Framing Effects on Asset Markets - An Experimental Analysis -*

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The results of an asset market experiment, in which 64 subjects trade two assets on eight markets in a computerized continuous double auction, indicate that (i) objectively irrelevant information influences trading behavior. Moreover, positively and negatively framed information leads to a particular trading pattern. However (ii), a probability variation of the framed information has no influence on trading volume. In addition, the results (iii) confirm the disposition effect. Participants who experience a gain sell their assets more rapidly than participants who experience a loss, and positively framed subjects generally sell their assets later than negatively framed subjects.

Keywords: Financial markets, Prospect theory, Anchoring and adjustment, Experimental economics, Disposition effect

JEL-Classification: C90; D44; D80; G12

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1 Introduction

The communication of information on asset return distribution is a central issue in finance. Take, for instance, investment consultants who are legally obliged to inform their customers about the potential risk of their investments, whereby financial risk is usually expressed by the variance or the standard deviation of the underlying distribution of the expected returns on the investment. Customers are thus implicitly required to accurately perceive and interpret statistical information, irrespective of how the information is presented. Also, a large investment consultancy industry has emerged during the last years, providing investors with financial information, and suggesting that the more information available to investors the higher their expected profits will be. However, information does not only play an important role in individual investment decisions, but also in market environments. Market efficiency, for instance, requires that neither objectively *irrelevant* information nor symmetrically distributed selective information affects aggregated market behavior. If, for example, some traders receive a positive signal about the likely returns on an asset, whereas an equal number of traders receive the opposite signal, this information should be completely revealed, leading aggregated market behavior to remain unaffected.

In this paper we investigate the impact of objectively *irrelevant* information on trading behavior. Moreover, we draw upon a novel type of framing; distinguishing between positively and negatively framed information. Traders are confronted with randomly distributed selective information about performance chances of potential investments, employing an anchoring and adjustment framework, in which subjects are presented additional irrelevant information to a fully described decision problem. This additional information, which is either positively or negatively framed, is assumed to be perceived as an anchor in the decision process. Since we symmetrically distribute the additional information among traders, aggregated market behavior should remain unaffected. We also investigate the robustness of the disposition effect in a competitive market environment with real time data available.

The paper is organized as follows: section 1.1 provides a short literature review on framing effects, and section 1.2 focuses on the disposition effect as one of the possible implications of prospect theory. In section 2 the experimental design and the procedure are introduced. Section 3 deals with the results, and in section 4 we discuss the most striking results and arrive at our conclusions.

1.1 Framing effects

Expected utility theory assumes, among other things, descriptive invariance, implying that different representations of the same choice problem should yield the same preference. However, several empirical studies indicate that this axiom is frequently violated in individual decision making. McNeil et al. (1982), for instance, showed that the same medical statistics framed either in terms of mortality rates or in terms of survival rates lead to different preferences. Framing effects were also observed in decisions involving risky lotteries and monetary payoffs (Kahneman and Tversky 1983, Tversky and Kahneman 1981). More recently, Statman (1995) as well as Kahneman and Riepe (1998) applied the concept of framing to financial decisions, such as dollar-cost averaging.

Weber et al. (2000) investigated the impact of endowment framing on market prices in an experimental asset market. Participants were either put in long position by receiving some amount of cash plus a certain amount of positively valued risky assets (positive framing) or were put in short position by receiving a larger amount of cash and certain state-contingent liabilities (negative framing). The objective value of initial endowments was identical in terms of final wealth. In line with the predictions of prospect theory, Weber et al. (2000) found that overpricing[1] was more often observed for negatively framed market participants than for positively framed participants.

In contrast to Weber et al. (2000) who altered participants' initial actual endowments, the present study investigates whether framing effects are also robust under weaker conditions, for instance, when participants only obtain different and more importantly *irrelevant* information. Our experimental procedure differs from the way framing effects were originally studied by Tversky and Kahneman (1981). In their experiments subjects were presented with scenarios in which a hypothetical decision problem was either semantically framed in terms of "gains" or in terms of "losses". However, the concept of framing in studies that emphasize the role of language in the representation of the decision problem lack conclusive empirical evidence. Kühberger (1995) found that a variation of missing items of information in the decision problem produced markedly different framing effects. Moreover, with fully described decision problems, no framing effects at all emerged. While the results of a meta-analysis of 136 empirical studies indicate that generally framing effects are a reliable phenomenon (Kühberger 1998), the results of a further meta-analysis, particularly focusing on Asian disease-like studies, by

1 Overpricing refers to market prices that exceed the total value of the lotteries trade (Rietz 1993).

Kühberger et al. (1999) indicate that risk preference depends on the size of payoffs, on the probability levels, and on the type of good at stake.

In our experimental procedure, we employ a novel type of framing, which is not based on semantic variations of a decision problem. Participants are informed that dividends are randomly determined and drawn out of a normal distribution with a commonly known fixed μ and a fixed σ, whereby we assume that μ serves as the aspirational reference payoff. For a given probability p, $p \in \{0, ..., 0.5\}$, we let $\underline{X_p}$ and $\overline{X_p}$ denote the $100p$ and $100(1-p)$ percentiles, respectively. For a given p, subjects are told that dividends will be less than $\underline{X_p}$ with probability p (negative framing), or that dividends will exceed $\overline{X_p}$ with probability p (positive framing). We distinguish between two independent markets, A and B, in which percentile information follows two different probabilities. The framed information on market A deviates more extremely from the aspirational reference payoff μ than the framed information on market B ($p_A < p_B$).

Our approach to framing effects is also related to the "anchoring and adjustment"-bias (Tversky and Kahneman 1974), referring to a sequential decision situation in which initial information serves as an anchor, from which adjustments in the decision process are only made insufficiently.[2] In our experimental design, the positively and negatively deviating dividend information represents the initial information (anchor), from which unbiased traders are required to be uninfluenced in their trading behavior. However, if traders systematically respond to this additional percentile information, the anchoring effect is not sufficiently reduced, and trading behavior will be biased.

The percentile information in our approach might serve two different roles; an *informational* and a *framing* role. Although from a normative perspective the additional percentile information is logically redundant, given knowledge of the mean and variance of the normal distribution, individuals may perceive it as useful in the decision-making process; for instance, in order to learn about the shape of the distribution. However, since the percentile information is symmetrically distributed among subjects in the context of a competitive market environment, given that information dissemination takes place and that subjects have statistical training, the informational role is experimentally ruled out. Observed behavioral regularities in the experiment are therefore likely to be

2 Tversky and Kahneman (1974) asked subjects to estimate the percentage of African countries in the United Nations after a number between 0 and 100 had been determined by spinning a wheel of fortune. Estimates were dependent on the initial determined number. In case a high number had been selected, the median percentage of African countries exceeded the corresponding percentage in case a low number had been determined.

due *only* to the framing role.

Since it is assumed that participants insufficiently adjust their dividend expectations (from the positively or negatively framed information to the expected dividend μ), we (i) expect that this insufficiency also shows up in individual market behavior, leading to a particular trading pattern: Positively framed buyers are expected to purchase assets rather from negatively than from positively framed sellers, whereas in turn negatively framed sellers are expected to rather sell their assets to positively framed buyers than to negatively framed buyers.

In addition, if the framed information is strong enough to form and shape individual expectations, we (ii) expect that the trading volume will be higher on market A than on market B, since the dividend information on the former market deviates more strongly from the aspirational reference payoff μ than on the latter market. Extreme information is assumed to create more diverging price expectations which will increase the likelihood that pairs of participants willing to trade will actually meet on the market.

1.2 Disposition effect

The disposition effect is one implication of prospect theory (Kahneman and Tversky 1979, Tversky and Kahneman 1992). In contrast to the utility function implied by expected utility theory, the value function ν postulated by prospect theory is defined on gains and losses relative to a reference point and not on the basis of absolute levels of final wealth. Prospect theory assumes that the value function is concave for gains and convex for losses. In a financial context, one therefore can expect that winner assets will be sold more readily than loser assets in order to collect the gain and undo or "repair" the loss, respectively (Shefrin and Statman 1985).

This hypothesis has been supported empirically, for instance, for field data (Heisler 1994, Odean 1998), and in experimental asset markets (Heilmann et al. 2000, Weber and Camerer 1998). Odean (1998) analyzed trading records for 10,000 accounts at a large discount brokerage house and found that investors held losing stocks a median of 124 days, whereas winners were only held for 104 days. Heilmann et al. (2000) showed on an experimental call market that in periods of rising trading prices with respect to the previous trading period the number of assets offered as well as the number of assets sold was higher than in periods of falling trading prices.

In contrast to Heilmann et al. (2000) who used the price of the previous trading period as the reference point, the present study focuses on individual behavior and defines the reference point as the subject's purchase price as Weber and Camerer (1998) did. But unlike the experimental procedure followed by Weber and Camerer (1998) who determined the prices not on the basis of the trading actions of subjects but by a random process, our market prices are determined solely by the market participants themselves on a computerized experimental asset market using the software z-Tree (Fischbacher 1999). Our contribution to the existing literature is to study the disposition effect in the context of a competitive market environment with real time data available. We thus (iii) expect that a purchase price lower than the previous trading price implies a gain that will lead to more rapid selling, whereas a purchase price higher than the previous trading price implies a loss that will lead to less rapid selling.

2 The experiment

2.1 Participants

Overall, 64 participants, all students either at the University of Vienna or at the Vienna University of Economics and Business Administration, participated in eight sessions of an experimental asset market. On average, participants earned € 19.14 with a standard deviation of € 14.94. Twenty-two females and 42 males, aged 19 to 31 ($M = 22.52, SD = 2.90$), participated in the experiment. The time required for conducting the experiment was about 2 hours and 15 minutes. Forty-nine participants were students of economics, whereas the remaining 15 participants were enrolled in other social science disciplines. All participants had attended introductory courses in statistics during their studies.

2.2 Experimental design

The experiment was conducted in a 2 x 2 factorial design in order to study the interaction of differently framed participants within one market. The independent variables were (i) the framing of dividend information (positively versus negatively framed information) as a between-subjects factor and (ii) the probability of the framed information (low versus high probability; $p_A = .05$ and $p_B = .45$) as a within-subjects factor. Participants were randomly assigned to one of the two framing conditions. All participants were informed that dividends would be randomly drawn out of a normal distribution with

$\mu \in \{95, 135, 105\}$ and $\sigma \in \{20, 30, 40\}$. For the combination and the sequence of μ and σ see Table 1.

Insert Table 1 about here

Note that both, the framing of dividend information and the probabilities of the framed information are objectively irrelevant information to the decision maker, because the decision problem is sufficiently described by μ and σ. According to standard economic theory, irrelevant information is not only required not to interfere with the decision being made, but should also leave the decision problem itself merely unchanged. In other words, the presence of irrelevant information should not increase the probability that it is actually used in the decision process nor that it irradiates on the decision problem itself and thereby influences choice.

2.3 Experimental procedure

The experiment consisted of four phases. In the first phase, subjective propensity towards risk was measured experimentally by the methods of certainty equivalents and by binary lottery decisions in order to control for differences in individual risk attitude. In the second phase, the experimental asset market was opened and assets were traded. In the third phase, participants were asked to complete a short questionnaire, and finally in the fourth and last phase, the procedure to control for risk attitude was repeated. The exact sequence of events in the experiment is shown in Figure 1.

Insert Figure 1 about here

Phase 1: After brief instructions, participants were asked (i) to reveal their certainty equivalent for a lottery that offers a payoff of 100 Experimental Guilders[3] with a probability of $p = .50$, and zero Experimental Guilders otherwise; and (ii) to make seven decisions among risky lotteries. The payoffs of the lotteries are listed in Table 2. As a control for position effects, the lotteries were systematically varied with respect to a_1 (highest possible payoff) and a_2 (lowest possible payoff) as well as to A (certain payoff) and to the sequence of a_1/a_2 (risky payoff).

Insert Table 2 about here

3 100 Experimental Guilders equal € 0.73.

The certainty equivalent allows the experimenter to infer participants' attitude towards risk. More precisely, it allows him/her to discriminate between risk aversion, risk neutrality and risk seeking behavior. A certainty equivalent that is lower than the expected value of the lottery, which is 50 Experimental Guilders, indicates risk aversion, whereas a certainty equivalent equal to the expected value indicates risk neutrality, and finally a certainty equivalent above the expected value indicates risk seeking behavior. Also, the seven decisions among lotteries can be used to infer risk attitude. However, since each lottery has the same expected value in each of its two components, namely the certain payoff and the risky payoff, the design only allows to distinguish between risk aversion (certain payoff) and risk neutrality (risky payoff).

One of the seven decisions was randomly selected in order to determine the individual payoff. The payoff from the lotteries was added to the total payoff from the auction. Phase 1 took 15 to 20 minutes.

Phase 2: After receiving instructions about the experimental asset market, subjects participated in two trial periods of six minutes each in order to become familiar with the selling and buying procedures on the market. After the trial periods, the asset market was opened. Overall, eight sessions were run with eight subjects each on a computerized asset market, using the software z-Tree (Zurich Toolbox for Readymade Economic Experiments, Fischbacher (1999)).

The computer screen for the auction is displayed in Figure 2. Each market participant was entitled (i) to submit bids and asks, (ii) to accept standing bids and asks, whereas only better offers, for instance higher bids and lower asks respectively were allowed, or (iii) to stay passive. Bids and asks were automatically ranked, indicating the most favorable offer. Information about trading history, provided as a chronological list of contracts, was displayed throughout the trading periods.

Insert Figure 2 about here

The experiment was performed as a continuous anonymous double auction. Participants were endowed with 1,000 Experimental Guilders (100 Experimental Guilders equal € 0.18) plus five risky assets A and five risky assets B. The assets were traded separately on market A and market B. To ensure comparability between the sessions, the sequence of the two markets was chosen in advance and applied to all eight sessions. Dividends were randomly determined and drawn out of a normal distribution (see Table

1). Participants were informed that the markets would be open for at least eight and at most twelve periods. The probability that the markets would end after the eighth, ninth, tenth, or eleventh period was 25 percent. Participants were informed that at the end of the final market period the liquidation value of the asset would be zero. Again to ensure comparability between the sessions, the last market period was randomly chosen once for all eight sessions. According to this random selection, it was determined that each market ended after the ninth period. Each trading period lasted for 180 seconds.

Before the market was opened, participants (i) were told which market (A or B) and which trading period (1 to 9) were opened, and received information about the last average market price as well as the closing price of the asset traded, (ii) they received either positively framed dividend information or negatively framed information, and (iii) they had to predict the next average trading price of the assets, generate a subjective confidence interval of 98 percent range, and they had to state how certain they were that their predictions were accurate. Phase 2 took about 80 to 90 minutes.

Phase 3: Participants were asked to fill out a computerized post-experimental questionnaire with items designed to measure how well they had understood the experiment and how much effort they had put into arriving at accurate decisions. Phase 3 took about 15 to 20 minutes.

Phase 4: Finally, participants again had to reveal their certainty equivalent for a lottery offering a payoff of 100 Experimental Guilders with a probability of $p = .50$ and zero Guilders otherwise; and to make seven decisions among lotteries (100 Experimental Guilders equal €0.73). The payoffs were identical with those used in phase 1 and displayed in Table 2. Phase 4 took about 15 to 20 minutes.

3 Experimental results

3.1 Descriptive data analysis

Over the eight sessions with two times nine trading periods each, participants submitted 6,983 offers out of which 3,168 contracts were concluded. Thus, on average participants concluded 22 contracts per period ($SD = 9.19$), ranging from a minimum of four contracts to a maximum of 68 contracts. The average market price was 368.15 Guilders ($SD = 390.71$).

Figures 3 and 4 indicate that over the trading periods, the percentages of concluded contracts decreased both in market A ($\chi^2 = 112.91, p < .001$) and in market B ($\chi^2 = 73.83, p < .001$), while the percentages of not accepted offers increased in market A ($\chi^2 = 75.02, p < .001$) and market B ($\chi^2 = 20.16, p < .05$).

Insert Figure 3 about here

Insert Figure 4 about here

One explanation as to why the number of accepted offers decreased would be that prices increased over trading periods. This conjecture was confirmed; average trading prices were statistically significantly higher in the last period of both markets, A ($M_{A,9} = 235.77, SD_{A,9} = 216.29$) and B ($M_{B,9} = 354.34, SD_{B,9} = 425.30$), compared to the first period ($M_{A,1} = 150.06, SD_{A,1} = 83.73; F(1; 649) = 40.52, p < .001; M_{B,1} = 163.94, SD_{B,1} = 82.45; F(1; 625) = 50.74, p < .001$). However, Figure 5 indicates that average trading prices on both markets sharply declined in late trading periods when uncertainty about market duration was important. Thus, uncertainty about market termination depressed average trading prices, although these prices were still higher in the last period than in the first. Figure 5 also indicates that in times of high uncertainty, especially in late trading periods, the variance of market prices increased.

Insert Figure 5 about here

To control for differences with respect to individual risk attitude, it was investigated whether individual risk attitude differs between sessions and between experimental conditions with respect to the elicitation method of certainty equivalents and with respect to the lottery decisions. The average certainty equivalent that was revealed by the subjects was 44.23 ($SD = 31.20$), indicating a slight degree of risk aversion. Certainty equivalents did not differ significantly between the eight sessions ($F(7; 56) = 0.48, p = .84$). An index for risk attitude ranging from 0=risk neutrality to 7=risk aversion was computed out of the seven decisions among lotteries. Participants' average risk attitude amounted to 3.66 ($SD = 2.15$). Again no statistically significant difference between the eight sessions was observed ($F(7; 56) = 0.95, p = .47$). Also, there was no statistically significant difference between positively and negatively framed subjects with respect to the certainty equivalent ($F(1; 62) = 0.09, p = .76$) and the lottery decisions ($F(1; 62) = 0.05, p = .82$). Thus, it can be expected that any differences observed in the experiment between experimental conditions are not caused by different risk attitudes.

In addition, it was found that risk attitude does not differ between the first measurement before the auction was performed and the second measurement after the auction, both for certainty equivalents ($M_I = 44.23, SD_I = 31.20; M_{II} = 45.58, SD_{II} = 31.91; F(1; 62) = 0.15, p = .70$) as well as for the lottery decisions ($M_I = 3.34, SD_I = 2.10; M_{II} = 3.67, SD_{II} = 2.44; F(1; 62) = 1.22, p = .27$). The results thus indicate that the market behavior did not have a reactive impact on individual risk attitude.

Questionnaire results reveal that instructions were clear and easy to understand ($M = 7.16, SD = 2.00$) and confirmed that participants carefully considered their buying orders ($M = 6.13, SD = 1.91$) and their selling orders ($M = 6.09, SD = 2.08$). Subjects also emphasize that they had tried to maximize their earnings ($M = 6.83, SD = 1.94$). All questions were formulated as statements that subjects could disagree with or agree with (ranging from 1=I do not agree to 9=I fully agree).

In the following we are presenting the results with respect to (i) framing effects, (ii) the variation of the probability of the framed information, and (iii) the disposition effect.

3.2 Framing effects

Our results confirm our conjecture that positively framed buyers purchase assets rather from negatively than from positively framed sellers ($\chi^2 = 6.61, p < .01$), whereas in turn negatively framed sellers rather sell their assets to positively framed buyers than to negatively framed buyers ($\chi^2 = 11.26, p < .001$).[4] Tables 3 and 4 show the observed and the expected trading volume between positively and negatively framed subjects.

Insert Table 3 about here

Insert Table 4 about here

Second, we expected that varying the probabilities of the framed information would form and shape individual price expectations. Since the framed dividend information on

4 The expected values for the Chi-Square Test were adjusted with respect to the different trading opportunities within and between experimental conditions: A positively framed participant, for instance, can trade with six negatively framed participants, but only with five other positively framed participants, because (s)he cannot trade with himself/herself.

market A was more extreme than on market B, it was expected that the trading volume on the former market would be higher than the trading volume of the latter market, due to more diverging price expectations.

The results at least weakly support our conjecture. The total number of concluded contracts was higher on market A than on market B ($\chi^2 = 3.41, p = .07$). More precisely, on market A a total of 1,636 contracts was concluded compared to 1,532 contracts concluded on market B. However, the total number of not accepted offers did not differ between the two markets ($\chi^2 = 0.12, p = .73$). On market A 1,918 offers were not accepted by other market participants, whereas on market B 1,897 offers were not accepted.

However, since Figure 5 indicates that participants seemed not to distinguish between the two asset markets, the observed higher trading volume on market A may be due to the unbalanced sequence of periods of the two markets. Figure 5 indicates that prices followed an upward trend on both markets up to the sixth period of market B, and then sharply decreased in late trading periods. Note, that in the beginning of the experiment, when participants were still highly inexperienced, market A was opened more often than market B, whereas in later trading periods this pattern was reversed. Thus, the higher number of concluded contracts may be a result of this particular sequence of trading periods.

3.3 Disposition effect

Based on prospect theory we expect that a purchase price lower than the previous market price implies a gain situation that leads to more rapid selling, whereas a purchase price higher than the previous trading price implies a loss situation that leads to less rapid selling.

To test this conjecture two different scenarios, one describing a gain situation and another describing a loss situation, were defined. The gain scenario was defined as a situation in which the purchase price was below the previous market price, whereas the loss scenario was defined as a situation in which the purchase price was higher than the previous market price. The software z-Tree (Fischbacher 1999) used in the experiment enables us to calculate the exact time in seconds between a subject's buying and a subject's selling. It could be shown that market participants who experienced a gain sold their assets significantly earlier ($M_G = 10.12, SD_G = 23.30$) than market participants who experienced a loss ($M_L = 13.66, SD_L = 26.90; F(2; 1,306) = 3.01, p < .05$). This effect was mediated by framing (see Figure 6). Positively framed market participants generally sold their assets later than negatively framed market participants ($M_P = 13.90, SD_P = 27.62; M_N = 10.32, SD_N = 23.72; F(1; 1,307) = 6.34, p < .05$). Thus, it can be assumed that framing shaped individual expectations and thereby influenced market behavior. Positively framed participants seemed to be more optimistic than negatively framed participants about the likely performance and profit of the assets and thus were also more patient, both in gain and loss situations.

Insert Figure 6 about here

4 Conclusions

In this paper we investigate the impact of objectively *irrelevant* information on trading behavior. Moreover, we draw upon a novel type of framing that is not based on semantic variations of a decision problem. Participants obtain full information about a distribution, and are presented additional percentile information which either positively or negatively deviates from an aspirational reference payoff. Normative decision theories, such as the expected utility theory, require that this additional information is neglected in the decision process and thus does not influence behavior in a market environment. From a behavioral perspective, however, we expect that the additional information serves as an anchor in the decision process, and thereby systematically influences individual behavior, even in market environments. We also investigate the impact of a probability variation of the framed information and the robustness of the disposition effect in a competitive market environment with real time data available.

Our results (i) indicate that objectively *irrelevant* information influences individual trading behavior. Moreover, positively and negatively framed information leads to a particular trading pattern: Positively framed buyers purchased assets rather from negatively than from positively framed sellers, whereas in turn negatively framed sellers rather sold their assets to positively framed buyers than to negatively framed buyers. We find (ii) weak support for the conjecture that a probability variation of the framed information impacts trading volume. However, we believe that this effect is not due to the available information, but rather to the unbalanced sequence of trading periods of the two asset markets. Our results (iii) confirm the disposition effect. Participants more readily sold their assets in gain situations than in loss situations. Furthermore, this effect was mediated by framing. Positively framed market participants generally sold their assets later than negatively framed participants, indicating that the framing of dividend information influenced individual expectations and thereby also market behavior.

Since objectively irrelevant information influenced market behavior, our findings violate expected utility theory and the invariance axiom. Moreover, the results are neither consistent with expected utility theory nor with more modern theories which do not account for framing effects, such as rank dependent utility theories (Quiggin 1982) which are similar to cumulative prospect theory (see e.g. Weber and Camerer (1987), for a more in depth discussion). In addition, our experimental approach starts out with how information is perceived, which is neither captured by expected utility theory nor by rank dependent utility theories. Both theories do not capture the perception of information, but only start out one step later, with its processing.

On financial markets a huge amount of more or less reliable investment information is available to an increasing number of potential investors all around the world. The amount of available information is not only interesting to study from the viewpoint of limited individual information processing capabilities, but it also allows to investigate theoretical predictions: Standard finance theory, for instance, assumes that even if information does not add to a decision problem it does not exert negative externalities on it. Our findings cast doubt on this prediction. Additional irrelevant information does not leave the decision problem unchanged, but systematically influences trading behavior; even in competitive market environments.

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Table 1: Positive and negative dividend information of markets A and B for all periods

	Market and (Period)	$\sigma_1 = 20$ $\underline{X_p} - \overline{X_p}$	Market and (Period)	$\sigma_2 = 30$ $\underline{X_p} - \overline{X_p}$	Market and (Period)	$\sigma_3 = 40$ $\underline{X_p} - \overline{X_p}$
$\mu_1 = 95$	A(1)	56 - 134	A(2)	36 - 154	A(3)	17 - 174
	B(9)	92 - 98	B(8)	91 - 99	B(7)	90 - 100
$\mu_2 = 135$	A(4)	96 - 174	A(5)	76 - 194	A(6)	57 - 214
	B(6)	132 - 138	B(5)	131 - 139	B(4)	130 - 140
$\mu_3 = 105$	A(7)	66 - 144	A(8)	46 - 164	A(9)	27 - 184
	B(3)	102 - 108	B(2)	101 - 109	B(1)	100 - 110

Table 2: Lottery payoffs in Experimental Guilders

Lottery		Payoff	p	Expected value
1	a_1	160	.20	88
	a_2	70	.80	
	A	88	1.00	88
2	a_1	150	.32	99
	a_2	75	.68	
	A	99	1.00	99
3	a_1	178	.28	106
	a_2	78	.72	
	A	106	1.00	106
4	a_1	140	.35	101
	a_2	80	.65	
	A	101	1.00	101
5	a_1	135	.40	105
	a_2	85	.60	
	A	105	1.00	105
6	a_1	188	.25	98
	a_2	68	.75	
	A	98	1.00	98
7	a_1	130	.30	102
	a_2	90	.70	
	A	102	1.00	102

Note: A denotes the certain payoff, whereas a_1 and a_2 denote the risky payoff of the lottery.

Table 3: Observed and expected trading volume between positively framed buyers and negatively and positively framed sellers

	Positively framed buyers	
	Observed trading volume	Expected trading volume
Negatively framed sellers	870	820.4
Positively framed sellers	634	683.6
$\sum$	1,504	

Table 4: Observed and expected trading volume between negatively framed sellers and positively and negatively framed buyers

	Negatively framed sellers	
	Observed trading volume	Expected trading volume
Positively framed buyers	905	839.5
Negatively framed buyers	634	699.5
$\sum$	1,539	

Figure 1: Sequence of events in the experiment

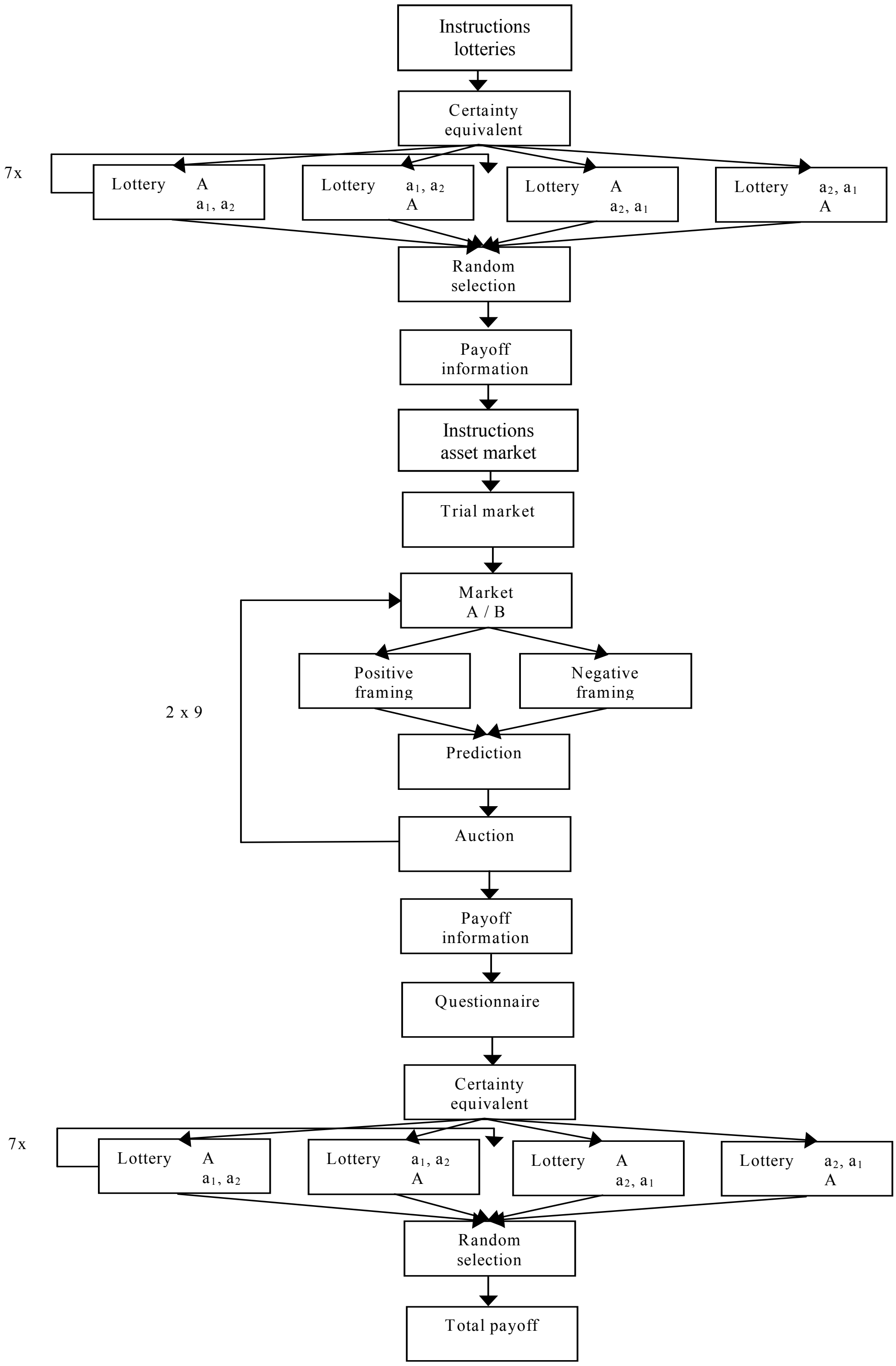

Figure 2: Computer screen for the auction

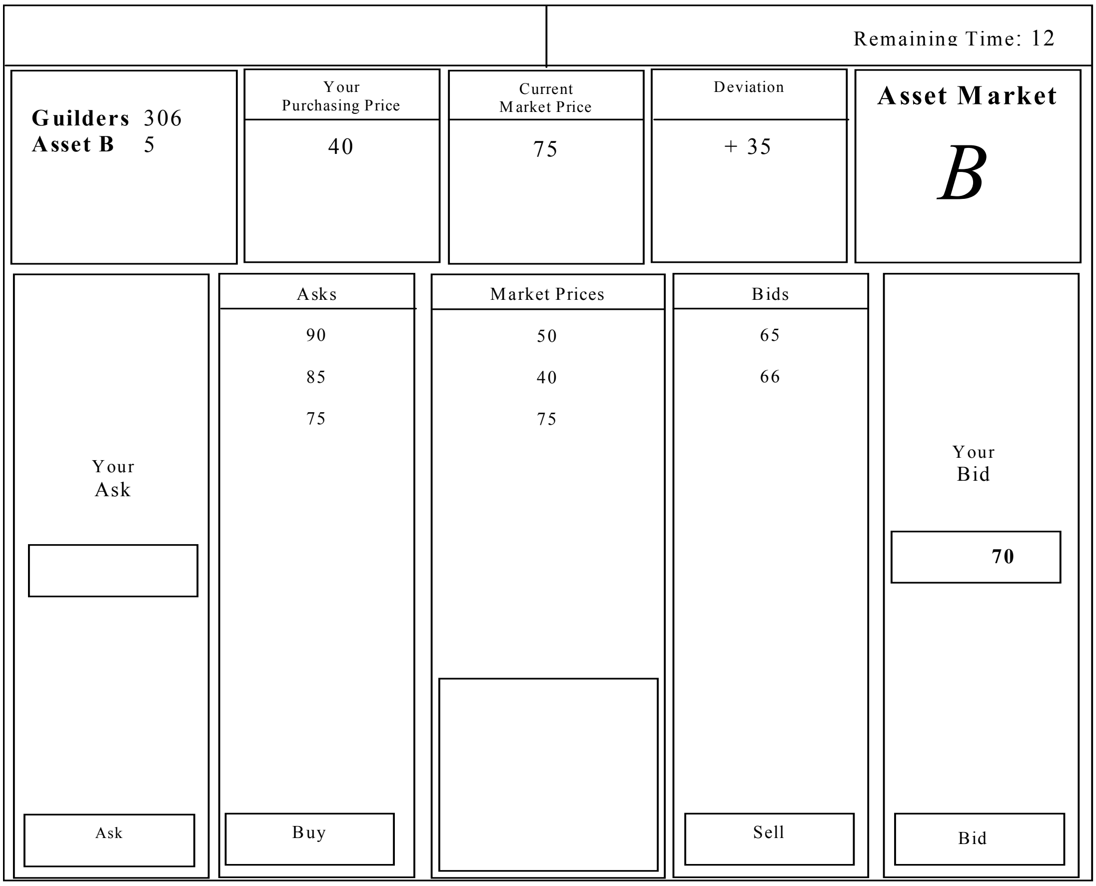

Figure 3: Percentage of accepted and not accepted offers for market A

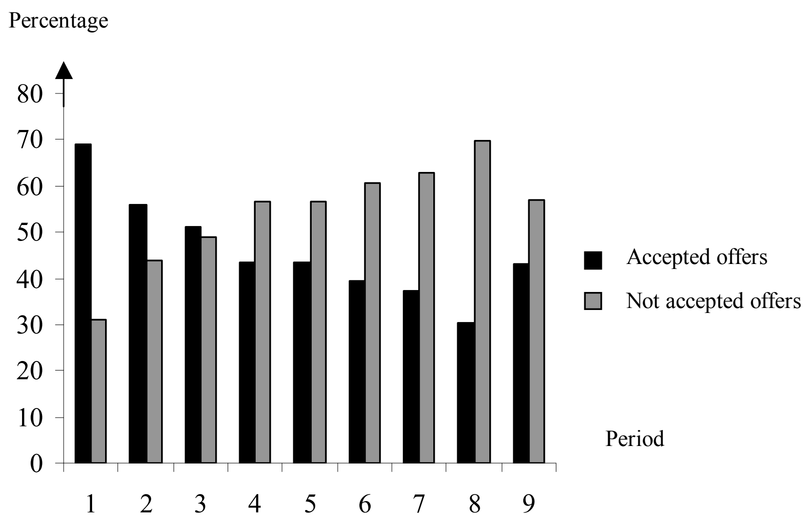

Figure 4: Percentage of accepted and not accepted offers for market B

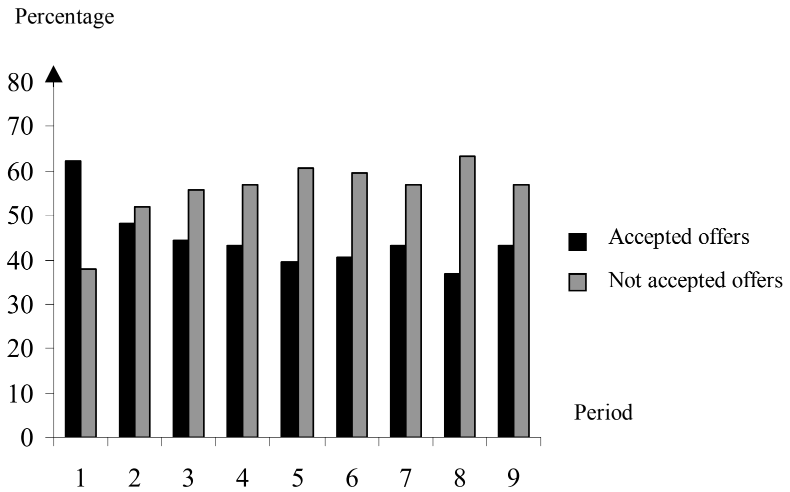

Figure 5: Average trading prices and standard deviations for market A and market B across periods

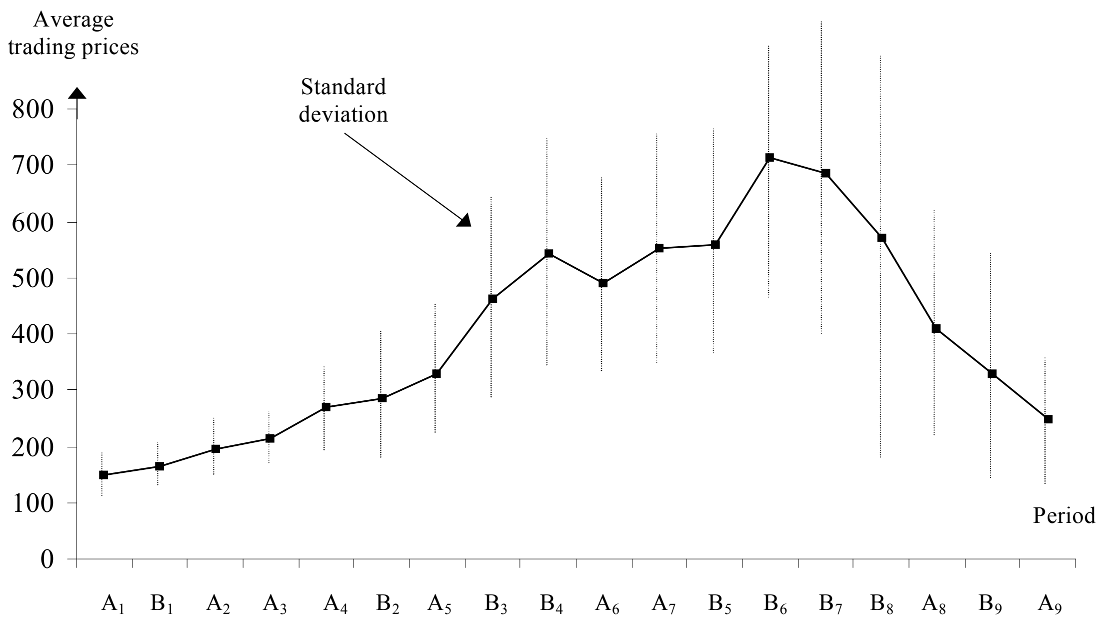

Figure 6: Average time difference between a subject's buying action and the next selling action for positively and negatively framed participants in gain and loss scenarios