Behavior in a Simplified Stock Market:  The Status Quo Bias,
the Disposition Effect and the Ostrich Effect

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Abstract

Specific behavioral tendencies cause investors to deviate from optimal investing. We investigate three such tendencies in a simplified stock market. Subjects rarely follow the fully profit-maximizing strategy, most commonly by ignoring information and continuing to hold on to a stock regardless of its performance. The results support the predictions of the status quo bias, but not the ostrich effect or the disposition effect. These deviations cost subjects a substantial portion of their potential earnings.

Keywords: behavioral finance, experimental economics, status quo bias, self-signaling, disposition effect

JEL subject numbers: C91, D01, D53, D83

Recent research has shown a number of instances in which investors behave in ways that traditional economic theory does not predict. These deviations from standard economic theory have given rise to the behavioral finance literature (see Stracca, 2004 for a survey). This paper implements a simplified stock market experiment and examines whether subjects follow traditional profit-maximizing strategies, or deviate from them following previously established behavioral tendencies, namely the status quo bias, the ostrich effect, and the disposition effect.

Our experimental design is not intended to replicate the complexities of a large-scale stock market. Instead, we look to see if the behavioral tendencies suggested to exist in field settings are observed in a simple laboratory experiment. As such we keep only the most basic elements of stock trading: subjects hold only one stock at a time, and can observe the market and exchange stocks after every period in which prices change. Stocks follow a known distribution resulting in a clear identification of the optimal stock(s). The three behavioral tendencies we look for work against subjects acquiring this optimal stock, thereby reducing subjects' earnings. Thus, if these behavioral biases reveal themselves when the optimal strategy is so simple and transparent, they are likely to be at work in other markets which are much more complicated and the optimal strategy is much harder to determine as well.

Investors in our experiment do secure a little over half of the increased profits to be had as a result of following the optimal investment strategy (53.4%). However, they fall short of maximum possible earnings, primarily as a result of the failure to consistently compare the returns on their currently held stock to the returns on the available set of stocks. We distinguish this form of the status quo bias from the ostrich effect, the tendency of investors to observe their portfolio more often during strong performances than weak, which we do not observe in the data. Further, conditional on choosing to compare their existing stock to the available choices, subjects do *not* suffer from the disposition effect as they generally hold on to superior performing stocks and trade in poorer performing stocks.

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We attribute the failure of the disposition effect here compared to other studies to differences in the way we implement stock market choices, as our procedures do not trigger the framing effect considered to underlie the disposition effect. The status quo bias observed in our data is consistent with one or more of the behavioral biases identified in Samuelson and Zeckhauser (1988) and Benabou and Tirole (2002), which are discussed in detail below.

The paper is organized as follows: Section 2 describes the design of the experiment; Section 3 characterizes the behavior of fully rational, income maximizing investors along with what each of the three behavioral deviations would predict given our design. Section 4 reports the results and Section 5 summarizes our main results.

## 1. Experimental Design and Procedures

The experiment employed a simplified stock market setting. Subjects pick one of twenty stocks to hold. The performance of all stocks is determined by one of three random distributions known to subjects. Capital gains varied randomly, independent of their previous values. In this way each stock performed as a random-walk sequence. Each stock followed a discrete probability distribution based on its type as shown in Table 1.

Table 1 – Discrete probability distribution of movement for each type of stock

| Stock | Stock value distribution per day | | | | | | |
| | -20 | -10 | -5 | No change | +5 | +10 | +20 |
| --- | --- | --- | --- | --- | --- | --- | --- |
| A | 0.025 | 0.075 | 0.100 | 0.200 | 0.250 | 0.200 | 0.150 |
| B | 0.075 | 0.125 | 0.200 | 0.200 | 0.200 | 0.125 | 0.075 |
| C | 0.150 | 0.200 | 0.250 | 0.200 | 0.100 | 0.075 | 0.025 |

Subjects received all of this information about stock performance except the type of each stock. For each trial they were given 180 experimental currency units (ECUs) to invest in the market over twenty periods. In each period they could only hold one stock. Gains and losses in value were independent and identical draws from the characterized distributions. Thus, a gain of 5 on a stock would increase one's holdings for example, from either 90 or 270 to 95 or 275 respectively.

At the end of each period subjects got to see the performance of the stock they were holding (See Figure 1). They also had the opportunity to continue on to the next trial or to observe the past performance of the full set of 20 stocks by clicking on the label "Market." If they chose to observe the market, Figure 2 would come up which lists the net change in value since the beginning of the trial for each stock (the column labeled "Total") along with the current period change in the value of the stock. If subjects observed the market they could choose a new stock by choosing the relevant stock next to the "Select Stock" option, or they could continue to hold their existing stock by clicking "Cancel" and returning to Figure 1 and clicking "Continue." If they changed stocks, whatever gains or losses the new stock accumulated were added to the existing net gains or losses for their previously held stock in that trial. There were no capital gains or losses associated with changing stocks; i.e., subjects could exchange stocks one-for-one regardless of past performance of the currently held stock or the one they were exchanging it for.
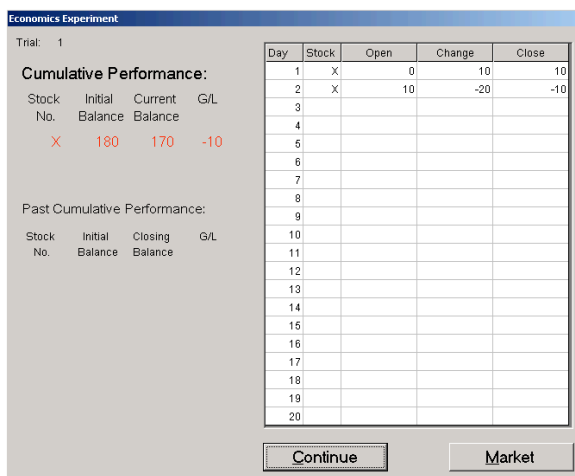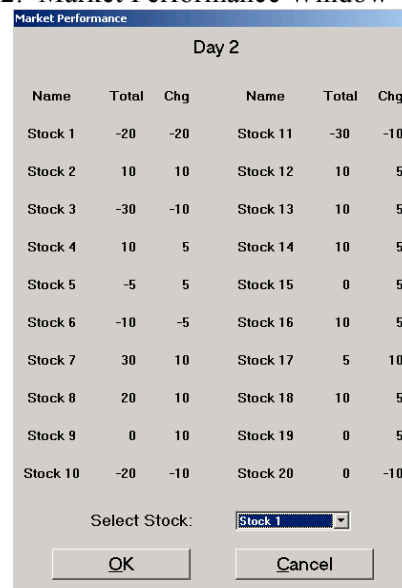
Figure 1: Experiment Window

Figure 2: Market Performance Window



After 20 periods, subjects received information concerning the type of each stock they had held during each of the 20 periods and their final balance for that trial. They then began a new trial, with the program randomly reassigning the types of all stocks. There were 8 trials in each

experimental session. At the end of the eight trials, one trial was randomly chosen to be paid off on using the conversion rate of 1ECU = .1 U. S. dollars applied to the end of trial balance.

The experiment was conducted at the Ohio State University economics laboratory. Subjects were recruited from undergraduate students enrolled in economics classes. An average session lasted about 1.5 hours. A total of 21 subjects participated in the experiment.

## 2. Characterization of Optimal Behavior and Behavioral Tendencies

### 2.1 Traditional Profit-maximizing Strategy

With unlimited time, brainpower and full information, rational subjects could calculate the conditional probabilities of any stock being type A, B or C based upon its performance. Since an A, B and C stock had an expected return of 4.5, 0 and -4.5 per period respectively; it is possible to construct the conditional expected return of any stock based upon its actual performance in the experiment. However, given the tremendous amount of time and effort it would take to perform these calculations, in our design the stock with the highest cumulative return serves as an excellent proxy for the stock with the highest expected return and will be used as such, along with the stock with the highest expected return in the few cases where the two are not the same. Observing the market and determining which cumulative return is highest (see Figure 2) should take minimal cognitive resources.

Traditional economic theory implies that in each round subjects will observe the market and choose the stock that maximizes expected profit for the remaining periods in a trial. In what follows, we treat choosing the stock with the highest expected return for the next period, or the stock with the highest total net change from the beginning of a trial (which is easily recognizable), as the profit-maximizing strategy, and will refer to it as the "optimal stock."[1]

If a subject begins a period holding an optimal stock, he will continue to hold it, or if two optimal stocks exist he may exchange one for another. If he begins a period holding a non-optimal

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stock he will exchange it for an optimal one. Table 2 shows a summary of the profit-maximizing strategy. Notice that a subject will not know which state he is in until he has observed the market. Thus he must observe the market in order to follow the profit maximizing strategy.

Table 2 – Profit-Maximizing Strategy

| state | Action |
|---|---|
| has optimal stock | observe market, hold current stock or possibly exchange for another optimal stock |
| has non-optimal stock | observe market, exchange for one of the optimal stocks |

## 2.2 The Status Quo Bias

In a variety of field and laboratory data, Samuelson and Zeckhauser (1988) observe a "status quo bias," the tendency of individuals to maintain their previous decisions regardless of the changes in their environment. While they note that a status-quo bias may be optimal if there are high calculation or transactions costs, they find evidence for it even with minimal calculation and/or transactions costs present. They attribute part of the status quo bias to loss aversion as in prospect theory (see section 2.3 below). But their main explanation for the status quo is psychological phenomena.

> "In sum, status quo bias is pervasive. It is a natural consequence of many well-known psychologically based deviations from the rational choice model. As a result the canonical choice model is unlikely to provide a reliable explanation for a substantial range of behavior, including economic behavior." (Samuelson and Zeckhauser, pg. 41)

"Psychologically based deviations" from optimal choice that Samuelson and Zeckhauser consider are regret avoidance, drive for consistency, self-perception theory, and illusion of control. All would cause individuals to feel a status-quo bias.

In *regret avoidance* individuals feel greater regret for a bad consequence if it is the result of an action rather than inaction (Kahneman and Tversky, 1982). An individual, who prefers to avoid regret, would then exhibit a preference for inaction, producing a status quo bias. The *drive for consistency* is a natural product of cognitive dissonance theory in which an individual, already believing a previously made choice is optimal, distorts information to maintain the original perception

of the choice, thereby producing a bias for the status quo. *Self-perception theory* suggests an individual infers his own preferences from his past decisions as if he were an outsider observing those decisions. Thus, he will defer to past decisions as a guide for future ones, and exhibit a bias for the status quo. (On these last two, also see Benabou and Tirole, 2002, who suggest that individuals may prefer to ignore information if that information could cause them to lose confidence or doubt their ability, both of which are valuable assets over one's life.[2]) Finally, individuals tend to maintain an *illusion of control*, a belief in personal success at greater levels than what objective data dictates. For example, in experimental studies with lotteries individuals are less likely to exchange their ticket for a ticket with a higher expected payoff if they chose their ticket than if it were given to them (Langer, 1975). The illusion of control generates a status quo bias, as an individual incorrectly believes that their initial choice has a greater probability of success than its objective probability warrants.

It is not essential that all of these psychological factors are at play at the same time to generate a status quo bias in economic decisions. They have been listed, in the same way as Samuelson and Zeckhauser, to show the relatively high number of psychological tendencies that may cause an individual to favor the status quo over an optimal alternative. These tendencies can produce a status quo bias on two levels in our experiment – (i) choosing not to even look to compare returns on the current stock a subject is holding relative to the alternative available (e.g., regret avoidance or self-perception theory) and (ii) choosing to stand pat with a suboptimal stock after having looked and comparing returns with other stocks (e.g., the drive for consistency or the illusion of control).

**2.2.1 The Ostrich Effect**

The ostrich effect, defined by Karlsson et al (2005), is the tendency of investors to observe their portfolio more often during strong performances than weak. The authors suggest agents prefer to receive positive information about their financial holdings than negative information, and do so by selectively avoiding negative information. Karlsson et al find empirical evidence to suggest the

existence of an ostrich effect on the part of investors.

Another definition of the "ostrich effect" used by Galai and Sade (2006) is the preference of investors to avoid information that reveals the level of risk of their investment. They show that Israeli investors pay a premium on an illiquid asset (bank deposits) versus a liquid asset of similar risk (government t-bills) and cannot attribute the difference to taxes, risk or transaction costs. They conclude, "…investors show preferences (even at a cost) to investments with performance that is less frequently reported… (pg. 2744)"

Table 3 – The Status Quo Bias According to the Ostrich Effect

| State | Action |
|---|---|
| holds a winner | observe market |
| holds a loser | do not observe market |

Both of these somewhat different views of the ostrich effect[3] involve a general tendency to avoid negative information. In our design subjects can avoid negative information (as well as regret) by not observing the market when the stock they are holding is performing poorly. If this is due to the ostrich effect, we should see subjects observing the market significantly more often when they hold a stock that has gained value while they are holding it (a winner) as opposed to when the stock has lost value (a loser). Table 3 codifies these tendencies.

## 2.3 The Disposition Effect

Coined by Shefrin and Statman (1985), the disposition effect involves the tendency of investors to sell investments that have gained in value and to hold onto investments that have lost value. The disposition effect is not consistent with standard utility theory, but it is consistent with prospect theory. Prospect theory suggests that economic agents do not make decisions based upon their final outcomes; instead, they choose a value as a reference point and make decisions based upon gains or losses from that value (Kahneman and Tversky, 1979). The theory also requires agents to be risk averse concerning gains, but risk seeking concerning losses. As applied to the stock market, this

theory suggests investors would sell winners quickly to realize gains, and hold onto losers, gambling that their losses will be reduced.

As Shefrin and Statman note, suppose an investor purchased a stock one month ago for $50, which is now selling for $40, and expects that in the next period the stock will either increase or decrease in price by $10 with equal probability. If we exclude transaction costs, discount rates, and tax considerations, the investor is faced with a choice of a $10 loss now or an equal chance of losing $20 or breaking even. If an investor has a S-shaped value function as in prospect theory, where the convexity in the loss domain is more severe than the concavity with respect to gains, the investor may well choose to hold onto the stock, gambling that his losses will be reduced. Under traditional theory with diminishing marginal returns to wealth the investor, if risk averse, would take the first option.

Examination of investor data supports the existence of a disposition effect. Shefrin and Statman found that investor data patterns were consistent with a combined effect of tax considerations and a disposition to sell winners and ride losers. Odean (1998) found that investors exhibit the disposition effect in all months except December. Later, Odean (1999) concluded that investors' excessive trading is caused by the disposition effect, as well as the large number of securities available to buy, the financial media, and investor reluctance to sell short. In experimental studies Weber and Camerer (1998) as well as Chui (2001) found evidence of the disposition effect.

We test for a disposition effect conditional on subjects observing the market. Table 4 shows predicted behavior with the disposition effect.

Table 4 – Predictions of the Disposition Effect

| State | Action |
|---|---|
| holds a loser | observes market, continues to hold stock |
| holds a winner | observes market, exchange for other stock |

## 3. Results

Taken over all periods and all trials subjects did not bother to observe the market in 50.4% of all cases. One possible rational explanation for this is that subjects observe the market early on,

determine that they are very likely holding an A type stock and after several periods do not bother to observe the market. The data, however, are not consistent with this hypothesis as the frequency with which subjects observe the market in the first 5 periods does not dip below 39.3% in any given period and is quite high in period 1 (see Table 5).

Table 5: Decisions to Not Observe Market by Period

| Period | Ignored Market (pct of 152) |
|---|---|
| 1 | 50.6% |
| 2 | 44.6% |
| 3 | 45.2% |
| 4 | 44.0% |
| 5 | 39.3% |
| 6 | 47.0% |
| 7 | 52.4% |
| 8 | 48.2% |
| 9 | 57.1% |
| 10 | 50.6% |
| 11 | 51.8% |
| 12 | 49.4% |
| 13 | 51.2% |
| 14 | 54.8% |
| 15 | 55.4% |
| 16 | 47.0% |
| 17 | 56.5% |
| 18 | 54.2% |
| 19 | 58.9% |

We examined the choice to observe the market in the first and last ten periods by subject, taking the average difference between the frequencies, by subject, and running paired tests over the difference. In this technique the unit of observation ($N$) is each individual subject, eliminating the significance problem of repeated measures when all subject decisions are pooled together. The results are shown in Table 6. Neither the parametric paired t-test nor the nonparametric Wilcoxon signed rank test indicates significantly different frequencies between the first and last ten periods.

Table 7 shows the choice to observe the market depending on the conditional probability of holding a type A stock. While the frequency of observing the market is affected by the conditional probability of holding a type A stock, the effect is not economically meaningful. Subjects when holding a stock that is very likely type A (likelihood > 0.9) ignore market information 4% more often

than when holding a stock that is not as likely type A (likelihood ≤ 0.9). Individual subject data confirm this tendency (p-value < 0.08). However, given the relatively small differences in frequency of observing the market, this effect does not account for most observations of subjects ignoring the market.

Table 6: Frequencies of Observing the Market in First vs. Last Ten Periods: Individual Subject Averages as the Unit of Observation

| frequency of observes market | | |
|---|---|---|
| | Period 1-10 | Period 11-20 |
| mean | 0.521 | 0.521 |
| S | 0.283 | 0.268 |
| N | 21 | 21 |
| 2-tailed paired t-test | | |
| mean difference | | 0 |
| stdev difference | | 0.227 |
| t-statistic | | 0 |
| p-value | | 1 |
| 2-tailed Wilcoxon signed rank test | | |
| positive rank sum | | 108 |
| z-statistic | | -0.261 |
| p-value | | 0.794 |

Note, however, that Table 7 shows that the probability of holding a Type A stock is usually greater than 0.25, the market average, indicating some movement towards choosing superior stocks over time. We will have more to say about that below.

Table 7 – Decisions to Not Observe Market by Probability of Holding Type A Stock

| Range of Expected Return/Period | Frequency | Does not Observe the Market | Percentage of Times Not Observe the Market |
|---|---|---|---|
| (0.9, 1) | 939 | 502 | 53.5% |
| (0.5, 0.9] | 1150 | 566 | 49.2% |
| (0.1, 0.5] | 778 | 367 | 47.2% |
| (0, 0.1) | 325 | 175 | 53.8% |
| Total | 3192 | 1610 | 50.4% |

Most subjects followed this pattern of not observing the market on a regular basis. Table 8 shows the number of times each individual subject chose not to observe the market after a period. While there are clearly individual subject deviations on observing the market, we see that nearly half the subjects (9 out of 21) chose not to observe the market a majority of the time.

Finally, the frequency of observing the market does not change materially, on average, over the course of the eight trials. Using individual subject data as the unit of observation and comparing the frequency of observing the market in the first four trials versus the last four, we find no significant differences ($|t| < 1.0$; $|z\text{-statistic}| < 1.0$). Thus, there does not seem to be a quasi-rational model that can explain the high frequency with which subjects do not observe the market.

Table 8 – Individual Subject Decisions Not to Observe the Market

| Subject | Did Not Observe | Percentage Not Observe | Subject | Did Not Observe | Percentage Not Observe |
|---|---|---|---|---|---|
| 1 | 60 | 39.5% | 12 | 121 | 79.6% |
| 2 | 138 | 90.8% | 13 | 116 | 76.3% |
| 3 | 62 | 40.8% | 14 | 111 | 73.0% |
| 4 | 62 | 40.8% | 15 | 33 | 21.7% |
| 5 | 62 | 40.8% | 16 | 6 | 3.9% |
| 6 | 15 | 9.9% | 17 | 116 | 76.3% |
| 7 | 72 | 47.4% | 18 | 58 | 38.2% |
| 8 | 69 | 45.4% | 19 | 127 | 83.6% |
| 9 | 28 | 18.4% | 20 | 121 | 79.6% |
| 10 | 82 | 53.9% | 21 | 141 | 92.8% |
| 11 | 10 | 6.6% | Total | 1610 | 50.4% |

### 3.1.1 The Ostrich Effect

Table 7 suggests that the ostrich effect is not responsible for subjects' tendency to ignore market information as subjects ignored information when holding strongly performing stocks about as often as when holding stocks that had lost value. Table 9 brings these data together in terms of conditioning on winners and losers.

Table 9 – Decisions to Not Observe Market by Net Gain of Stock since Holding It
(choices consistent with the ostrich effect are **in bold**)

| State | Action | |
|---|---|---|
| | Does not Observe the Market | Observes the Market |
| held winner 2209 times | 1189 53.8% | **1020** **46.2%** |
| held loser 820 times | **342** **41.7%** | 478 58.3% |
| held neither winner or loser 163 times | 79 48.4% | 84 51.5% |

Contrary to the ostrich effect, subjects observe stocks relatively more often when holding a losing stock (a stock that has lost value since they had acquired it) then when holding a winning stock (a stock that has gained value since it was acquired). Thus, subjects are clearly acting somewhat more rationally than the ostrich effect suggests.[4]

**3.2 Performance Relative to the Profit-Maximizing Strategy**

Tables 7 and 9 indicate that subjects are clearly capturing some of the profits to be had by following an optimal investment strategy. This section explores the basis for this outcome. First, subjects choose to observe the market more often when holding a non-optimal stock than when holding an optimal stock (51.6% of the time versus 45.4% of the time).[5] Second, as also shown in Table 10, conditional on holding an optimal stock and looking at the market, subjects overwhelmingly chose to stay with their existing stock (80.7% of the time), switching to a non-optimal stock 1.9% of the time, and switching to another optimal stock 7.9% of the time. Thus, if anything, the status quo bias helps to achieve an optimal outcome in this case. Third, conditional on observing the market and holding a non-optimal stock, subjects switch to an optimal stock 19.8% of the time and continued to hold their non-optimal stock 37.6% of the time.

Table 10 – Observations Testing Traditional Theory
(choices consistent with profit-maximizing strategy is in **bold**)

| State | Action | | | |
|---|---|---|---|---|
| | Observes Market | **Conditional on Observing Market** | | |
| | | Continues with existing stock | Exchanges for non-optimal stock | Exchanges for an optimal stock |
| had optimal stock 1040 observations | 472 45.4% | **381** **80.7%** | 9 1.9% | **82** **7.9%** |
| had non-optimal stock 2152 observations | 1110 51.6% | 417 37.6% | 473 42.6% | **220** **19.8%** |

When not switching to an optimal stock (42.8% of the time), subjects switched to a stock with higher cumulative return a little over half the time (52.6% of the time), but also switched to a stock with a lower cumulative return 40.9% of the time. This relatively high frequency of sticking with a non-optimal stock, or switching to an even poorer performing stock, after observing the market is

surprising since it should be reasonably obvious that there were other, better performing stocks out there. These choices are however consistent with the "gamblers fallacy" that such stocks are "due" for better outcomes. Under any circumstances, such choices do not help investors' bottom line.

Overall these deviations from the profit-maximizing strategy – failure to observe the market and failure to move to an optimal stock conditional on observing the market - cost subjects $3.82 per session versus a maximum gain of $8.19 (see Table 11).[6] This represents 46.6% of the maximum possible gain lost as a result of not following the optimal investment strategy. Earnings are however significantly greater than random decisions making ($p < 0.01$), but also significantly less than if choosing optimally ($p < 0.01$). Although the absolute loss here is relatively small, the additional time it would have taken subjects to look at the market on a regular basis and to choose the optimal stock was quite small as well. [7]

Table 11–Average subject earnings compared to optimal

|  | Numerical Amt | In US $ |
|---|---|---|
| Starting Balance | 180.00 | $18.00 |
| Average Actual Gain | 43.72 | $4.37 |
| Average Total Gain | 223.72 | $22.37 |
| Average Forgone Gain from not Choosing an Optimal Stock | 38.23 | $3.82 |
| Total | 261.95 | $26.20 |

## 3.3 The Disposition Effect

When subjects do look at the market, the disposition effect cannot account for their failure to choose the optimal stock. Table 12 shows all decisions made conditional on observing the market. The disposition effect predicts that subjects are more likely to get rid of winning than losing stocks after looking at the market. However, Table 12 shows subjects are more likely to do the reverse, selling losers and holding winners (p<0.005 for individual subject tests).

While we fail to find a disposition effect, the structure of our experiment is different from those investment situations where a disposition effect has been reported, which creates a very

different framing of the problem for our investors. In our experiment disposing of one stock for another does not generate a realized capital gain or a realized loss of capital since stocks are exchanged one-for-one. Thus, the decision to dispose of a winner or hold on to a loser does not trigger the same gain/loss framework believed to underlie the disposition effect. Rather, the exchange impacts the future flow of gains and losses. We believe it is this difference in framing that is responsible for the absence of a disposition effect here compared to those studies where it is reported.

Table 12 – Trades after market is observed (1582 observations)[8]
(choices consistent with the disposition effect are in **bold**)

| State | Action | |
|---|---|---|
| | continues | exchanges |
| held winner 1020 times | 647 63.4% | **373** **36.6%** |
| held loser 478 times | **114** **24.2%** | 364 76.2% |
| held neither winner or loser 84 times | 37 44.0% | 47 55.9% |

### 4. Summary and Conclusions

Subjects exhibited a robust status quo bias throughout this experiment that is not consistent with standard economic theory. In a majority of decisions subjects chose to ignore information that could have potentially led to higher earnings. This status quo bias is reasonably robust across individuals, over time and independent of the stocks performance. It is present in an environment in which there are very low costs of identifying better performing stocks. This behavior is not consistent with the ostrich effect as subjects tend to compare their own stock's results to other stocks when their stock is earning a below average rate of return as opposed to an above average rate of return. The behavioral bias most likely underlying this status quo bias is individuals' reluctance to receive information that might question their own abilities – hence they choose to limit comparing the returns on their existing choices to the other options that were at their disposal. Evidence of ignoring the performance of other stocks has also been found in empirical work. When explaining the persistence

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of his result that stocks investors sell outperform their future portfolio, Odean (1999) notes that investors likely do not observe the performance of stocks they have sold nor compare that performance to their current portfolio. Thus, they do not learn to correct this trend. Although Odean does not attribute investors' reluctance to observe past stocks to a specific behavioral tendency, it could be explained by regret avoidance or a general tendency to ignore possibly negative information. In our experiment it would be enough to cause subjects to avoid observing the market, since they would learn the performance of their previously held stock.

The data provide little evidence for a disposition effect conditional on observing the market. After observing the market, subjects were more likely to hold onto winners and exchange losers than vice versa. They also had a greater tendency to hold onto winners than losers in general. This experiment allows subjects to exchange one stock at a time for another regardless of the performance of any stock, a feature not found in actual asset markets. This do-over apparently fails to trigger the gain/loss framing of selling winners and holding onto losers that underlies those settings in which a disposition effect has been identified, and which is believed to underlie the disposition effect.

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[1] In 121 (of 3192) decisions a subject held a stock with the highest expected return that did not have the highest cumulative return. By including both cases, if anything, we bias the outcomes in favor of the maximizing hypothesis.

[2] Bodner and Prelec (2002) have a model dedicated to this type of self-signaling. The model underlies the Karlsson et al. (2005) and Galai and Sade (2006) theory of the ostrich effect, discussed later in this paper.

[3] To distinguish our ostrich effect from Karlsson et al.: in their scenario an agent knows the market performance but has a choice whether to observe his own investments. In our experiment the agent knows his portfolio's value but can choose to observe (or avoid) the market, learning his portfolio's relative performance. We believe both decisions can be affected by an agent's desire to note or ignore information.

[4] Both tests in our subject-by-subject analysis of observing the market reject the notion of subjects observing the market equally often for a winner and loser at the 0.001 level.

[5] $P < 0.5$ using individual subject data.

[6] This is calculated on a per trial basis, so this represents forgone earnings from participating in the session.

[7] We estimate it would have taken subjects about 5-10 seconds to observe the market and select the stock with the highest net change. Given the average number of times subjects failed to look at the market this would take an extra 6-12 minutes in total, with a very high potential hourly rate of return, only a little less than the hourly rate of return that they got from looking and choosing better stocks.

[8] If we consider all observations, including the times subjects chose to ignore market information, subjects held winners and continued to hold them 83.1% (1836/2209) of the time, they held losers and continued to hold them 55.6% (456/820) of the time, and continued 71.1% (116/163) when holding neither a winner nor loser. Thus, by these measures behavior is even more at odds with a disposition effect.

# Appendix 1:  Experimental Instructions

[This appendix is not intended for publication; it is for the use of referees and will be posted on a

web-based version of the paper.]

## Experimental Instructions

This experiment simulates a simplified stock market.  It will consist of eight trials.  In each trial you will trade stocks for twenty "days."  To begin, you will select one stock to hold.  During each day this stock's value will vary randomly.  At the end of the day, you will decide whether to hold this stock or exchange it for another.

Each stock will be either a type A, B, or C stock.  You will not be told the type of stock you are holding until the end of each trial.  An A stock will increase its value on average, a B stock has no change in value on average, and a C stock will lose value on average.  The chance that a randomly selected stock will be a type A stock is 25%. The chance it will be B is 50%. The chance that it will be C is 25%.  This information can be useful when you decide whether to exchange your stock.

The value of the stocks will vary randomly from day to day.  For a given day these are the probabilities of A, B, or C changing their value by a given amount:

| Stock | Stock value distribution per day | | | | | | |
|-------|------|------|------|-----------|------|-------|-------|
|       | -20  | -10  | -5   | No change | +5   | +10   | +20   |
| A     | 0.025 | 0.075 | 0.1  | 0.2       | 0.25 | 0.2   | 0.15  |
| B     | 0.075 | 0.125 | 0.2  | 0.2       | 0.2  | 0.125 | 0.075 |
| C     | 0.15  | 0.2   | 0.25 | 0.2       | 0.1  | 0.075 | 0.025 |

Thus a type A stock will increase by 20 in value on a single day 15% of the time, while a type C stock will only go up that amount 2.5% of the time.

You can exchange your stock at the end of any day except the last day of a trial.  There is no cost for exchanging your stock and you will be able to select from each of the same twenty stocks as before.  You can only hold one stock at a time.

In addition, when you exchange your stock you will receive information about the cumulative performance of all twenty stocks.  After observing this information you can still decide to keep your current stock if you choose.  Your decision to observe this information is entirely optional and will not influence the performance of any stocks.

After the twenty days a trial will be completed, and the final value for your earnings for that trial will be recorded.  After eight trials have been completed, one of your trial's totals will be randomly selected and you will be paid based on that total.  Your dollar earnings will be equal to that trial's earnings divided by 10.

**A typical experiment:**

This section presents a step-by-step guide through a typical trial. Refer to Figures 1-5 for a diagram of the experimental computer interface window.

1.      At the beginning of the experiment you will select one of twenty stocks (Figure 1). Any given stock will be an A, B, or C type stock with probabilities as specified above.

Figure 1: A diagram of the stock menu.
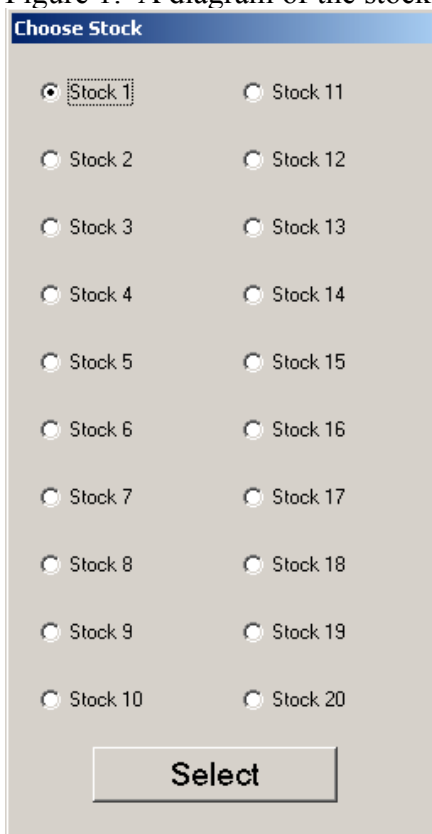
2.      After you select a stock (in this case stock "X") you will observe its performance for the first day (Figure 2).  There will be a twenty second delay between days.  At the end of day 1 you may "continue" to hold your stock or observe the "market."  If you keep your original stock, it will continue to vary randomly.  If you observe the "market" you can choose another stock, or decide to keep your original stock.

Figure 2:  Interface window after one day.

**Economics Experiment**

Trial:    1

## Cumulative Performance:

| Stock No. | Initial Balance | Current Balance | G/L |
|---|---|---|---|
| X | 180 | 190 | 10 |

Past Cumulative Performance:

| Stock No. | Initial Balance | Closing Balance | G/L |
|---|---|---|---|

| Day | Stock | Open | Change | Close |
|---|---|---|---|---|
| 1 | X | 0 | 10 | 10 |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |
| 16 | | | | |
| 17 | | | | |
| 18 | | | | |
| 19 | | | | |
| 20 | | | | |

Continue      Market
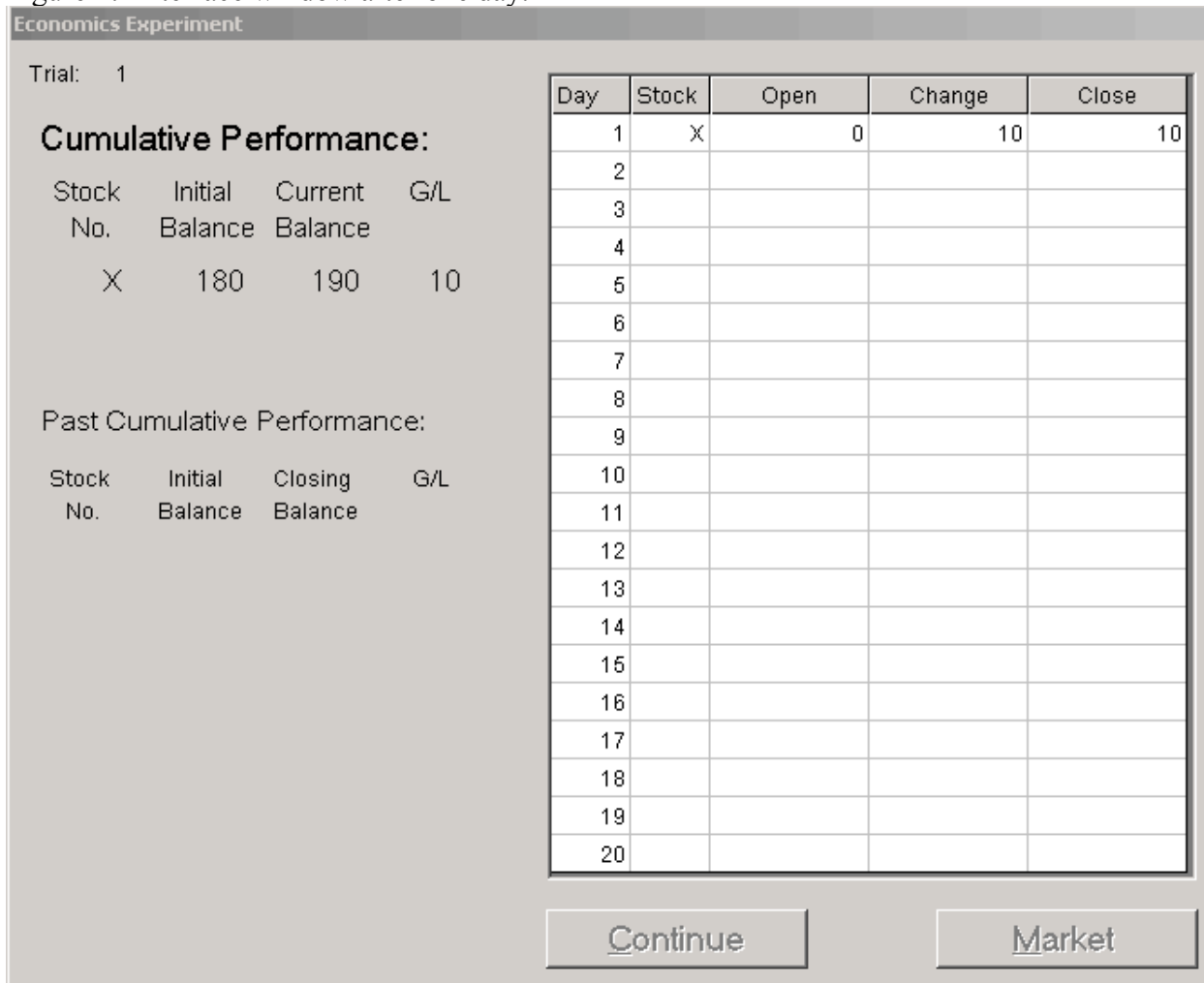
3.    In this example the investor chooses to hold stock X.

Figure 3:  Interface window after the choice, "continue."

**Economics Experiment**

Trial:    1

### Cumulative Performance:

| Stock No. | Initial Balance | Current Balance | G/L |
|---|---|---|---|
| X | 180 | 170 | -10 |

Past Cumulative Performance:

| Stock No. | Initial Balance | Closing Balance | G/L |
|---|---|---|---|

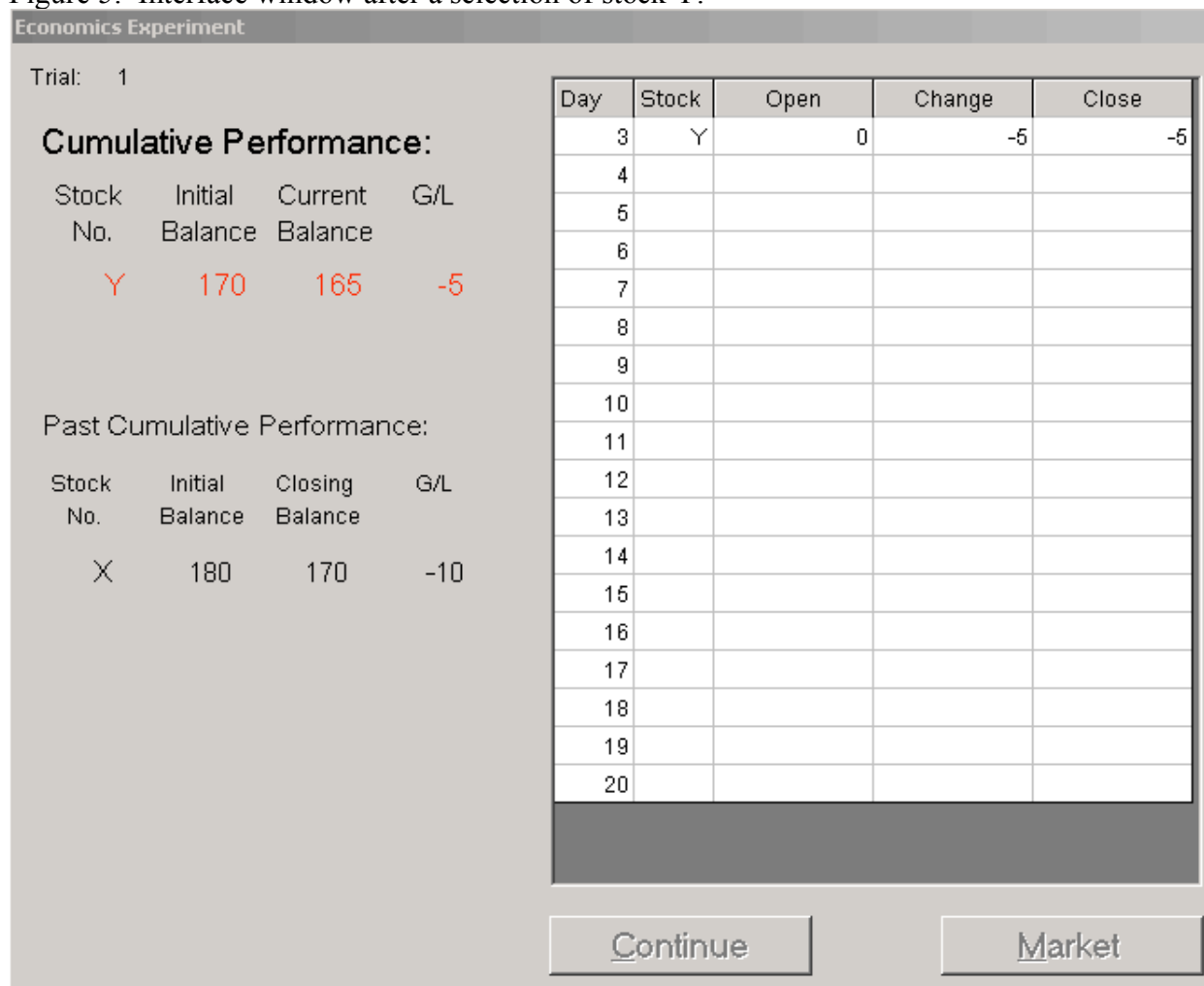| Day | Stock | Open | Change | Close |
|---|---|---|---|---|
| 1 | X | 0 | 10 | 10 |
| 2 | X | 10 | -20 | -10 |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |
| 16 | | | | |
| 17 | | | | |
| 18 | | | | |
| 19 | | | | |
| 20 | | | | |

Continue        Market

4

4.       In this example, after day 2, the investor chooses to examine the market of all stocks.  Figure 4 shows the market interface window.  The "total" column gives the total changes since the beginning of the experiment for each stock.  The "chg" column describes the daily change for each stock, in this case day 2.  The investor may select a new stock or "cancel" and return to the previous window.  Using the "select stock" box, the investor chooses stock Y.  Figure 5 shows the result of this choice.

Figure 4:  The "market" window.

**Market Performance**

## Day 2

| Name | Total | Chg | Name | Total | Chg |
|------|-------|-----|------|-------|-----|
| Stock 1 | -20 | -20 | Stock 11 | -30 | -10 |
| Stock 2 | 10 | 10 | Stock 12 | 10 | 5 |
| Stock 3 | -30 | -10 | Stock 13 | 10 | 5 |
| Stock 4 | 10 | 5 | Stock 14 | 10 | 5 |
| Stock 5 | -5 | 5 | Stock 15 | 0 | 5 |
| Stock 6 | -10 | -5 | Stock 16 | 10 | 5 |
| Stock 7 | 30 | 10 | Stock 17 | 5 | 10 |
| Stock 8 | 20 | 10 | Stock 18 | 10 | 5 |
| Stock 9 | 0 | 10 | Stock 19 | 0 | 5 |
| Stock 10 | -20 | -10 | Stock 20 | 0 | -10 |

Select Stock:      Stock 1 ▾

| OK | Cancel |
|----|--------|

Figure 5: Interface window after a selection of stock Y.



Economics Experiment

Trial: 1

**Cumulative Performance:**

| Stock No. | Initial Balance | Current Balance | G/L |
|-----------|-----------------|-----------------|-----|
| Y | 170 | 165 | -5 |

Past Cumulative Performance:

| Stock No. | Initial Balance | Closing Balance | G/L |
|-----------|-----------------|-----------------|-----|
| X | 180 | 170 | -10 |

| Day | Stock | Open | Change | Close |
|-----|-------|------|--------|-------|
| 3 | Y | 0 | -5 | -5 |
| 4 | | | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |
| 16 | | | | |
| 17 | | | | |
| 18 | | | | |
| 19 | | | | |
| 20 | | | | |

Continue       Market

5.  Outcomes for stock Y have been placed in the current performance section of the trading history.  In this example, stock Y lost 5 over day 3.  Notice that the initial balance of stock Y is equal to the "closing balance" of stock X.  All holdings in stock X have been transferred to stock Y.  The performance of stock X is in the past cumulative performance section of the window.

6.  Each trial will continue until twenty days have elapsed.  At that time the current balance in your cumulative performance window will be your final total.

7.  At the beginning of a new trial everything will appear as it did at the beginning of the last trial, except the trial number in the upper left corner will have increased by 1.  Remember that for each trial the types of the twenty stocks are randomly chosen again.  Thus, a stock that performed well (poorly) in the last trial may or may not perform well (poorly) in the next trial.

8.  After eight trials have elapsed the experiment is finished.  A trial will be randomly selected and you will be paid based on the current balance in your cumulative performance window for that trial.