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ON TEACHING INNOVATIONS AND EXPERIMENTS IN ECONOMICS

by

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Abstract

This paper focuses on the role of the class experiment as a teaching innovation in economics principles classes. The paper describes the outcomes of an experiment in which students act as buyers and sellers in a pit market. The experiment provides a useful background for the discussion of the standard demand and supply model. In addition, the experiment yielded some interesting insights. First, public announcements of trading prices increased market efficiency. Second, bargaining strength is asymmetric: buyers are better at it than sellers. Third, trading skills are enhanced through learning by doing. Finally, experience leads to more realistic profit expectations, but the modal trader remains too optimistic. The wider use of active learning tools such as class experiments is advocated.

Keywords: oral double auction; experimental economics; teaching methods
JEL Classification Numbers: A22, C91, D44

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* We are grateful to Professor Charles A. Holt for having introduced the "trading pit" session into the undergraduate economics principles course at the University of Tsukuba and to our colleague Professor Stephen Turnbull for subsequently having passed the details of this class experiment on to us.
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1. Introduction

Economics uses theoretical models to describe, analyse and predict aspects of resource allocation facing individuals and society. The leap from model to reality is often difficult to follow for students enrolled in a first-year economics principles course. Teaching both the essence of the models and their application then becomes part of the pedagogical challenge, as it is important that students understand both. Attention to applications in teaching may also help motivate students, as some enroll in principles courses because of their interest in practical economic problems.

A rough gauge of how well this is done may be the retention rate of students, or the proportion who continue from the principles course to the economics major. This measure does not indicate unqualified success in this respect, as low and declining retention rates are seen both in New Zealand and the USA during the 1990s (Bartlett, 1995; Bethwaite, 1995). Though this drop may be caused by demand factors and competition from other disciplines, it has caused renewed interest in how the content and delivery of economics principles courses can be improved.

A solution emphasizing content is "dual track teaching" that presents models and their applications side by side (Bethwaite, 1995) to better motivate students and to give understanding of the applied side of economics. This approach to teaching has considerable popularity in the USA, at least as reflected in the textbooks' increased emphasis on examples from everyday situations familiar to students, or concerning major economic and political events. It cannot be the entire solution, however, as these changes in content have not halted the decline in the US retention rate.

An additional solution is to make the delivery of the material more attractive to students. This can be done by simply using innovative teaching methods and better teaching aids (such as computer generated OHP transparencies). A recent survey of American tertiary institutions finds much room for improvement, as the vast majority of US economics teachers lecture in front of a class with chalk and a blackboard as the only teaching aids (Becker and Watts, 1996). The benefit of better teaching aids is, first, to increase the motivation of students, and second, perhaps to increase the learning as well. The motivational effect of improvement in teaching methods does not seem to have been studied carefully, though our experience is that it is high. In this paper we describe a trading pit experiment carried out in class which gets top marks in our teaching evaluations.

Some research has been carried out on the learning benefit of innovative teaching methods, at least as measured by test scores of students. However, the results are as yet rather inconclusive. Cardell et al. (1996) describe a properly randomised experiment at Washington State University to test whether an active learning, or laboratory, approach (with the use of computers, data on economic behaviour and in-class experiments) enhanced test scores of students relative to those taking a conventional introductory

economics course. The preliminary results suggested that the students taking the active learning approach did not do significantly better than the other students. Another test of the value of the laboratory approach was carried out by Robin Bartlett at Denison University (also described in Cardell et al. 1996). In her case, this approach did significantly improve test scores, but the statistical generality of her result could not be established due to non-random effects in the sample selection.

Although the current statistical evidence of the benefits of innovate teaching methods is still inconclusive, tests scores are not the only measuring rod in any case. Innovate teaching methods may provide a net benefit when they make the course more enjoyable for students and can be introduced at little cost. One innovation, namely the introduction of laboratory-type experiments in economics classes which we discuss in this paper, may in fact have an external benefit of providing useful experiment-derived information on economic behaviour.

While economics is still primarily seen as a non-experimental science, the field of experimental economics has been growing rapidly in recent years and students appear good subjects to play roles of economic agents in such experiments (Davis and Holt 1993, p.17). Thus, games played in class may be a useful teaching tool but may have benefits for research as well when conducted in a scientific way.

In this brief paper we describe a "trading pit" experiment used in an undergraduate principles of economics course at the University of Tsukuba in Japan. This course is taught in the English language and compulsory for second-year students majoring in economics (who have already had economics courses taught in Japanese in their first year). Other "active learning" activities introduced in the course included student speeches on economic topics of their choice, a survey-based derivation of a demand schedule and simple non-cooperative games. Moreover, lecture topics were drawn from the students' interest sphere. Examples are "the demand for part-time jobs" and "Big Mac prices and exchange rates".

The next section provides information about the "trading pit" experiment. The experiment simulates the type of trading one can observe on the floor or "pit" of certain commodities futures markets. The experiment was carried out in two concurrent principles classes. There were a few differences between the two classes. These will be mentioned. The results are summarised in section 3. These results give rise to some interesting observations, which we will highlight. The last section provides some final remarks.

2. The trading pit experiment

The supply and demand model is the backbone of most microeconomic principles courses. Ever since Marshall's *Principles of Economics* a century ago, the conventional method to teach this model is the drawing of the two-dimensional demand and supply

schedules, supplemented in many cases with the algebra of solving the corresponding equations.

One way of making the study of this model more appealing is to simulate a market in which students act out the roles of buyers and sellers. There are many ways in which this can be done. One method consists of students playing a "trading pit" experiment. This experiment was first developed by Chamberlin (1948).

In the experiment, students obtain non-face playing cards. The number on a card represents the value to the student of one unit of an unspecified commodity (e.g. 1 tonne of sugar, 1 barrel of oil, 1 bar of gold) to be traded. Red cards correspond to buyers and black cards to sellers. A sellers will look for a buyer willing to pay more than what is on the seller's card and a buyer will look for a seller willing to accept less than what is on the buyer's card. Both sides are expected to try to maximise their personal gain from a transaction. Transactions take place in short trading periods during which buyers and sellers walk across the central area in the classroom (the trading floor). Some will call out offers (sellers). Others will call out bids (buyers). When a buyer and seller find that they have "matching" interests, a deal is negotiated somewhere between the offers and bids. All trades are recorded. When all bids, offers and transaction prices are displayed publicly, this particular market is referred to as an oral double auction (see Smith 1962). Details about how to carry out this experiment in an actual class situation, with an example of an undergraduate class at the University of Virginia, can be found in Holt (1996). Our class experiment was conducted in the same way.

In addition to relying on the competitive spirit to ensure that students will play as optimising agents, monetary incentives can be offered. For example, in the Tsukuba University case, book vouchers were given to the students who obtained the largest aggregate profit derived from four trading periods.

After four trading rounds were concluded, the concepts of the demand schedule, the supply schedule and equilibrium were introduced in class on the basis of the experimental outcomes. This was followed up by hand-in assignments in which students' understanding of the economic theory behind the "game" was tested.

The experiment reported here included two innovations compared with experiments in earlier years. The first is that two types of markets were introduced: one in which the agreed price of a trade was immediately recorded on the blackboard (and therefore became public information) and one in which there was no such information made available. The role of information in market adjustment to equilibrium could be studied in this way. The second innovation was to ask students to record their *expected* contract price before trading commenced. Implicitly, they revealed therefore also their expected profit (the difference between the card value and the expected contract price). This enabled us to study how expectations changed between trading periods.

The experimental set up and the results are reported in the next section.

3. The outcomes of the pit market experiment

There were two concurrent principles classes, one with about 80 students and the other with about 50 students. The course was compulsory for all second-year students majoring in economics. The difference in class size was largely due to administrative procedures. The allocation of students across the two classes was rather arbitrary as far as we can ascertain and we did not expect any self selection to affect the results (but this was not formally tested). On the day of the experiment, most students attended class so that the trading pit for the larger class had 36 buyers and 36 sellers (trading pit A) while the smaller class had 24 buyers and sellers (trading pit B). Trading pit A used three card decks and B used two. Red cards (hearts and diamonds) with the numbers 10, 9, 8, 7, 5 and 4 represented values to buyers. Black cards (clubs and spades) with the numbers 2, 3, 4, 5, 7 and 8 represented costs to sellers. The monetary unit was ¥1000. For example, a black 5 represented a cost of ¥5000 for one unit of the commodity to the seller. Ordering values of buyers and sellers, demand and supply curves emerge as in Figure 1.

Figure 1 about here

This figure clearly shows that in equilibrium 24 units are traded in trading pit A and 16 units in trading pit B. The price which clears the market is in this particular situation not unique: it could be anywhere between ¥5001 and ¥6999. Given that students switched roles of buyers and sellers in successive trading rounds and given the symmetry of demand and supply with respect to a ¥6000 line, we expect that a competitive market will eventually settle at an average price of about ¥6000. If all trades take place at this price, the total surplus in trading pit A is ¥120,000 and in trading pit B it is ¥80,000, equally divided between buyers and sellers.

Trading took place in four 5-minute periods. To avoid any collusive action, the class was split along the middle path of the lecture room. Because friends tend to sit next to each other, this split will put them on the same side of the market. Thus, collusion in the form of collaboration between friends to maximise joint profit could be avoided. Cards were randomly allocated. Students tended to be very vocal during trading when calling out offers and bids, particularly in the later trading rounds.

An important difference between the two experiments is that agreed prices of trades were not announced in trading pit A, while in trading pit B they were announced. A resembles the experiment discussed by Chamberlin (1948). Chamberlin observed that a greater quantity was traded in his experiment than predicted by the model of perfect competition. He thought that this was due to the way in which negotiations took place in small groups. The situation in pit B comes closer to resembles the double auction experiment of Smith (1962), who showed that in his experiment the market converged to

efficient competitive outcomes. Values, costs and negotiated prices for four successive trading rounds are shown in chronological order in Figure 2.

Figure 2 about here

Figure 2 shows that the number of trades in trading pit A was 23 in all four trading periods, i.e. close to the theoretical equilibrium number of 24. As noted above, Chamberlin (1948) found that the number of transaction tended to be greater than the quantity at the intersection of the demand and supply curves, but this was not the case here. In trading pit B, the theoretical equilibrium would require 16 trades, while the observed number of trades varied between 13 and 16. The majority of trades took place at competitive prices (within the ¥5001 to ¥6999 range). In trading pit A, the maximum number of trades in the competitive range was achieved in round 4 (16 out of 23). In trading pit B, the maximum number of trades in the competitive range was 12 out of 16 in round 3.

The efficiency of the market can be gauged by considering actual surplus as a percentage of the maximum surplus obtainable with 24 (pit A) or 16 (pit B) transactions at a price of ¥6000. The results are reported in Table 1.

Table 1 about here

Several conclusions can be drawn from Table 1. First, the actually realised gains from trade are about three quarters or more of the theoretical maximum surplus of ¥120,000 in trading pit A and ¥80,000 in trading pit B. Second, the efficiency of the market displayed a slight upward trend over successive trading rounds. This provides some evidence of student traders gaining experience.

Second, the improvement in overall efficiency can be attributed in Pit A to the buyers (with the buyers' extracting of surplus showing a clear trend from 89.2% in round 1 to 95.2% in round 4) and in Pit B to the sellers (with surplus extraction increasing from 49.75% to 75.75%).

Third, it is clear from Table 1 that students are better bargainers as buyers than as sellers: the buyers are always better at extracting surplus than the sellers. We believe that this result is not due to a self-selection effect, because all students in trading pit A switched between being buyers and sellers in successive trading rounds.[1] The asymmetry in the distribution of surplus when it is theoretically equally divided between buyers and sellers can also be detected in the work of Smith and Williams (1982). We think that the reason for the asymmetry is that students have more experience in

[1] In trading pit B, students did not switch between being a buyer and a seller.

bargaining to buy something than to sell something. That is, they are better able to "haggle" to get the price down as a buyer than to get the price up as a seller.[2]

Finally, the value of making the information regarding the prices of trades publicly available is evident from the higher efficiency of pit B, compared with A, in rounds 2 to 4. This is true for both buyers and sellers.

The importance of gaining trading experience and obtaining market information can also be detected by studying the collected data on price expectations. Before each round of trading, the students wrote down the price at which they expected to trade the good (or they wrote that they did not expect to be able to trade). These price expectations were transformed into profit expectations (price minus cost for sellers and value minus price for buyers). If they did not expect to trade, their expected profit was zero (there was no cost incurred by just entering the pit).

It is of some interest to analyse the distribution of the agents' expectational errors, which simply equal the expected profit minus the realised profit of each trade. Table 2 shows the results of a test of a change in the mean expectational error resulting from the experience gained in previous rounds and from the value or cost assessment of the good. The latter effect was tested because it appeared that some students with bad draws of costs or values persisted in believing they could negotiate trades outside the usual price range.

Table 2 about here

These effects were tested by means of a simple OLS regression. The dependent variable is expected profit. Besides the intercept and dummy variables for trading rounds 2 to 4, the only explanatory variable is the profit which each agent would have realised if all trades took place at the market clearing price of ¥6000. The intercept indicates the mean expectational error for the hypothetical student who would have drawn a 6 card in the first trading round and in both trading pits this error is more than ¥1000. Thus, students were generally too optimistic and expected a greater profit than they achieved.

In both trading pits, profit expectations became more realistic in subsequent trading rounds. This is clear from the negative coefficients of the dummy variables (period 2 in pit B is the exception). There is some indication that students learn in both conditions from the experience of the first round, but only in the " price announcements" condition of pit B there is a clear trend of expectational errors becoming smaller in subsequent rounds.

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[2] This point is also made by Davis and Holt (1993), p. 168, footnote 34.

The negative coefficient of the market-clearing profit variable indicates that students with higher equilibrium profits had more realistic expectations. The coefficient is significant at the 1 percent level in both pits.

Of course, the learning effect and the "luck of the draw" effect do not explain much of the overall variance in expectation errors. The R squared of the pit A observations was 11.5% and of pit B 16.9%. It may be of some interest to study in a future - more carefully controlled - experimental situation, the correlation between the errors and certain characteristics of the student participants (e.g., their test scores in the course).

Figure 3 displays the frequency distributions of the expectational errors. The effect of price announcements is very clear from the downward trend in both the mean and the standard deviation in pit B. These trends can be observed even when the student who twice overestimated the profit by ¥7000 is removed from the data. While strong optimism gradually vanishes, many students persist in believing that they can outperform the market at least a little.

Figure 3 about here

The learning of forming expectations about the market is probably not the only type of learning that takes place here. It is likely that students in both pits were improving the execution of trades by learning skills such as how to find trading partners, and whether to complete negotiations or move on to another potential trading partner. Such procedural learning can improve the performance of the trading pit even when individual traders are not learning rapidly. For the purpose of teaching students not just how to trade, but also how the market operates, the environment with announcements appears better, since it resulted in a greater improvements in the students' ability to predict the outcomes of their trading rounds.

4. Some final remarks

The main purpose of the class experiment described in this paper was to give students a better understanding of the supply and demand model. We could not formally test whether this goal was achieved, as we did not attempt a proper statistical test with a control group comparison such as was done by Cardell et al. (1996). However, being able to teach the notions of consumer and producer surplus, market efficiency, etc. by reference to the class experiment, made the subsequent lectures on the demand and supply model at least easier to teach. Moreover, the majority of students nominated the trading pit experiment in course evaluations as the aspect of the course they enjoyed most.

Given that we did not design the experiment as carefully as would have been necessary to yield publishable findings regarding the role of agents' behaviour and institutional arrangements in the trading pit market, we did not expect any major insights from the class experiment. Yet four interesting observations could be made, which each warrant a validation by properly designed experimental work.

The first of these concerns the role of information. The large investment in fast computers, sophisticated software and up-to-date telecommunication technology has led to a continuous stream of price information in financial market, which has undoubtedly enhanced the efficiency of these markets. Our experiment provided some evidence of the value of information in this context.

Our second observation is that students - and it is not implausible here to expect that this applies to other types of individuals too - are better bargainers as buyers than as sellers. Most of us have little experience in selling. Moreover, our major role as a seller is that as a seller of labour, which is traded in a market which least resembles the pit market.

The third observation is that trading requires skills which are acquired through learning by doing. In most cases, buyers and sellers learnt how to improve their results in successive trading rounds.

Finally, there is some evidence that the student traders were persistently too optimistic regarding their profit opportunities. The modal student forecast his or her profit at ¥1000 more than the actual outcome in both pits and all four trading rounds. It is tempting to think that a similar persistent optimism may have contributed in real pit markets to the spectacular losses incurred by some young traders in recent years.

Class experiments can of course be designed to study a wide range of other economic models. Given the emphasis in current economic theory on carefully designed microfoundations, the class experiment provides an ideal environment of a "joint production" of students' better understanding of such foundations and a controlled verification of the plausibility of the behavioural assumptions.

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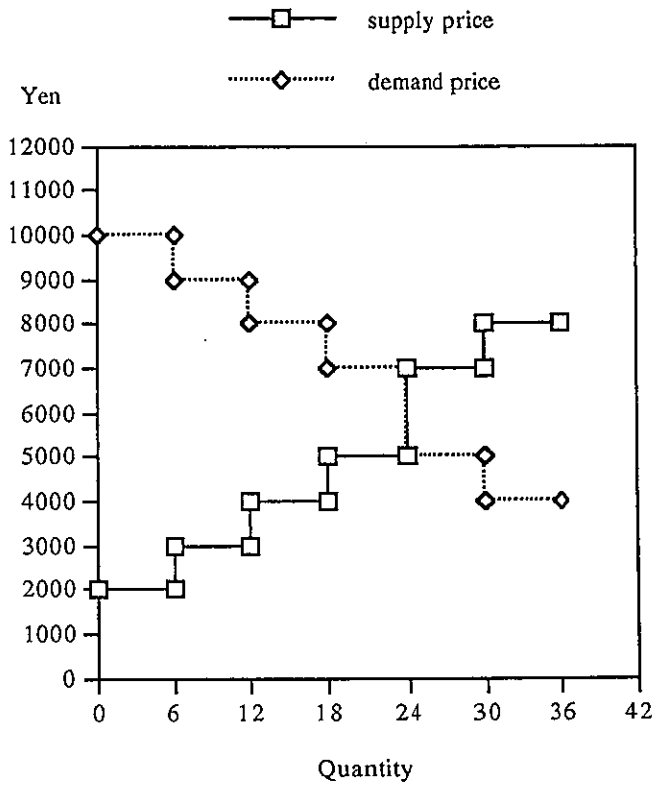
Table 1 Observed efficiency in the trading experiment

Round	Pit A			Pit B		
	Seller	Buyer	Total	Seller	Buyer	Total
1	74.2%	89.2%	81.7%	49.75%	95.25%	72.50%
2	60.7%	89.3%	75.0%	60.75%	99.25%	80.00%
3	73.8%	92.8%	83.3%	75.50%	97.00%	86.25%
4	71.5%	95.2%	83.3%	75.75%	94.25%	85.00%

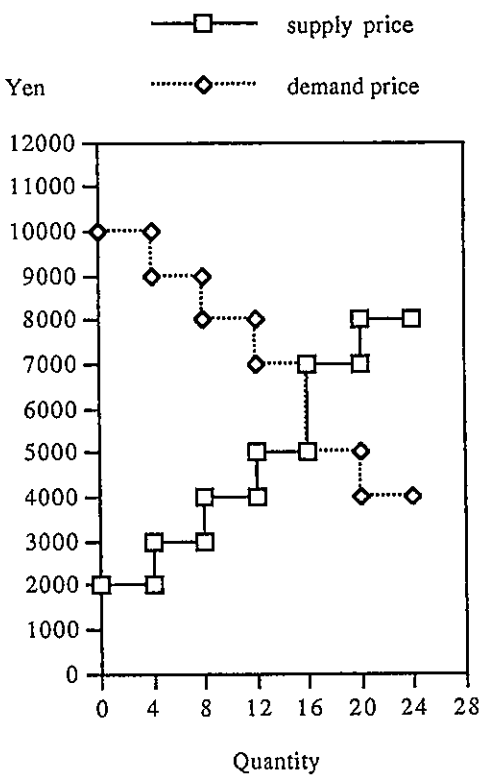
Table 2 **Expectational errors and learning during the trading pit experiment**

	Pit A (without public price announcements)		Pit B (with public price announcements)	
Equilibri. Profit	-0.190	0.039	-0.332	0.068
Intercept	1038.84	136.43	1386.39	222.48
Period 2 dummy	-181.16	164.97	55.78	280.18
Period 3 dummy	-307.08	164.46	-387.56	280.31
Period 4 dummy	-134.68	164.47	-645.70	280.50
R-Squared	0.115		0.169	
F Test	6.959		8.440	
Observations	171		220	

Figure 1 The demand and supply curves for the trading pit experiment



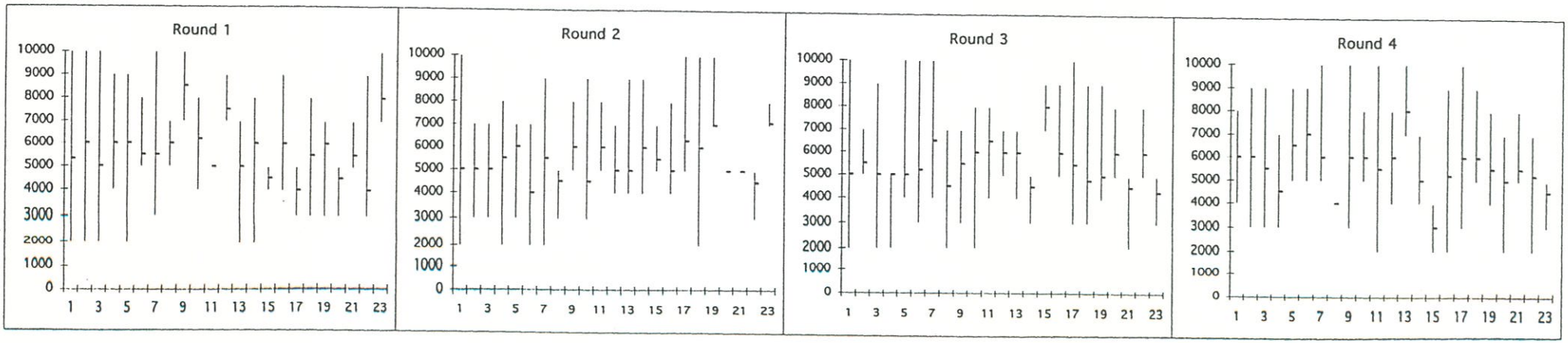
Trading Pit A



Trading Pit B

Figure 2 Values, costs, and negotiated prices in the pit market

TRADING PIT A (WITHOUT ANNOUNCEMENTS)



TRADING PIT B (WITH ANNOUNCEMENTS)

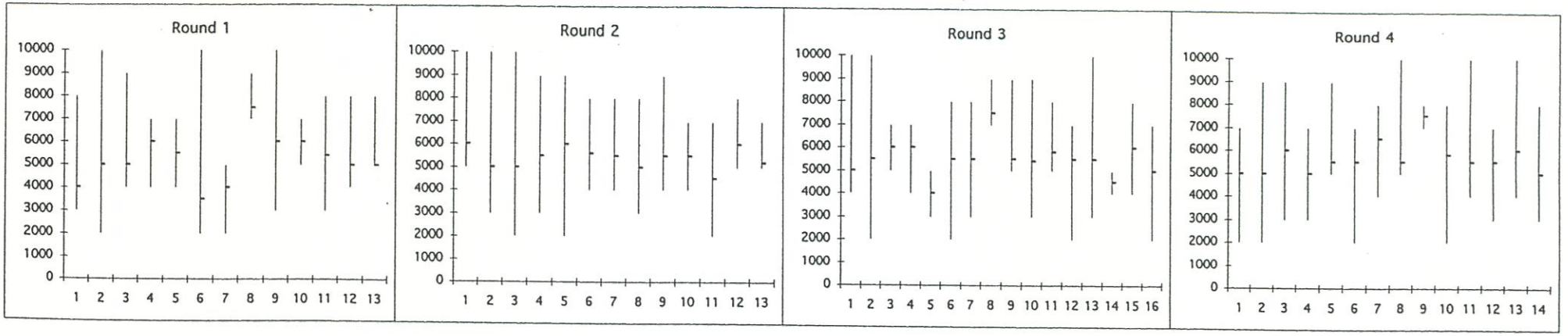
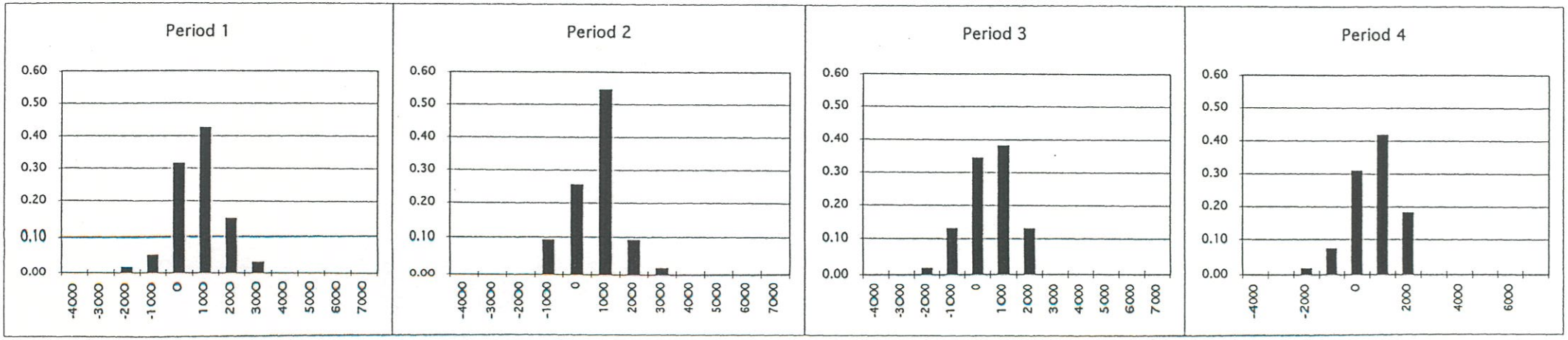


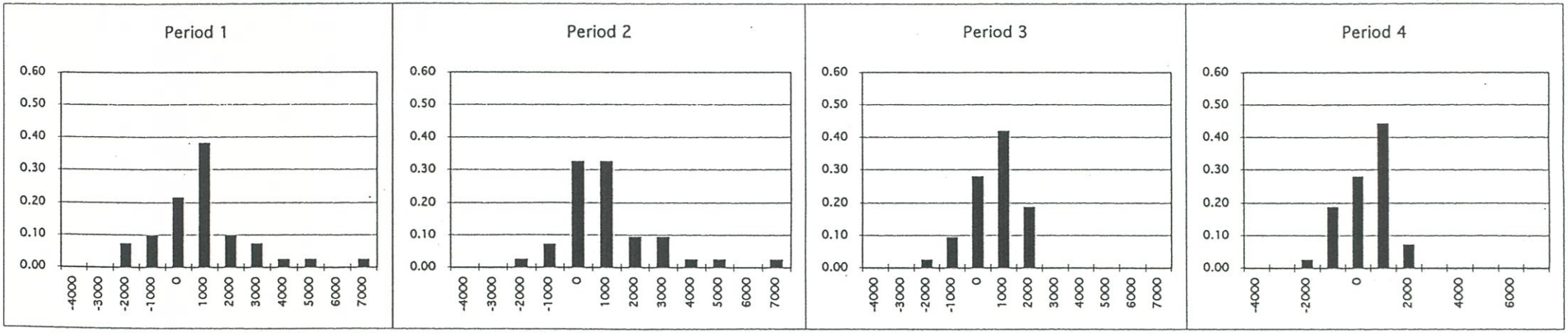
Figure 3 The distribution of profit expectation errors

TRADING PIT A (WITHOUT PRICE ANNOUNCEMENTS)



Period 1		Period 2		Period 3		Period 4	
Mean	694.4	Mean	578.2	Mean	372.9	Mean	576.4
Std. Dev.	944.9	Std. Dev.	806.9	Std. Dev.	905.5	Std. Dev.	915.7

TRADING PIT B (WITH PRICE ANNOUNCEMENTS)



Period 1		Period 2		Period 3		Period 4	
Mean	904.8	Mean	948.6	Mean	474.4	Mean	193.1
Std. Dev.	1,760.1	Std. Dev.	1,653.2	Std. Dev.	913.5	Std. Dev.	874.0