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Volatility in Returns from Trading

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Odean [1999] observes that naïve investors tend to trade too often, but we know little about what motivates them and why their performance is often so poor. This paper describes an experiment where naïve traders take part in a share market game with limited information, unlimited credit, and unlimited short-selling. We find that trading profit volatility is positively correlated with the level of understanding of the market, the level of self-efficacy or self-confidence, and the level of trading. Large profits and losses tend to be earned by individuals who trade heavily and have a reasonable understanding of how the market works and how shares are valued. There is also some evidence that a high level of self-efficacy is positively correlated with trading profit volatility.

Introduction

Odean [1999] and Barber and Odean [2000] have found that naïve investors tend to trade too often, and their performance is fairly poor. This paper describes an experiment where naïve traders take part in a limit order share market game with limited information, unlimited credit, and unlimited short-selling. Our analysis is timely, given the rapid growth in day trading over the last ten years.

Our experiments were conducted in October 2003 and October 2004, and we note some consistency in the factors that explain trader profit volatility. Specifically, the volatility of trading profits generated by a naïve trader is positively correlated with the level of perceived understanding of the market and the level of trading. There is also some evidence of a positive relationship between trading profit volatility and self-efficacy, or self-confidence. In essence, the volatility in trading profits exhibited by a trader with low (high) understanding of the market, low (high) trading volume, and, to some extent, low (high) self-efficacy is relatively low (high).

The finance literature has tended to focus on naïve trader performance, but our analysis of naïve trader profit volatility suggests it may be useful to look beyond performance. Our research extends the literature by modelling the determinants of trading profit volatility across participants who took part in a share market trading game. We replicate our results across two different experiments with two sets of participants (first-year finance students in 2003 and in 2004) and two different trading conditions (individual traders only versus a combination of group and individual traders). The first experiment took place in October 2003 with forty-four individual traders; the second took place in October 2004 with seventeen groups and twenty individuals.

The article is organized as follows. The second and third sections describe the participants in the study and the trading game used to simulate the share market. We define the data in the fourth section and report results in the fifth section. We conclude the paper in the sixth section.

Participants

The participants in our two experiments came from a first-year undergraduate finance course at Australian National University. We paid cash incentives to participants as follows:

1) a fixed amount to compensate for their time, and
2) a performance-based incentive to encourage risk-neutral, return-maximizing behavior.

All the participants had similar levels of previous experience with the trading game. All attended a one-hour tutorial as part of their first-year finance course, and

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all completed another one hour of trading experience while taking part in earlier experiments.

The first experiment had forty-four participants trading as individuals. The second experiment included seventeen groups, with two traders in each group, and twenty individual traders, making thirty-seven "participants" in the game (see Heaney et al. [2005]). We used stratified random allocation to divide participants into the individual and group trader categories, with stratification based on gender. Seventeen males and seventeen females were denoted group traders, and ten males and ten females were denoted individual traders. Group traders were randomly allocated across the groups, with four groups consisting of two males, five groups consisting of two females, and eight groups consisting of one male and one female. The trading groups were physically separated from the individual traders, with groups and individuals given separate computer rooms.

The share market trading game is run on a common computer network; each participant or group enters trades into the electronic share trading market game through a personal computer. The participants in both experiments were first-year undergraduate finance students in an introductory finance course. They are essentially naïve traders, with little understanding of share markets, limit order trading systems, or share valuation prior to the introductory tutorial we provided them prior to the experiments. These students appear quite similar to the day traders who have taken a more active role in equity markets today.

Trading Game

We use one of a suite of computer trading games, the market efficiency game (RE1) described in O'Brien and Srivastava [1991] and supplied by OS Financial Trading Systems (www.ftsweb.com.). The game is divided into ten-minute trials, with each trial consisting of two five-minute trading periods, period 1 and period 2. The market includes two shares, and there is no limit on short-selling or borrowing.

Day traders generally have access to considerable levels of credit, so the lack of a credit constraint seems reasonable. Furthermore, short-selling can be replicated when the day trader has a portfolio of shares by selling shares from the portfolio with a view to buying them back in the future. Thus this unconstrained share market game appears to be a reasonable basis for analyzing naïve day trader behavior.

While participants have access to up-to-date market information, including the last trade and the bid-ask spread for each share, they were not given full information about future dividends (as discussed below). There is a facility for discounting in the valuation of the shares, but for simplicity we set the discount rate to zero, and share value is simply the sum of the expected dividend payments.

The two assets traded in the market pay an uncertain dividend at the end of each five-minute trading period. The security dividend schemes are described in more detail in Appendix 1, with a new valuation scheme applying to each trial (each pair of consecutive five-minute trading periods).

For example, in a particular ten-minute trial period, a participant might receive information that the dividend received at the end of period 1 is not X, and the dividend received at the end of period 2 is also not X. If this information is provided for CRA at the beginning of the trading trial, the participant knows that CRA will take a value of 8, 12, 18, 20, 24, 30, 32, 36, or 42, each with a probability of 1/9. The participant can work out the expected value of the share with two dividend payments due (24.7), as well as the maximum value of 42 and the minimum value of 8.

Upon completing the first trading period, the first dividend is paid and the valuation problem is simplified. The remaining dividend is 8, 12, or 18, with an equal probability of 1/3 (the expected final dividend value is 12.7, with a maximum value of 18 and a minimum of 8). A new information set is allocated at the start of the next trial (two five-minute trading periods). Thus, the participants receive incomplete information but the market has sufficient information to value the share. (See appendix 1).

At the beginning of the game, the participants are allocated cash and securities, with the actual amounts varying across individuals. Once trading begins, the participants flag their wish to buy or sell securities by either entering a bid or ask price, or choosing to accept existing ask or bid prices by buying at market or selling at market.

A copy of the trading screen is provided in Appendix 2. The key features are apparent, including the ability to enter bid and ask prices and quantities, the disclosure of current bid and ask prices, and the current position of each participant in the two stocks, ABC and CRA. The central white rectangle contains the information the participant has been given about dividend payments.

Data

We obtain measures of trading profit and participant confidence, understanding of the game, and trading level from either the FTS audit trail (for trading profit and level), or from questionnaires (for measures of confidence and understanding).

Trading Profit Volatility

Trading profit (TOT_GC) reflects dividends received from the shares on hand at the end of each five-minute trading period, plus trading profits and losses and the value of shares on hand at the end of

Table 1. *Trading Profit Volatility and Participant Characteristics*

	LATOT_GC	LMATO_GC	LSDTO_GC	Confidence	Understanding	Total Trades
Panel A. Descriptive Statistics						
October 2003 (N = 44)						
Mean	3.50	2.44	2.61	16.68	3.48	650.18
Median	3.66	2.71	3.08	17.00	3.00	486.50
Maximum	8.25	6.46	6.02	23.00	7.00	2556.00
Minimum	−2.81	−0.99	−2.30	5.00	0.00	58.00
Std. Dev.	2.43	1.92	2.15	4.10	1.95	599.17
Skewness	−0.32	−0.10	−0.55	−0.51	0.13	1.56
Kurtosis	2.67	2.30	2.69	2.80	2.23	5.33
October 2004 (N = 37)						
Mean	1.12	0.59	0.45	16.73	6.27	186.81
Median	0.68	0.02	0.35	17.00	6.50	120.00
Maximum	5.48	4.77	4.82	25.00	10.00	1284.00
Minimum	−3.99	−1.11	−3.12	2.00	1.00	15.00
Std. Dev.	2.00	1.55	1.75	4.76	2.06	218.14
Skewness	0.04	1.08	0.56	−0.76	−0.54	3.64
Kurtosis	3.43	3.20	3.11	4.14	2.82	18.54
Panel B. Pearson Correlation Coefficients						
October 2003 (N = 44)						
LMATO_GC	0.83					
LSDTO_GC	0.77	0.98				
Confidence	0.35	0.19	0.16			
Understanding	0.47	0.37	0.28	0.15		
Total trades	0.42	0.38	0.39	−0.18	0.19	
October 2004 (N = 37)						
LMATO_GC	0.87					
LSDTO_GC	0.73	0.94				
Confidence	0.21	0.02	−0.09			
Understanding	0.30	0.25	0.18	0.28		
Total trades	0.25	0.30	0.37	−0.23	−0.15	

Notes: TOT_GC is a measure of trading profit and reflects the sum of dividends received from the shares on hand at the end of each five-minute trading period, plus trading profits and losses and the value of shares on hand at the end of the game. LATOT_GC is the natural log of the absolute value of the total trading profit, LMATO_GC is the natural log of the mean absolute trading profit, and LSDTO_GC is the natural log of the trading profit standard deviation. Confidence is a measure of self-efficacy or confidence. Understanding is a measure of participant understanding. Total trades is the number of orders entered into the system, i.e., the total number of bids, asks, clear bids, clear asks, buys, and sells that the individual or group make during the total trading period.

the game. Our volatility measures based on trading profit are LATOT_GC (the natural log of the absolute value of the total trading profit), LMATO_GC (the natural log of the mean absolute trading profit), and LSDTO_GC (the natural log of the trading profit standard deviation). Table 1 gives descriptive statistics and correlation coefficients for these variables.

The simplest approach to estimating trading profit volatility is to take the absolute value of trading profit for each participant at the end of the game and use it as an approximation of the volatility in trading profit for that individual. Alternatively, we can use the break at the end of each ten-minute trading period, when performance is measured and compensation is determined, to obtain subperiod volatility estimates.

In the October 2003 experiment, there were six ten-minute trading periods; in October 2004 there were three ten-minute periods. Given this data, we choose three measures of trading profit volatility. The first is the absolute value of the total trading profit accumulated over the experiment:

$$ATOT\_GC = abs(TOT\_GC) \tag{1}$$

The second is the mean absolute trading profit earned over the trading periods in the experiment, where *abs(x)* is the absolute value of x. The number of trading periods, P, would again be six for October 2003, and three for October 2004.

$$MATO\_GC = \frac{1}{P}\sum_{t=1}^{P} abs(TOT\_GC_t) \tag{2}$$

The final measure is the standard deviation of the trading profits earned over the ten-minute subperiods in the experiment:

$$[SDTO\_GC]^{0.5} = \frac{1}{P}\sum_{t=1}^{P} (TOT\_GC_t - E(TOT\_GC))^2 \tag{3}$$

The volatility estimates are rescaled using the natural log function to better deal with large values in the data. This ensures regression residuals are well behaved. The natural log variables become LATOT_GC, LMATO_GC, and LSDTO_GC.

Self-Efficacy or Self-Confidence

Research has found that participant self-efficacy (Bandura [1978]) or confidence (CONF_I) is an important factor in determining whether an individual will successfully complete a task (Chan and Lu [2004], Christoph, Schoenfeld, and Tansky [1998], Hayashi et al. [2004], and Tan and Zhao [2003]). To capture this effect on our participants, we ask how confident they are about five tasks, with responses coded over a five-point Likert scale ranging from 1 (not at all confident) to 5 (totally confident). The five tasks are "pricing a share," "setting a bid," "setting an ask," "buying," and "selling," and they account for parts (a) to (e) of the first section of the questionnaire.

These questions were answered before the simulation and are replicated in Appendix 3. For the 2004 experiment, we average the CONF_I measure across the two members of a group to estimate the group's self-efficacy. We use the questionnaire completed by the partner who did most of the trading, but find it did not affect the final results.

Understanding

Participant understanding of securities pricing and the dividend process should also be important in successful trading. Thus we include a series of questions addressing the participant's understanding (UN_TOT_I) of the key elements of share valuation, dividend uncertainty, and functioning of a limit order system. These questions make up the latter part of the questionnaire in Appendix 3.

The first subsection has four questions, (a) through (d); the remaining subsections have only one question per subsection. The first subsection focuses on the dividend information provided to each participant in the simulation. The second and third subsections focus on the ability of participants to identify share price limits. Subsection 4 questions the relationship between first period dividends and dividends paid in the following period. Finally, subsections 5, 6, and 7 test understanding of the bid and ask prices and how market prices are set.

The responses to these questions were either correct or incorrect, and were allocated a value of 1 or 0. We sum the responses to obtain UN_TOT_I. For the 2004 experiment, we average the UN_TOT_I measure across the two members of a group to estimate their understanding. We again used the questionnaires completed by the partner who did most of the trading, and the results were consistent across the two measures.

Trading Level

As indicated in Table 1, the level of trades (TOTAL TRADES) varies considerably between the two experiments. There is also some variation between groups and individuals in the October 2004 experiment. We define the level of trades as the number of orders entered into the system, in other words, the total number of bids, asks, clear bids, clear asks, buys, and sells that the individual or group make during the total trading period.

Group Effects

For the 2004 trading experiment, we include a group dummy variable (GRP_TRDR), along with interaction terms with the other variables, to capture the impact of the groups. Note there is no need to include this type of variable or interaction term for the October 2003 experiment as only individual traders took part.

Analysis

We are interested here in the trader characteristics that appear to explain volatility in trading profit across participants. Why would one participant exhibit more volatile trading profits than another? Few would argue that risk and return are core concepts in finance, but there is little analysis of why some traders generate more volatile trading profits than others. We analyze the determinants of trading profit volatility generated by naïve traders.

October 2003 Experiment

The October 2003 experiment consisted of forty-three individual participants trading over six trials of ten minutes each. We regress the volatility estimates (either LATOT_GC, LSDTO_GC, or LMATO_GC) on participant confidence, understanding, and trading level, with the basic model taking the form:

$$\text{volatility}_i = \alpha_0 + \alpha_1\ \text{Confidence}_i + \alpha_2\ \text{Understanding}_i + \alpha_3 \text{Total\_trades}_i + \varepsilon_i \quad (4)$$

where, for individual i,

Volatility_i = trading profit volatility (either LATOT_GC, LSDTO_GC, or LMATO_GC),
Confidence_i = self-efficacy or confidence,
Understanding_i = participant understanding,
Total_trades_i = level of trading.

Statistical significance of the final results is sensitive to the volatility estimates used. However, as Table 2 shows, the coefficients for confidence, understanding,

Table 2. *Volatility in Participant Wealth*

	LATOT_GC	LMATO_GC	LSDTO_GC
October 2003 (N = 43)			
Constant	−2.7138*	−0.9196	−0.7774
	−2.07	−0.77	−0.56
Confidence	0.2201*	0.0993	0.1077
	3.09	1.53	1.44
Understanding	0.4121*	0.2706+	0.1941
	2.74	1.97	1.23
Total Trades	0.0017*	0.0012*	0.0014*
	3.48	2.63	2.72
R-squared	0.46	0.28	0.24
F-statistic	11.33*	5.25*	4.10*
Prob(F-statistic)	0.00	0.00	0.01
October 2004 (N = 37)			
Constant	−4.2704*	−2.6819*	−2.5610+
	−2.89	−2.31	−1.98
Confidence	0.1244+	0.0372	0.0090
	1.89	0.72	0.16
Understanding	0.3489*	0.2800*	0.2805*
	2.36	2.41	2.17
Total Trades	0.0033*	0.0027*	0.0034*
	2.45	2.49	2.86
Group and Total Trades Interaction Term	0.0085*	0.0068*	0.0079*
	2.49	2.56	2.67
R-squared	0.34	0.32	0.35
F-statistic	4.13	3.78	4.23
Prob(F-statistic)	0.01	0.01	0.01

Notes: LATOT_GC, LMATO_GC, and LSDTO_GC are measures of trading profit volatility. TOT_GC reflects the trading profit earned by the individual (the sum of dividends received from the shares on hand at the end of each five-minute trading period, plus trading profits and losses and the value of shares on hand at the end of the game). LATOT_GC is the natural log of the absolute value of the total trading profit, LMATO_GC is the natural log of the mean absolute trading profit, and LSDTO_GC is the natural log of the trading profit standard deviation. Confidence is a measure of self-efficacy or confidence. Understanding is a measure of participant understanding. Total trades is the number of orders entered into the system, i.e., the total number of bids, asks, clear bids, clear asks, buys, and sells that the individual or group make during the total trading period. Group and total trades interaction term is the group trader dummy variable, with a value of 1 if the participant is a group and 0 otherwise. Group and total trades interaction term is the product of the group dummy variable and total trades. It is an interaction term added to the regression to capture the differing response to trading between the groups and individuals. The Jarque-Bera test, White's test for heteroscedasticity, and Ramsey's reset test for null hypotheses are not rejected for any of the regressions reported above, consistent with fairly well behaved models.

and trading are all positive. All the regression coefficients estimated using the first volatility measure, LATOT_GC, are positive and statistically significant. The results for confidence and understanding vary somewhat with the remaining two volatility estimates. We thus have strong statistical evidence of the link between the number of trades and trading profit volatility. Higher levels of trading are positively correlated with more volatile trading profits; lower levels of trading are correlated with less volatile trading profits.

There is also some support for the contention that higher levels of understanding are correlated with higher levels of trading profit volatility, and that higher levels of confidence are correlated with higher levels of trading volatility. The results for self-efficacy and understanding are statistically less persuasive. However, the parameter signs are always positive. Furthermore, the correlation coefficients between the explanatory variables of around 0.20 suggest that multicollinearity may partly explain the variation in coefficient significance.

October 2004 Experiment

Given that this experiment used groups, it is necessary to also model their impact on trading profit volatility. We use a dummy variable and a set of interaction terms with respect to the dummy variable. The initial model takes the form:

$$volatility_i = \begin{bmatrix} \alpha_0 + \alpha_1 \text{Confidence}_i + \alpha_2 \text{Understanding}_i \\ \quad +\alpha_3 \text{Total trades}_i \\ +\alpha_4 GRP\_TRDR_i + \alpha_5 (GXCONF\_I_i) \\ +\alpha_6 (GXUNTOT\_I_i) + \alpha_7 (GXTRD_i) + \varepsilon_i \end{bmatrix} \quad (5)$$

where

GRP_TRDR_i = the group trader dummy variable, with a value of 1 for a group and 0 otherwise.

GXCONF_I = the product of the group dummy variable and the confidence variable.

GXUN_TOT_I = the product of the group dummy variable and the understanding variable.

GXTRD = the product of the group dummy variable and the total trades variable.

We estimated the initial model with the group dummy and all the interaction terms, although variable exclusion tests suggested a more parsimonious model. Table 2 reports the results.

$$LATOT\_GC_i = \begin{bmatrix} \alpha_0 + \alpha_1 \text{confidence}_i + \alpha_2 \text{Understanding}_i \\ +\alpha_3 \text{Total\_trades}_i + \alpha_4 (GXTRD) + \varepsilon_i \end{bmatrix} \quad (6)$$

The two coefficients on the level of trading, total trades and GXTRD, are both statistically significant and positive. The total trades coefficient shows that the level of individual trading is positively correlated with the level of trading profit. The interaction term, GXTRD, suggests this positive relationship is statistically more sensitive for group traders than for individuals.

The coefficient on understanding is also positive and statistically significant at the 5% level in all cases. The coefficient for confidence level or self-efficacy (confidence), is positive and statistically significant at the

10% level for LATOT_GC, but not for the other volatility measures. Thus, self-efficacy is positively correlated with cross-sectional variation in trading profits, but this result is not statistically significant across each volatility measure.

Summary

The level of trading coefficient is positive and statistically significant in both experiments. The more heavily a participant trades, the more volatile the trading profits. The level of understanding is also positively correlated with trading profit volatility in all cases, and is generally statistically significant at least at the 10% level. It seems that a better understanding of the game results in an increase in trading profit volatility for our naïve traders. The impact of confidence is less statistically important, but the coefficients are always positive. Finally, note that in the October 2004 experiment, profit volatility is more sensitive to trading level for group traders than for individual traders.

Conclusion

Trading profit volatility is positively correlated with the level of trading and participant understanding. There is also some evidence that trading profit volatility is positively correlated with participant confidence, but this result is much less persistent across the three measures of trading profit volatility we analyze here.

The October 2004 experiment also shows that the relationship between group trading levels and trading profit volatility was much stronger for groups than for individuals. However, note that both groups and individuals will tend to face more volatility if they trade heavily.

To date we are not aware of any other research that provides insights into naïve trader profitability. The critical point we make is that higher levels of trading and higher levels of understanding correlate positively with higher profit and loss volatility.

To some extent, this result is also apparent for the level of confidence exhibited by the participant. Naïve investors, even well educated and confident naïve investors, are not guaranteed profitable trading, although it appears they face more volatility in their trading profits. Finally, not only are higher levels of trading dangerous to your wealth (Barber and Odean [2000]), they are associated with greater volatility in trading profit for naïve traders.

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Appendix 1: Dividend Determination

There are two trading periods, and dividend payments are paid at the end of each period. Participants are given only partial information about the payments. Table 1 describes the equally likely events affecting each firm, and the dividends paid at the end of period 1.

		Dividend
Firm ABC		
Event x	Poor economic conditions, labor strike	0
Event y	Poor economic conditions, no strike	12
Event z	Fair economic conditions, good labor relations	24
Firm CRA		
Event w	Poor economic conditions, labor strike	0
Event x	Poor economic conditions, no strike	12
Event y	Fair economic conditions, no strike	12
Event z	Fair economic conditions, good labor relations	24

The dividends paid at the end of period 2 depend on both the period 1 event and the period 2 event.

Period 1 Event	**Period 2 Event**			
		Firm ABC		
Per 2 Col/Per 1 Row	x	y	z	
x	0, 0	0, 0	0, 12	
y	12, 0	12,12	12, 24	
z	24, 12	24, 12	24, 24	
		Firm CRA		
Per 2 Col/Per 1 Row	w	x	y	z
w	0, 8	0, 8	0, 12	0, 18
x	12, 8	12, 8	12, 12	12, 18
y	12, 8	12, 8	12, 12	12, 18
z	24, 8	24, 8	24, 12	24, 18

Examples for Interpreting the Dividend Tables

Suppose the realized events for ABC are:

(1) Y in period 1 and Y in period 2. At the end of period 1, ABC would pay a dividend equal to 12; at the end of period 2, it would pay 12 (see cell row Y, column Y in the ABC table above (12, 12 for periods 1 and 2, respectively).

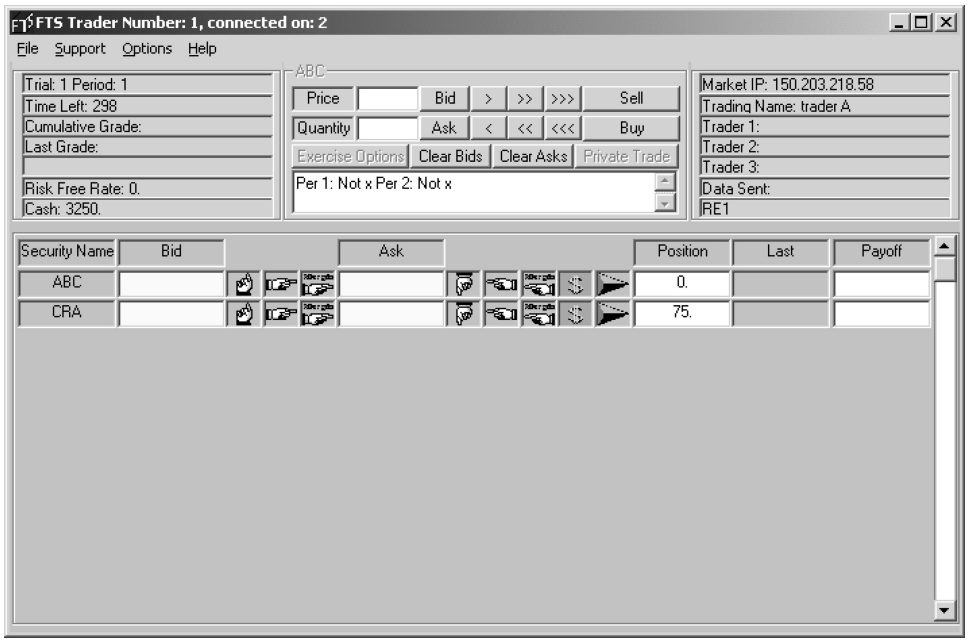
(2) Z in period 1 and X in period 2. At the end of period 1, ABC would pay a dividend equal to 24; at the end of period 2, it would pay 12 (see cell row Z, column X in the ABC table above (24, 12 for periods 1 and 2, respectively).

Suppose the realized events for CRA are:

(1) W in period 1 and Z in period 2. At the end of period 1, CRA would pay a dividend equal to 0; at the end of period 2, it would pay 18 (see cell row W, column Z above (0, 18 for periods 1 and 2, respectively).

(2) Z in period 1 and X in period 2. At the end of period 1, CRA would pay a dividend equal to 24; at the end of period 2, it would pay 8 (see cell row Z, column X above (24, 8 for periods 1 and 2, respectively).

Appendix 2: Screen Dump for the Trading Screen



Notes: This is the screen participants see while trading. There are essentially four sections to the screen, the top right section, the top left section, the top middle section, and the middle section. The top left-hand section identifies the particular trading periods, the time remaining in the present trading period, the wealth measures (cumulative grade and last grade), the risk-free rate, and the level of cash currently on hand. The last grade is a measure of wealth earned in the last trading period and the cumulative grade is the wealth accumulated over the trading periods completed thus far. The risk-free rate is set to zero for simplicity. The top right-hand section provides static participant identification information. The top middle section is where trades are entered. For a buy or sell at market, the participant enters the quantity of shares and selects buy or sell. For a limit order, the participant enters the quantity and the price that is required and then enters bid or ask. There are also buttons to clear current bids and asks. The middle section provides current best-bid and best-ask prices, as well as the participant's current position in the shares, the last price for the share, and the last dividend payoff received from the share.

Appendix 3: Self-Efficacy and Understanding Questionnaire

Confidence in trading with the FTS trading system game (self-efficacy)

Listed below are activities that could be completed during financial trading with the FTS system. Please indicate how confident you feel in performing each activity by circling one number. If you are not sure of what to do or what the question refers to, please circle the "0."

a) Pricing a share

0	1	2	3	4	5
Not sure	Not at all confident		Moderately confident		Totally confident

b) Setting a bid

0	1	2	3	4	5
Not sure	Not at all confident		Moderately confident		Totally confident

c) Setting an ask

0	1	2	3	4	5
Not sure	Not at all confident		Moderately confident		Totally confident

d) Buying

0	1	2	3	4	5
Not sure	Not at all confident		Moderately confident		Totally confident

e) Selling

0	1	2	3	4	5
Not sure	Not at all confident		Moderately confident		Totally confident

FTS Stock Valuation

Please answer the following questions about stocks ABC. You may need to read the "Dividend Determination Sheet" to answer these questions.

1. For stock ABC, if it is event "Y" in the first period and event "Z" in the second period:
   a) What is the dividend paid in the first period? _____
   b) What is the dividend paid in the second period? _____
   c) What is the value of the share in the first period? _____
   d) What is the value of the share in the second period? _____
2. What is the minimum value that ABC can take in the first period? _____
3. What is the maximum value that ABC can take in the second period? _____
4. If you know "not y in period 1" for stock ABC, what are the possible dividends that could be paid in period 1? _____
5. If the current bid and ask prices/depths are \$22/200 and \$26/300, respectively and you place a "buy" order for 200 shares, what price will you pay for the shares?

   \$_____ per share
6. If the current bid and ask prices/depths are \$22/200 and \$26/300, respectively, and you place an "ask" at a price/depth of \$25/250, will your new ask be used if the next action in the market is a buy order for 100 shares?

   □ Yes □ No
7. If the current bid and ask prices/depths are \$22/200 and \$26/300, respectively, and you place an "ask" at a price/depth of \$27/250, will your new ask be used if the next action in the market is a buy order for 100 shares?

   □ Yes □ No