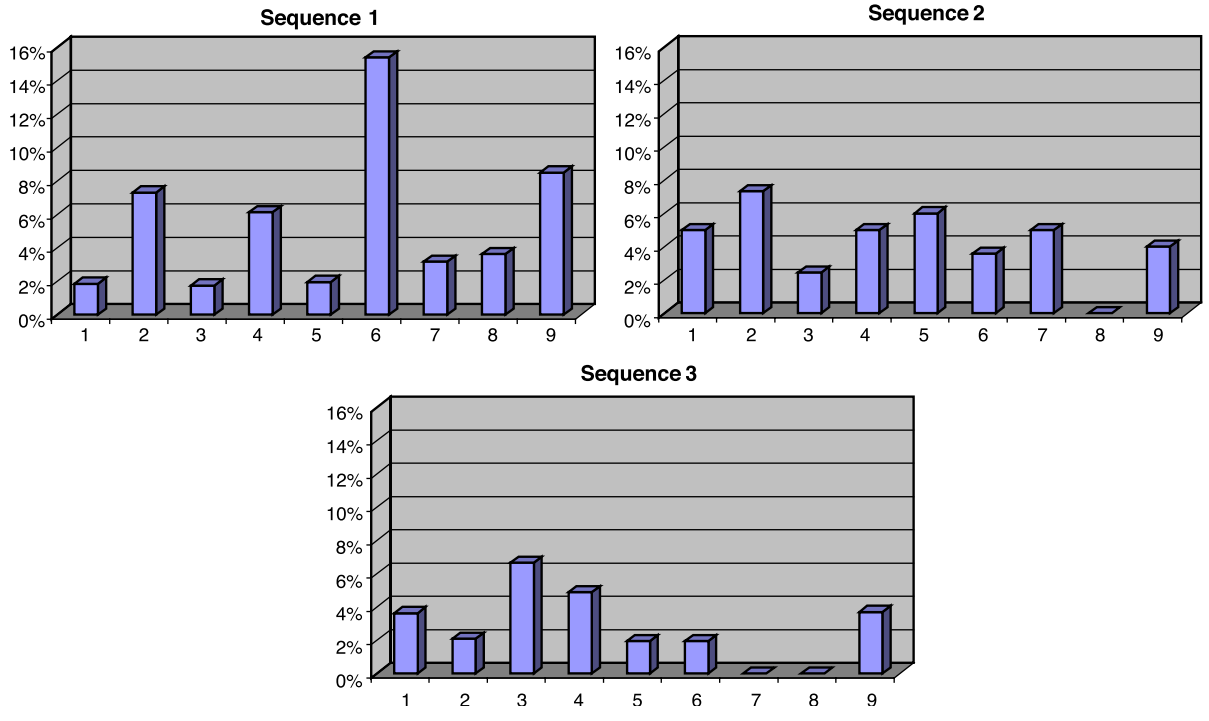

Fig. 1. The percentage of canceled orders in the different experiments. The first three rounds were practice, therefore only the nine "live" rounds are presented. Firms were presented to traders in three different sequences.

3. Results

3.1. Use of the option to cancel

The first question asked was to what extent traders use the option to cancel orders. The average percent of cancellation (which consist of three different groups of traders in 27 rounds) is 4.2% (t-value = 6.77) and the median is 3.6% (average of 5.5%, 4.3% and 2.8%, respectively, for each sequence)[10]. In three out of 27 effective rounds the participants canceled at least one order[11]. As a result we conclude that the traders used the option to cancel orders when they had the option. Fig. 1 represents the cancellation ratio for each of the sequences.

3.2. Volume related variables

After observing that the participants use the option to cancel orders, we next investigated whether the use of the cancellation option affected the level of the volume submitted and transacted. We examined the standing orders (orders that were not canceled) between the two treatments. As presented in Table 1, the average of the number submitted in all three sequences when allowing cancellation is higher than the average of the number of orders submitted when disallowing cancellation. The distribution according to the three different sequences is presented in Fig. 2. Although our results meet the Savage test we also conducted additional formal statistical tests[12].

For each sequence of firms we constructed the following paired variable[13]. Order Difference (hereafter OD_{ti})=(The number of standing orders when allowing cancellation)$_{ti}$ − (the number of standing orders when not allowing cancellation)$_{ti}$[14]. The mean of OD_{ti} is 16.77 and significantly different from zero[15]. Not allowing cancellation causes significantly lower levels of order submission.

As presented in Table 1 and Fig. 3 more transactions are executed when we allow cancellation of orders. We also constructed the following paired test. Transaction Difference (hereafter TD_{ti})=(the number of transactions when allowing cancellation)$_{ti}$ − (the number of transactions when not allowing cancellation)$_{ti}$. The mean of TD_{ti} is 2.55 and significantly different from zero. The Z value for the Wilcoxon Signed test is −3.01. Not allowing cancellation causes significantly lower levels of transactions.

Although we find that the number of orders and transactions is statistically higher when we allow cancellation, we also find that the ratio (transaction/standing orders) is slightly lower and statistically significant when we allow cancellation. On average, we find 23% of the standing orders were transacted when we do not allow cancellation (median is 23% as well) compared with 19% (median 18%) when we allow cancellation (Wilcoxon Signed ranks test and the Sign test indicate significant differences at 2%, P = 0.01, 0.02, respectively).

[10] When we include trial rounds the average is 4.5%.

[11] 55.5% of the canceled orders were bid orders and the rest ask orders.

[12] For a discussion of the Savage test see Friedman and Sunder, 1994, p. 92.

[13] Where (throughout the paper): i is the specific chosen order, i = 1, 2, 3; t is the type of the specific traded share, t = 3–12.

[14] Although we present the statistical analysis while excluding trial rounds, the quality of our results through all the paper stay the same when we include them.

[15] The Z value for the Wilcoxon Signed test is −4.54 and the Z value for the Sign test is −5.

Table 1
Summary of results

	With cancellation			No cancellation		
	Sequence 1	Sequence 2	Sequence 3	Sequence 1	Sequence 2	Sequence 3
Average number of standing orders	48.11	45.44	46	37.7	18.6	31.6
Average number of transactions	9.89	7.78	9	8.5	4.2	7.6
Average variation (STD) of limits	22.5	6.72	31.56	9.12	41.43	36.41

3.3. Price related variables

Given the fact that we find differences in the amount of standing orders it is of interest to learn whether there is also a difference in the limit structures. We calculated the standard deviation (STD) of

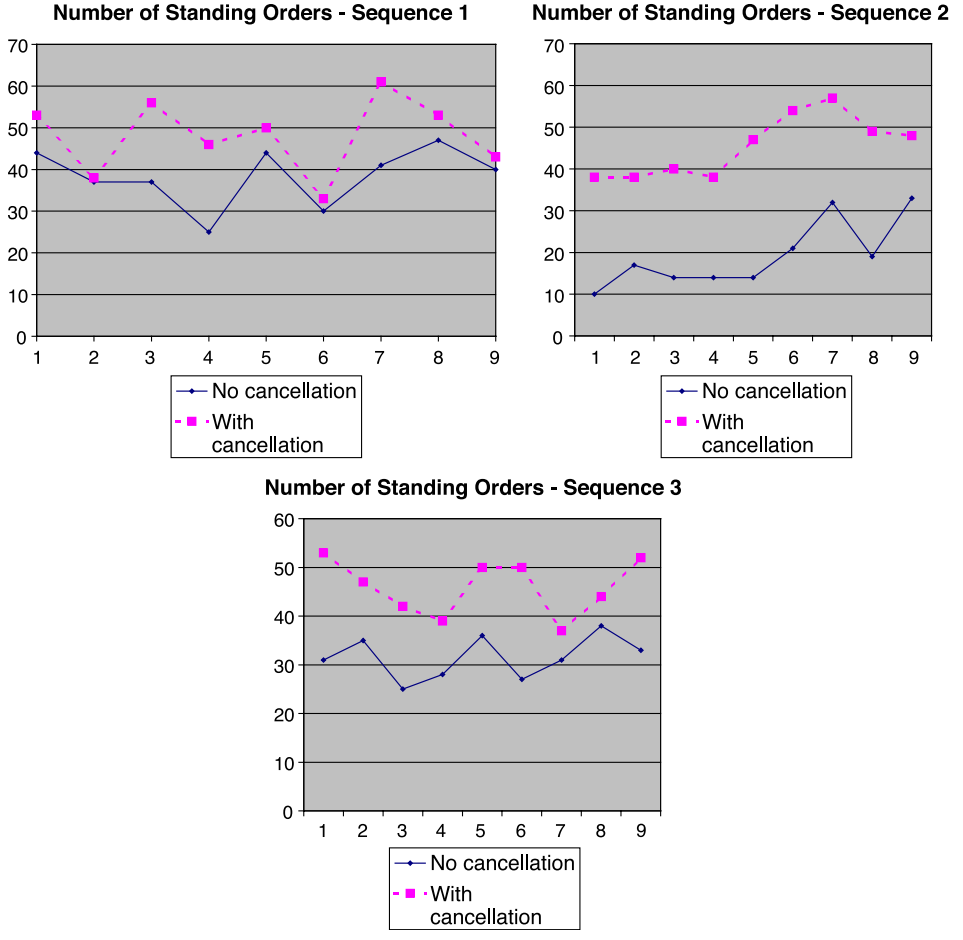

Fig. 2. The distribution of the number of standing orders. The first three rounds were practice, therefore only the nine "live" rounds are presented. Firms were presented to traders in three different sequences.

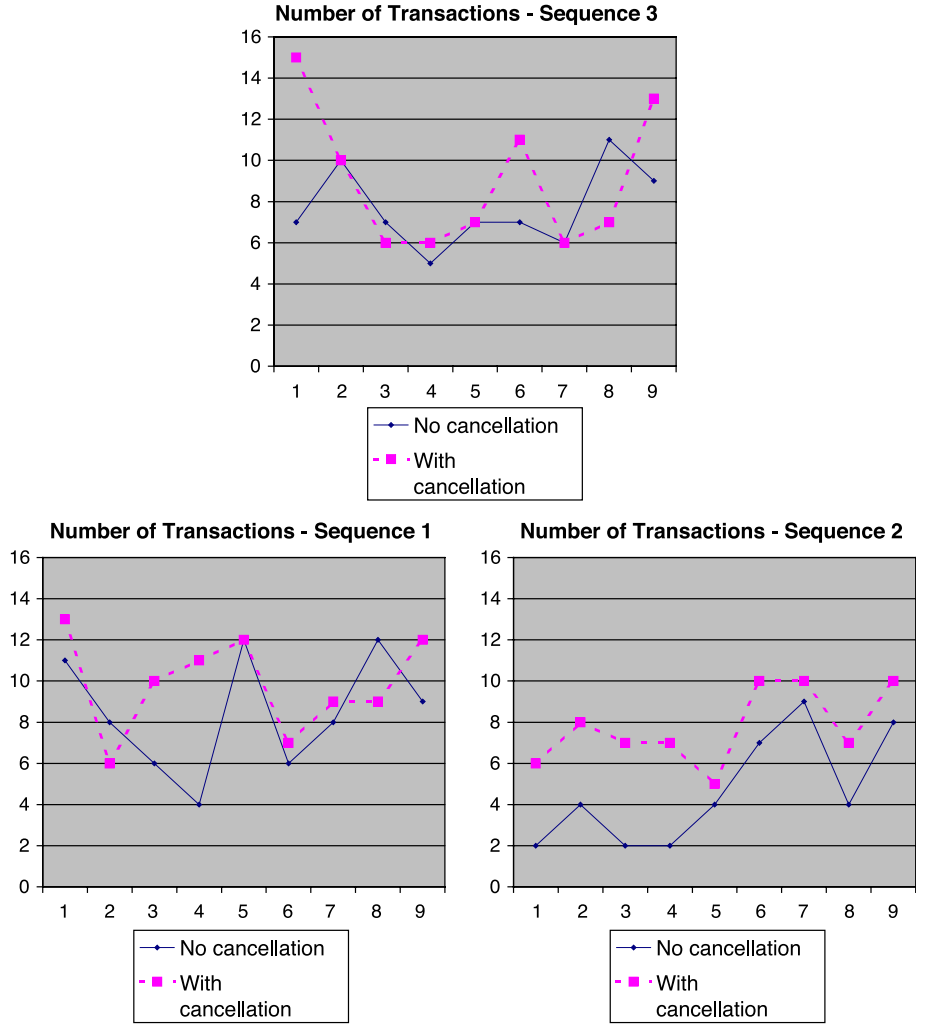

Fig. 3. The distribution of the number of transactions. The first three rounds were practice, therefore only the nine "live" rounds are presented. Firms were presented to traders in three different sequences.

the limits of the orders submitted in each experiment in each round. As reported in Table 1 there is no clear difference under the two treatments. Again, we constructed the following paired variable: STD Difference (hereafter $STDD_{ti}$)=(the STD of limits when allowing cancellation)$_{ti}$ − (the STD limits when not allowing cancellation)$_{ti}$. The mean of $STDD_{ti}$ of the limits of the orders is not statistically significant than zero according to the Wilcoxon Signed ranks test and the Sign test ($Z = -0.77$). As a result, we cannot report a difference in the variation of the limits that are submitted when we allow cancellation compared to disallowing cancellation.

Variation of the prices of the transaction is a common measure of liquidity in the empirical financial literature. As with the variation of the limits of orders, we find that the paired difference between the STD of prices of the transaction is not statistically significant from zero (the Wilcoxon Signed ranks test ($Z = -1.39$), the Sign test ($Z = -1.54$)).

When we examine the distribution of the traders' payoff we find that there is higher variation of profit when investors can cancel orders. Higher variation means less accuracy. Given the relatively small size of our sample (18 players in each manipulation) the difference in the variance is not statistically different using the *F*-test[16]. However, it is still interesting to observe that when we did not allow cancellation the transactions were closer to the NYSE closing prices.

4. Conclusion

We report results indicating that the cancellation option has an effect on the obtained results of an experimental double auction environment. We find that subjects use the cancellation option when it is available. Additionally, we find significant differences in the quantity of orders submitted and executed and we do not find significant differences in the limit structure.

Three possible explanations for these results exist. One is that subjects use the option to cancel because they can or because it is there. However, the data seem too systematic for such a "random event" explanation. A second, and arguably more plausible, explanation is that the option to cancel helps allocate risk. Risk aversion can reduce the number of submitted orders when a cancellation option is not available. A third explanation is related to a long-time concern of financial economics researchers market manipulations (Allen and Gale, 1992). This paper is not the first to conjecture the relation between the ability to cancel an order and possibility of manipulations in asset markets (cf. Camerer, 1998). In the game reported in this paper the option to cancel can be used to signal or otherwise facilitate collusion. However, the fact that the experimental prices are close to actual NYSE prices, suggests this is not a viable explanation. We leave for future research the investigation of explanations for the reported differences. In order to improve the comparison of research results, we recommend that future researchers report whether participants were given the option to cancel orders.

Acknowledgements

The authors wish to thank David Plumlee, Steven Kachelmeier, Stuart Mestelman, Mark Van Voeing, Charles Plott, an anonymous referee, and the editor for their helpful comments. We also wish to thank Brad Tuttle, Maribeth Coller and David Plumlee for making their data available. Brad Tuttle wrote the original laboratory market software. Financial support was provided by the School of Accounting and Information Systems at the University of Utah. Sade acknowledges the Krueger Center for Finance at the Hebrew University of Jerusalem for partial financial support. Part of the project was done while Sade visited the DESB, the University of Utah.

References

Allen, F., Gale, D., 1992. Stock-price manipulation. Review of Financial Studies 5, 503–529.

Camerer, C., 1998. Can asset markets be manipulated? A field experiment with racetrack betting. Journal of Political Economy 106, 475–482.

[16] As well as the non-parametric Siegel–Tukey and Moses tests.

Friedman, D., 1991. Evolutionary Games in Economics. Econometrica 59, 637–666.
Friedman, D., Sunder, S., 1994. Experimental Methods—A Primer for Economists. Cambridge University Press.
Jamison, J., Plott, C., 1997. Costly offers and the equilibration properties of the multiple unit double auction under conditions of unpredictable shifts of demand and supply. Journal of Economic Behavior and Organization 32, 591–612.
Kachelmeier, S., Limberg, S., Schadewald, M., 1991. A laboratory market examination of the consumer price response to information about producers' costs and profits. The Accounting Review 66, 694–717.
Lundholm, R., 1991. What affects the efficiency of a market? Some answers from the laboratory. The Accounting Review 66, 486–515.
Mestelman, S., Welland, D., 1995. Experience and inventory management in double-auction markets. Journal of Economic Behavior and Organization 26, 35–48.
Smith, V., 1962. An experimental study of competitive market behavior. Journal of Political Economy 70, 111–137.
Smith, V., 1982. Microeconomic systems as an experimental science. American Economic Review 72, 923–955.
Smith, V., Williams, A., Bratton, K., Vannoni, M., 1982. Competitive markets institutions: double auctions vs. sealed bid-offer auctions. American Economic Review 72, 58–78.
Tuttle, B., Coller, M., Plumlee, D., 2002. The effect of misstatements on decisions of financial statement users: an experimental investigation of auditor materiality thresholds. Auditing, A Journal of Practice and Theory 21, 11–27.
Van Boening, M., Wilcox, N., 1996. Avoidable cost: ride a double auction roller coaster. American Economic Review 86, 461–478.