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What Explains the Short-Term Stock Selections of Amateur Investors? An Experiment

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Abstract

This paper investigates how basic financial data available online affects the behavior of investors with little or no knowledge of finance. It presents the results of an experimental study in which undergraduate students were asked to invest in various stocks based on basic financial data available on the Yahoo Finance website at http://finance.yahoo.com. We found that subjects, as a group: (1) invest more in stocks with extremely high or extremely low short-term realized returns, (2) follow a momentum strategy based on short-term realized returns, and (3) follow a contrarian strategy based on long-term realized returns. We also found that (i) some subjects simultaneously use momentum and contrarian strategies, (ii) the investment strategies of individual investors tend not to change over time, and (iii) short-term momentum investors are more likely to follow a long-term contrarian strategy than investors who do not base their investment decisions on short-term realized stock returns.

JEL categories: G11
Keywords: individual investment decision; momentum trading; contrarian investment; experimental finance

1. Introduction

A cheap and easily accessible on-line trading gives ordinary people not only the ability to manage their own investment portfolios but also an opportunity to "beat the market" and to try making money by frequently trading stocks. People who try to beat the market do not necessarily have an exceptional ability to collect and analyze financial data. In fact, most of these people may have no finance background at all and the financial data they use may be limited to a basic summary statistic provided by their online brokers or available on investment-related websites such as Yahoo Finance. In a sense, their behavior may be similar to the behavior of a gambler who tries to come up with a strategy for playing roulette. This paper is aimed to analyze how such "unsophisticated" (i.e., inexperienced) investors make their investment decision and to describe the strategies that they use. Although the capital that "unsophisticated" investors bring to the market is only a small fraction of the total market capitalization and is not sufficient to have a significant effect on stock prices, it may still represent a disproportionately large portion of their own wealth. The latter makes it important to understand how these people behave and which market conditions may trigger an excessive investment that may lead to the future deterioration of their personal well-being.

Existing studies that analyze the behavior of small individual investors concentrate primarily on its dependence on the historical stock performance and classify investors as either *momentum* (also known as trend chasers or positive-feedback traders) or *contrarian* (or negative-feedback traders) investors. The investors' desire to buy past winners may be due to the documented positive short-term autocorrelation of stock returns (Conrad and Kaul 1989). For example, Jegadeesh and Titman (1993, 2001) show that a strategy of buying stocks with high realized returns over the preceding six-month period and selling stocks with low past returns results in an abnormal positive return[1]. Trend-chasing behavior can also be explained by adaptive expectations that inexperienced investors may have and by their desire to extrapolate recent price movements, as documented by the experimental studies of Smith, Suchanek, and Williams (1988) and Haruvy, Lahav, and Noussair (2007). The use of a contrarian strategy, on the other hand, can be explained by the documented stock price mean reversion and the negative autocorrelation of returns (De Bondt and Thaler, 1985, 1987; Fama and French, 1988; Poterba and Summers, 1988).

The use of momentum and contrarian strategies by different types of investors is documented by numerous empirical studies. Bange (2000) shows that portfolio holdings of small individual investors reflect momentum trading. Choi, Laibson, Madrian, and Metrick (2007) found trend-chasing behavior among passive S&P 500 mutual fund investors. Nofsinger and Sias (1999) found that institutional investors use a momentum trading strategy as well. Goetzmann and Massa (2002) found that about 12% of S&P 500 mutual fund investors are trend chasers while about 25% of investors follow contrarian investment strategies. In addition, they found that more active investors are usually contrarian while less active investors tend to be trend chasers. Grinblatt (2001) found that domestic investors in the Finnish market follow a contrarian strategy while foreign investors tend to be trend chasers.

Some researchers argue that buying decisions can be influenced by different factors from decisions to sell stocks that investors already own. Shefrin and Statman (1985) apply the ideas of prospect theory (Kahneman and Tversky 1979, 1982) and mental accounting (Thaler 1980, 1985) to study how past stock performance affects an investor decision to sell a stock the investor already owns. They argue that investors are reluctant to realize their losses, and, therefore, are

[1] Hong, Lim, and Stein (2000) found that the profitability of this strategy is lower for large firms.

more likely to sell a stock at a gain than at a loss. This hypothesis, known as disposition effect, was confirmed by Odean (1998), who found that investors tend to sell their winning stocks but do not want to realize their losses. Barber and Odean (1999), Weber and Camerer (1998), and Grinblatt and Keloharju (2001) provide additional evidence of the disposition effect. Ranguelova (2001) found that the disposition effect is relevant to trades involving large cap stocks only. Oehler, Heilmann, Laeger, and Oberlander (2003) study both the buying and the selling decisions of individual investors. They found that, while investors tend to hold on to their losses, they behave as trend chasers when they choose a new stock to buy. Dodonova and Khoroshilov (2007) conducted an experimental study of investor buying and selling behavior. Consistent with Oehler, Heilmann, Laeger, and Oberlander (2003), they found that investors tend to buy stocks with high past returns while they tend to hold on to stocks with low or negative past returns.

While selling decisions involve a choice among a limited number of stocks that investors already own, buying decisions can potentially involve a choice among all existing stocks. Odean (1999) argues that, when investors make their buying decisions, they are more likely to limit their decisions to stocks that have caught their attention recently, e.g., to stocks with some unusual features, such as extremely high or extremely low realized returns. He found that investors buy stocks that have a higher absolute price change over the preceding two years than the stocks they sell. This hypothesis, known as attention-driven investment, was also confirmed by Seasholes and Wu (2004), who show that individual investors on the Shanghai Stock Exchange are net buyers the day after a stock hits an upper price limit, and by Hirshleifer, Myers, Myers, and Teoh (2008), who documented that individual investors are net buyers following both positive and negative earnings surprises. Lee (1992) documents the same phenomenon for small individual traders.

The goal of this paper is to analyze which factors affect the buying decisions of short-term individual investors with little or no investment experience. In particular, this paper presents the results of an experimental study in which subjects (recruited from a pool of undergraduate students in various fields of specialization) were asked to buy stocks from a list of several comparable companies. Along with the list of stocks, subjects were provided with the basic financial information from the Yahoo Finance website. As a result, the subjects were able to base their investments strategies both on basic "fundamental" characteristics of the stock (such us dividend yield, price to earnings ratio, and stock price volatility) as well as on realized past stock return (both short- and long-term).

While most of the existing experimental studies of investors' behavior provide investors with historical returns over a single period of time, our subjects were able to use both short-term and long-term realized stock returns simultaneously. This allowed us to investigate how they react to the difference in stock performance over two different time horizons and to show that the same group of investors can follow both contrarian and trend-chasing strategies at the same time. In addition, we found that "short-term momentum" investors are more likely to follow contrarian strategies based on the long-term realized stock performance than investors who do not base their investment decisions on short-term realized stock returns. By analyzing individual investment decisions in two rounds of the experiment, we found that a significant number of subjects do not change their momentum and contrarian strategies over time. We also found that "fundamental" parameters, such as risk, P/E ratio, and dividend yield, have no significant effect on subjects' investment decisions, both at the group and at the individual levels.

The rest of the paper is organized as follows. In part 2, we describe the design of the experiment. In part 3, we analyze the data and report our findings. In part 4, we present our conclusions.

2. Methods

In total, 85 undergraduate students from the same Canadian university were recruited as subjects. The student were solicited to participate by recruitment announcement posted on campus (Appendix A), followed by e-mail invitation that outlines basic rules of the experiment (Appendix B). The study consisted of 2 rounds. In both rounds, we provided subjects with a list of stocks and basic financial information about these stocks. We then asked them to invest "play money" in one or several of these stocks. At the end of the experiment, subjects were compensated based on the value of their investment portfolios.

Out of 85 subjects 30 were undergraduate students at the School of Management (with various fields of specializations), 4 were from the Economics Department and 51 were from other departments. Since some business and economics students might have taken investment courses prior to the experiment, they may be more "sophisticated" than students from other departments. However, when we exclude these students from the subject pool, the results do not change[2].

In the first round, subjects were asked to invest in one or several (up to ten) stocks from a list of thirty stocks included in the Dow Jones Industrial Average (DJIA) index. Subjects were asked to invest one thousand experimental dollars (ED) based on the information provided to them[3]. They were given instructions by e-mail on Saturday morning and were asked to return their investment decisions by e-mail by the end of the next day (Sunday). They were told that their portfolios would be sold for cash in a two-week period.

In the second round, conducted four weeks after the first round, the same subjects were asked to invest another one thousand ED in one or several (up to ten) stocks from a list of thirty-four companies that belong to "Money Center Banks" or "Foreign Money Center Banks" industries according to the Yahoo Finance classification and that have a market capitalization of at least one billion dollars. The subjects were provided with the same type of information and instructions as in the first round.

In this study, we want to analyze how the most easily observable basic financial data affect the investment decisions of ordinary people. An example of such data may be a summary statistic provided by the Yahoo Finance website. This statistic consists of the current price, daily price change, previous day open and close prices, day's range, 52-week range, volume, average (3-month) volume, market capitalization, price to earnings (P/E) ratio, earnings per share (EPS), and dividend yield. In addition, a small chart of historical stock prices (for time windows between 1 day and 5 years) is given next to the summary statistic.

To make it easier for our subjects to understand and analyze this data and to prevent them from being overwhelmed by a large amount of information, we decided to provide them with only some of the information indicated above. In particular, we provided our subjects with information on the current stock price, realized return over the preceding 2-week period,

[2] We did not conduct any formal study to check whether all subjects were, indeed, inexperienced investors. However, given that our subject pool consisted of Undergraduate students, we believe that the assumption that most of them had little to know investment experience is plausible.

[3] If the total investment submitted by the subject does not sum up to 1000 ED, we have adjusted his/her investment proportionally.

dividend yield, price to earnings (P/E) ratio, and historical 52-week low and 52-week high stock prices. We included information on the realized stock returns over the preceding 2-week period because the Yahoo Finance website provides a chart and a list of historical stock prices, and we used a 2-week period for the realized stock returns because we asked our subjects to make their investment decision for the next 2-week period. At the same time, we decided not to include daily data (daily price change, previous day open and close price, and day's range). We decided to exclude trade volume and market capitalization because subjects were given a list of comparable stocks (which belong to the DJIA index or large banks). We excluded EPS but decided to keep the P/E ratio because both of these parameters provide information about the company's earnings but P/E is easier to understand and interpret for people without a finance background.

To encourage subjects to put effort into their investment decisions, their compensation was set as a function of the value of their investment portfolios. In particular, at the end of the experiment, the subjects were paid according to the following compensation rule (all subjects were informed about this compensation rule at the beginning of the experiment):

Each subject received \$5 for participating. In addition, the price pool of PP=\$15×N (where N=85 is the total pool of subjects) was divided among all subjects. The value of each subject's investment portfolio was transferred into "payment units" (PU) according to the following formula:

$$PU_i = VP_i - \min_j (VP_j), \tag{1}$$

where VP_i is the value of the portfolio of subject i in experimental dollars at the end of the experiment, and $\min_j (VP_j)$ is the minimum value of the portfolios of all subjects. Then, the final monetary compensation for each subject was set to

$$C_i = \$\left(5 + PU_i \times \frac{PP}{\sum_{j=1}^{N} PU_j}\right). \tag{2}$$

This compensation rule has two important features. The first is the existence of the minimum compensation that reduces subjects' downside risk and, thus, makes them less risk averse. The second is the dependence of the final payoff C_i on the relative portfolio performance PU_i instead of the absolute performance VP_i. The existence of the minimum compensation, or, at least, non-negative compensation, is a common practice in experimental research with human subjects, and it cannot be avoided[4]. However, given the compensation rule (1)–(2), only one out of eighty-five subjects receives the minimum compensation. The compensation of all other subjects is approximately linearly dependent on their portfolio performance[5]. Therefore, the effect of the

[4] The minimum compensation was required by the Research Ethic Board.

[5] The linear dependence for subject #i is approximate because $\sum_{j=1}^{N} PU_j$ in equation (2) depends on VP_i. However, given 85 participants, the effect of VP_i on $\sum_{j=1}^{N} PU_j$ is small.

minimum compensation on subjects' risk aversion should be relatively small. The desire to reduce the possible effect of the minimum compensation was the main reason for using the relative portfolio performance (PU_i) in the compensation formula. An alternative compensation rule that uses the absolute portfolio performance would have increased the role that the minimum compensation plays.

3. Results

3.1. Group investment

For each round, we analyzed the relationship between the investment decisions of the subjects and the following factors: the fundamental characteristics of the stock (risk, P/E ratio, and dividend yield), the historical short-term (2-week) realized returns, and the overall performance of the stock over the preceding year (measured by the current and 52-week low and 52-week high stock prices). In particular, based on the 52-week low and high stock prices, we constructed 2 variables that we included in our regression model. The first variable is the "coefficient of range," defined similarly to the coefficient of variation, i.e., as a 52-week price range (52-week maximum minus 52-week minimum prices) divided by the average between the 52-week maximum and 52-week minimum stock prices. This parameter can be used as a proxy for the historical volatility (or "risk") of the stock returns. The second variable is the current price percentile, defined as the difference between the current stock price and the 52-week minimum stock price divided by the 52-week price range. This parameter can be used as a proxy for the stock performance over the preceding year.

To determine factors that affected the total investment of the entire group in the first round, we estimated the following OLS regression model:

$$Inv = \beta_0 + \beta_1 \times STret + \beta_2 \times AbsSTret + \beta_3 \times LTperf + \beta_4 \times Risk + \\ + \beta_5 \times DivY + \beta_6 \times PE + \varepsilon \quad (3a)$$

where *Inv* is the total investment in a given stock (in dollars); *STret* is the short-term (i.e., 2-week) realized return (in decimal points); *AbsSTret* is the absolute value of *STret*; *LTperf* is a proxy for long-term (i.e., 52-week) stock performance, defined as the percentage of the 52-week price range that the current price of stock lies above the 52-week minimum price (i.e., as the "current stock price minus 52-week low" divided by the "52-week high minus 52-week low"); *Risk* is the relative volatility of the stock return defined earlier as the "coefficient of range" (i.e., as the "52-week high minus 52-week low," divided by the average between the 52-week high and 52-week low); *DivY* is the dividend yield; and *PE* is the P/E ratio. The first 3 explanatory variables in equation (3a) are included to measure how the past stock price movements affect the investor decisions. In particular, the coefficients for *STret* and *LTperf* measure investor reaction to short-term and long-term stock performance while the coefficient for *AbsSTret* measures "attention-driven" investment, as in Odean (1999). The second 3 variables represent some "fundamental" qualities of the stock.

In the second round, we modified regression equation (3a) by including a dummy variable *CanBank* for well-recognized Canadian retail banks such as Bank of Montreal, Bank of Nova Scotia, Canadian Imperial Bank of Commerce, Royal Bank of Canada, and Toronto-Dominion Bank. This dummy variable was introduced to capture the home bias effect that may exist among

subjects since all subjects were students at the same Canadian university[6]. Thus, for the second round, we estimated the following regression model:

$$Inv = \beta_0 + \beta_1 \times STret + \beta_2 \times AbsSTret + \beta_3 \times LTperf + \beta_4 \times Risk + \\ + \beta_5 \times DivY + \beta_6 \times PE + \beta_7 \times CanBank + \varepsilon \quad (3b)$$

Table 1 presents the basic descriptive statistics of the total investment allocation (in $s per stock) in Rounds 1 and 2. In the first round at least 3 people have invested in any given stock while in the second round there were 2 companies in which only 1 or 2 people have invested and one company with no investment at all. On average, people have invested in 4.1 stocks in round 1 (median = 4) and in 3.5 stocks in round 2 (median = 3).

Table 1: Total Investment - Descriptive Statistics

	Mean	**St. dev.**	**Min**	**1-st quartile**	**median**	**3-rd quartile**	**max**
Round 1	2833	2870	326	1057	2073	3237	14593
Round 2	2500	2693	0	918	1530	3660	13282

Table 2: Total Investment - Regression Analysis

	Const.	**STret**	**Abs STret**	**LTperf**	**Risk**	**DivY**	**PE**	**Can Bank**	**R^2**	**R^2-adj**
Round 1	7099 (0.007)	35761 (0.008)	61479 (0.008)	-9008 (0.001)	4639 (0.420)	-2133 (0.951)	-32.81 (0.692)		70%	62%
Round 2	3358 (0.006)	181454 (0.000)	165162 (0.000)	-3329 (0.007)	2208 (0.123)	11317 (0.550)	1.873 (0.673)	3395 (0.000)	88%	85%

Table 2 presents the estimation results for regression models (3a) and (3b) with the significance levels presented in brackets. It shows that, in both rounds, the coefficients for *STret* and *AbsSTret* are positive and statistically significant (at the 1% significance level) while the coefficients for *LTperf* are negative and statistically significant (at the 1% significance level). At the same time, none of the three "fundamental" stock characteristics (risk, dividend yield, and P/E ratio) was related to the total investment in either round. The following result summarizes the above findings:

Result 1: As a group, subjects:

- Follow a momentum strategy based on short-term realized stock returns (i.e., subjects, as a group, invested more in stocks that had increased in value in the preceding 2-week period).

[6] Indeed, the combined investment in these 5 Canadian banks constituted 40% of the total investment.

- Follow a contrarian strategy based on long-term realized stock performance (i.e., subjects, as a group, invested more in stocks with a current price close to the 52-week low).
- Are attention-driven investors, who invest more in stocks with extremely high or extremely low short-term realized returns.

3.2. Individual investment: basic analysis

Result 1 describes the behavior of the entire group. It may be possible, however, that some investors behave in a different fashion from the rest of the group. For example, a small fraction of investors may prefer to invest in stocks with a high dividend yield, but their investment may not be large enough to result in a positive significant coefficient in front of *DivY*. Alternatively, there may be two large groups of investors who behave in opposite ways. For example, if half of the subjects invest in stocks with a high P/E ratio while the other half invest in stocks with a low P/E ratio, their investments will cancel out when the aggregate investment is computed. As a result, the regression analysis presented in part 3.1 would not be able to identify this effect.

To analyze the behavior of individual investors, we apply regression models (3a) and (3b) to the behavior of each investor[7]. For each explanatory variable in models (3a) and (3b), we want to answer the question "does it affect the decision of at least one investor?" More specifically, we want to answer two questions: (1) "does it positively affect the decision to buy for at least one investor" and (2) "does it negatively affect the decision to buy for at least one investor?"

Table 3: Individual Investment

Explanatory variable	**Effect** (the corresponding estimated β_i is positive or negative and statistically significant at the 5% level)	**Round 1**	**Round 2**
STRet	**Statistically significant and positive**	**30.59% (0.000)**	**34.12% (0.000)**
	Statistically significant and negative	**7.06% (0.020)**	5.88% (0.178)
AbsSTret	**Statistically significant and positive**	5.88% (0.178)	32.94% (0.000)
	Statistically significant and negative	0.00% (0.136)	3.53% (0.727)
LTperf	**Statistically significant and positive**	1.18% (0.534)	0.00% (0.136)
	Statistically significant and negative	**25.88% (0.000)**	**14.12% (0.000)**
Risk	**Statistically significant and positive**	2.35% (1.000)	10.59% (0.000)
	Statistically significant and negative	1.18%	0.00%

[7] Note that the sample size for any "individual" regression is the same as for the group regression (namely, 30 for Round 1 and 34 for Round 2) because all stocks that the subject decides not to invest into were included into the regression with investment level of zero.

		(0.534)	(0.136)
DivY	**Statistically significant and positive**	3.53% (0.727)	4.71% (0.280)
	Statistically significant and negative	1.18% (0.534)	0.00% (0.136)
PE	**Statistically significant and positive**	5.88% (0.178)	**7.06%** **(0.020)**
	Statistically significant and negative	3.53% (0.727)	0.00% (0.136)

To answer the former question, for each β_i, we test the null hypothesis H0: "β_i=0 for all subjects" against the alternative H1: "β_i>0 for at least one subject." To test this hypothesis, we estimated regression models (3a) and (3b) for each subject. Assuming that H0 is correct, for any subject, the result of the OLS estimation may show a positive and statistically significant (at the 5% significance level) β_i with a probability of 2.5%. Therefore, if H0 is correct, the distribution of subjects with a significant estimated β_i follows a binomial distribution with N=85 and p=0.025. If H1 is correct, the proportion of subjects with a significant estimated β_i is more than 2.5%. Hence, to test H0, we use a 1-sided proportion test for the proportion of subjects with a positive and statistically significant (at the 5% significance level) estimated β_i.. To answer the latter question, for each individual β_i we use the same approach to test the null hypothesis H0: "β_i=0 for all subjects" against the alternative H1: "β_i<0 for at least one subject."

Table 3 presents the results of these tests. Namely, for each explanatory variable, it presents the proportion of subjects with a statistically significant (at the 5% significance level) positive or negative estimated coefficient β_i. For example, it shows that 30.59% of subjects have a positive and statistically significant (at the 5% significance level) estimated β_1 in regression (3a). The numbers in parenthesis under each proportion show the p-value for the appropriate proportion test (as described above). A p-value below 5% means that there is at least one subject whose investment decision is positively or negatively dependent on the corresponding parameter (for "positive" or "negative" effects, respectively).

The results presented in Table 3 confirm the findings for the "group behavior" reported in section 3.1. Namely, they confirm that some investors follow a momentum strategy based on the short-term realized stock returns while some investors follow a contrarian strategy based on the long-term realized stock performance. It does not provide any evidence of the existence of investors with investment strategies that are opposite to the ones described in Result 1 with the exception of a small number of subjects who followed a contrarian strategy based on the short-term realized stock returns in the first round. It also shows that only a small (and statistically insignificant) fraction of subjects base their trades on "fundamental" characteristics.

3.3. Individual investment: time consistency

To understand whether the investment strategy of an individual investor changes over time, we computed the conditional probability that an investor used a momentum trading strategy (β_1 is positive and statistically significant at the 5% level) in Round 2 given that he/she has used this strategy in Round 1. We also computed the conditional probability that an investor uses

contrarian trading strategies (β_2 is negative and significant)[8] in Round 2 given that he/she has used this strategy in Round 1.

Table 4: Individual Investment Strategies over Time

Strategy	**Prob (use in Round 2)**	**Prob (use in Round 2 | used in Round 1)**	**Significance level (χ^2 test)**
Momentum ($\beta_1>0$)	34.12%	53.85%	2%
Contrarian ($\beta_2<0$)	14.12%	31.82%	1%

Table 4 reports the ratios of subjects who used momentum (row 1) and contrarian (row 2) strategies is Round 2 among all subjects (column 1, "unconditional probabilities") and among subjects who used the same strategies in round 1 (column 2, "conditional probabilities"). For example, 53.85% of subjects who used a momentum strategy in Round 1 had used the same momentum strategy in Round 2. It can be seen from Table 4 that conditional probabilities are higher than unconditional probabilities for both strategies. To confirm that the conditional probability for each strategy is significantly higher than the corresponding unconditional probabilities, we have conducted two chi-square tests of independence with the null hypothesis H0: "using strategy X in Round 2 is independent of using strategy X in Round 1," where X="momentum" or "contrarian" strategies, respectively. Note that, since a momentum strategy is based on *STret* while a contrarian strategy is based on *LTperf*, there may be some investors who use neither of these strategies and there may be some investors who use both of these strategies simultaneously. Therefore, the use of two separate chi-square tests of independence is appropriate. The following result summarizes this finding:

Result 2: A statistically significant number of investors do not change their momentum and contrarian strategies over time.

3.4. Individual investment: simultaneous use of momentum and contrarian strategies

As Tables 2 and 3 show, some investors follow a momentum strategy (based on past short-term stock returns) while some investors follow a contrarian strategy (based on the past long-term stock performance). To understand whether these two groups of investors are separate or whether there is a significant number of investors who follow both momentum and contrarian strategies simultaneously, we computed the proportions of "long-term contrarian" investors (β_2 is negative and statistically significant at the 5% level) among "short-term momentum" investors (β_1 is positive and statistically significant at the 5% level) and among all other (i.e., "non-momentum") investors (β_1 is negative or not significant) in each round. Table 5 presents these proportions (columns 1, 2, 4, and 5).

[8] We provide this analysis only for momentum and contrarian strategies because they are the only strategies that are significant at the individual level in both rounds.

Table 5: Simultaneous Use of Contrarian and Momentum Strategies

	Round 1			Round 2		
	Among momentum ($\beta_1>0$)	**Among non-momentum**	**Difference**	**Among momentum ($\beta_1>0$)**	**Among non-momentum**	**Difference**
Contrarian ($\beta_2<0$)	65.38% (0.000)	8.47% (0.371)	56.91% (0.000)	10.34% (0.401)	16.07% (0.002)	-5.73% (0.444)

Assuming that the 2 groups of investors do not intersect, the proportions of "long-term contrarian" among "short-term momentum" investors should be equal to 5% (which is type 1 error of the corresponding regression). The numbers in brackets under the corresponding proportions present the p-value for the 1-sample proportion test of null hypothesis H0: "proportion=0.05" against the alternative hypothesis H1 "proportion>0.05." Although both proportions are above 5% (65% for Round 1 and 10% for Round 2), only in the first round the proportion of "long-term contrarian" among "short-term momentum" investors is significantly (at the 1% significance level) higher than 5%. The following result formalizes this finding:

Result 3: In the first round, there is a significant number of subjects who simultaneously use a momentum investment strategy (based on the short-term realized stock returns) and a contrarian investment strategy (based on the long-term realized stock performance).

To investigate further how investors are divided based on their use of momentum and contrarian strategies, we computed a difference between the proportions of "long-term contrarian" among "short-term momentum" investors and of "long-term contrarian" among "non- momentum" investors (Table 5, columns 3 and 6). This difference is positive and significant (at the 1% significance level using the 2-sample proportion test) for Round 1 and it is not significant in Round 2. The corresponding p-values are presented in brackets under each difference (columns 3 and 6). Therefore, the following result follows:

Result 4: In the first round, short-term momentum investors are more likely to follow a long-term contrarian strategy than investors who do not base their investment decisions on short-term realized stock returns.

The difference between the first and second round results, and, in particular, the insignificant number of subjects who used both momentum and contrarian strategies in the second round, can be explained by high home biased effect observed in the second round and the realized distribution of short-term and long-term returns for Canadian banks at the time of the experiment. Indeed, the inclusion of 5 Canadian banks into the list of stocks given to the subjects in the second round resulted in approximately 40% of total investment allocated toward these 5 banks. At the same time, the correlation between short-term and long-term realized returns for these 5 banks was 81% while the same correlation for the entire sample of 34 banks was only 30%. The combination of these two facts lead to an insignificant number of investors who simultaneously used both momentum and contrarian strategies in the second round.

4. Conclusion

This paper presents the results of an experimental study in which a group of undergraduate students from various academic departments was asked to invest fictional currency in one or more stocks from a list of stocks provided to them. The students were given basic information about these stocks available on the Yahoo Finance website. We found that investors, as a group, invested more in stocks with extremely high or extremely low short-term realized returns; followed a momentum strategy based on short-run realized stock returns; and followed a contrarian strategy based on long-run realized stock performance. By analyzing the investment decisions of individual investors, we found that: (1) a significant number of investors do not change their strategy over time; (2) there is a significant number of investors who simultaneously use a momentum strategy based on short-term realized stock returns and a contrarian strategy based on long-term realized stock performance; and (3) "short-term momentum" investors are more likely to use a "long-term contrarian" strategy than investors who do not base their investment decisions on short-term realized stock returns.

While students were free to gather any publicly available information prior to making their investment decision, a specific subset of information from Yahoo Finance website was conveniently provided to them which made them more likely to use this particular information. Such experiment design, although allowed us to easily identify the parameters of interest, is one of the major limitations of our study because it does not allowed us to identify the exact parameters that investors are more likely to use in making their decisions.

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Appendix A: Recruitment Poster

EARN $20 for a few minutes of your time

Call for volunteers for the research study in investors behavior

Your participation will consist of two or three experimental sessions conducted over e-mail. You expect to spend about 10 minutes of your time for each session. Your compensation will depend on your investment decisions and can be anywhere between $5 and $35 with the average compensation of $20 per student. For details and to enroll please, e-mail Prof. (name) at (e-mail address) before (date). Please, put "information request" in the subject of your e-mail and your name and e-mail address in the body of your e-mail. You will receive a response with the details of the experiment on (date).

Appendix B: General Instructions

You receive this e-mail because you have replied to the poster regarding the study in investors' behavior. Below you will find the timeline and basic procedures of the experimental study. If you agree to participate in this experiment – please, confirm your participation by e-mail before (date) to Prof. (name), at (e-mail address). Please, put "confirmation" in the subject of your e-mail and your name, major, and e-mail address in the body of your e-mail.

Timeline:

Participants will be randomly divided into two groups. Each participant will participate in two rounds of experiments during which he/she will be asked to buy or sell stocks using fictional money. All communication will be done by e-mail. In particular,

1) The first round will be conducted on (date). At that day you will receive instructions by e-mail and will be asked to buy or sell some stocks using fictional money. You must submit your investment decision by (date).
2) The second round will be conducted on (date). At that day you will receive additional instructions by e-mail and will be asked to buy or sell some other stocks using fictional money. You must submit your investment decision by (date).
3) Your compensation for the participation will depend on the relative value of your investment portfolio (relative to the portfolios of other students in your group) as of (date), and will be determine according to the formula below.

Formula for your payoff:

The average payoff will be $20 per student; however, your exact payoff may be lower or higher depending on your portfolio performance. In general, you should expect to receive somewhere between $5 and $35. If you will not submit your investment decision on-time, I will assume that you want to withdraw from the experiment, in which case you will not receive any compensation.

Each student will receive $5 for participation. In addition, the price pool of PP=$15×N (where N is the number of students in the group) will be divided among the group members. The value of your investment portfolio will be transferred into "Payment units" (PU) according to the

following formula: PU = ED – min(ED), where ED is the value of your portfolio in ED ("experimental dollars", a fictional currency) at the end of the experiment, and min(ED) is the minimum value of portfolios of all students in your group. You compensation will be equal to $5 + PU \times \frac{PP}{\sum_{j=1}^{N} PU_j}$ dollars. Note that your compensation depends on how well you did relative to the other students, not on the absolute value of your portfolio. You will receive your payments on (date).

Appendix C: Round 1 Instructions

Thank you very much for your willingness to participate in the experimental study of investors' behavior. This is the first round of the experiment. In this round you are given $1000 of "play money" that you must invest in some stocks from the list of stocks attached to this message. The attached file provides you a list of 30 stocks included into the DJIA index and their basic characteristics. You need to invest all of your fictional money in some of these stocks. You can invest all you money in one stock or choose several stocks (no more than 10 stocks!!!). The stocks that you will choose will be held in your portfolio for two weeks and will be sold on XXX (at the closing price at that day). You must submit your investment decision by e-mail no later than 11:59pm on Sunday, YYY. Please, use the following submission guidelines as close as possible:

1) put "Round 1" into the subject of your e-mail
2) Start your e-mail with your name and student number
3) State your major
3) For each stock you want to buy, state the name of the stock and the amount of money you would like to invest in this stock (not the number of shares you want to buy)
4) Make sure your total investment is exactly equal to $1000
5) Make sure you invest in no more than 10 stocks

You should get an auto-reply message from me confirming that your submission is received. Sunday night I will send reminder to people who will not submit their investment decisions by that time yet. If you will receive such reminder from me – it meant that I did not get your e-mail.

Thank you again for your help in this research study.