Fee Structure, Return Chasing and Mutual Fund Choice: An Experiment*

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Abstract

We present a laboratory experiment to investigate the effect of the fee structure and past returns on mutual fund choice. We find that the inclusion of a (periodic and small) operation expenses fee does not distort investment choices. However, a fee in the form of a, much larger, front-end load is used by subjects as a commitment device and leads to lock-in into one of the funds. In addition we find that, even when subjects know that future returns are independent of past returns, these past returns are an important determinant of subjects' investment choices.

Keywords: Mutual fund choice, fee structure, experimental economics, return chasing.

JEL Code: C91, G02, G11.

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1 Introduction

Mutual funds are important investment vehicles: according to Investment Company Institute (2016) the value of assets invested in mutual funds in the US was about 15.7 trillion US dollars in 2015, which is more than 85% of US GDP. Moreover, mutual funds are particularly important for household finance. In 2015 a total of 44.1% of US households owned funds, and the median value of mutual fund assets owned per household was $120,000$ US dollars. Given this large size of the mutual fund industry it is evident that understanding how investors choose between mutual funds is crucial for evaluating the performance of financial markets and might help in constructing appropriate regulatory policies.

This paper presents a laboratory experiment on sequential individual decision making that is aimed at shedding some light on mutual fund choice. In particular, we focus on two specific determinants of this decision problem. First, we study the role that the structure of the fee, charged by mutual funds, plays. More precisely, we consider two types of fees that are commonly used in practice: a *front-end load*, which is a fixed commission that has to be paid when an investor purchases shares of the fund, and an *operation expenses fee* or *management fee* that represents the costs for operating the fund and that, as opposed to the front-end load, needs to be paid by the shareholder periodically. Second, we investigate whether past returns of the mutual funds affect investors behavior, even under circumstances where it should be clear to these investors that they do not convey any additional information about future returns.

Much of the earlier empirical research in this area uses data from actual mutual funds, which introduces several endogeneity problems. The advantage of our laboratory experiment is that we have full control over the mutual fund return and fee structures. This allows us to test the effects of these two aspects directly. In our individual decision making experiment subjects choose between investing their wealth in one of two experimental funds (A and B) each period. The subjects know the return generating processes and fee structure of both funds, and observe past returns of both funds as well. They are explicitly informed that neither the past returns nor their own actions affect future returns. We construct three treatments, in all of which no fee is charged by fund A. The fee structure for fund B is different across treatments. In particular, in treatment **N** fund B charges no fee, in treatment **O** it charges an operations expenses fee and in treatment **F** it charges a front-end load, respectively. Moreover, our experiment is designed in such a way that, although the decision problem is framed differently – with the fee in treatment **F** much more salient than that in treatment **O** – subjects in the three different treatments face essentially the same choice, since investing in fund B gives the same expected return (net of fees) in all three treatments. This expected return is higher than the expected return of fund A (which is also the same across treatments), implying that the optimal decision is to invest in fund B in every period. In particular, neither the fee structure, nor the past returns should have an effect upon investment choices of subjects.

We find that this is true for the operation expenses fee: subject behavior in treatment

O is not significantly different from behavior in treatment **N**. Although not very salient the operation expenses fee is therefore not systematically ignored by the subjects. However, there are significant differences between treatment **F** and the other two treatments, in particular at the individual level. More specifically, the fraction of subjects that invest in fund B in (almost) every period is much higher in treatment **F**. These subjects understand they should pay the front-end load not more than once, and therefore get locked-in to the more profitable fund B. On the other hand, a number of subjects in treatment **F** switch between funds A and B more often and consequently end up with relatively low payoffs. In the aggregate, therefore, subjects in treatment **F** choose fund B more often, but there is much more heterogeneity in their earnings, and average earnings are actually lower than in the other treatments. Finally, for all treatments we find that past realized returns do have a substantial effect on investment decisions.

The impact of the fee structure on mutual fund choice has also been studied empirically. Barber, Odean, and Zheng (2005), for example, find that the flow of money into mutual funds is negatively correlated with the front-end load, but not correlated with the operation expenses fee. They argue that people pay more attention to the front-end load fee because it is more salient and transparent. Khorana and Servaes (2012), however, find that fund families that charge a front-end load have a significantly larger market share than funds charging operation expenses, which they explain by the fact that, like in our experiment, the front-end load may serve as a commitment device for investors, and thereby reduces search costs. Related to this, Chordia (1996) shows that funds may use front-end and back-end loads to discourage switching to another fund.[1] To our knowledge, only limited experimental research on the relation between fee structure and fund choice exists. An early contribution is Wilcox (2003), who shows that subjects pay too much attention to past performance and to the front-end load, and too little to the operation expenses fee. His experimental design differs from ours since he considers a fund that charges both a front-end load and an operation expenses fee. Moreover, his experiment conducts a one period cross-sectional comparison, while ours uses a multi-period setting to study investment over a longer horizon. Ehm and Weber (2013) employ a large scale survey (without payments to the subjects) to investigate how people choose between two hypothetical funds that only differ in the fee structure: one fund charges a performance fee (meaning that the fund charges a fraction of the gains, instead of a fraction of the total asset value) whereas the other charges an operation expenses fee. They find that people have a higher propensity to choose funds that charge a performance fee, which they explain by loss aversion.

There is also substantial empirical evidence that investors on actual financial markets base their investment decisions on past performance of the funds, see e.g. Sirri and Tufano (1998), even though past performance may have limited predictive power about the future returns of the

[1]A separate literature focuses on whether the size of the fee is justified by the performance of the fund. Remarkably, Carhart (1997) and Gil-Bazo and Ruiz-Verdú (2009) find that the fees charged by funds are *negatively* related to returns. Khorana, Servaes, and Tufano (2009) provides a comprehensive investigation on mutual fund fees and finds a large dispersion of fees between different countries, which is difficult to explain by the difference in returns to the investors.

funds.[2] In particular, Choi, Laibson, and Madrian (2010) find that people rely strongly on the annualized past return of funds in making fund selection decisions even when such information is irrelevant. They design a field experiment where subjects choose between four funds that are based on the same index, and will therefore generate the same returns. In the manuals of the funds, however, they have different annualized past return rate records due to differences in the launching time, and the funds with a higher past return record charge a higher fee. Although people should ignore the past return information and select the fund with the lowest fee, many of them fail to do so. In an earlier paper by Choi, Laibson, Madrian, and Metrick (2009), the authors find that people's investment choices can be described by reinforcement learning: investors who experience rewarding outcomes from 401(k) savings tend to increase their savings level more than they optimally should. Similarly, in a large-scale experiment Asparouhova, Bossaerts, Copic, Cornell, Cvitanic, and Meloso (2015) find that subjects tend to invest their wealth with fund managers that had better performance in the immediate past. Our work is also related to Bloomfield and Hales (2002), who ask subjects to predict the next step of an earnings time series that follows a random walk. They find that the subjects do not take the random walk as random, but divide the time series into "trend" and "mean reverting" regimes, and try to use the frequency of past earnings reversals to predict the likelihood of a future earnings reversal. Finally, our paper is related to experimental studies on the hot hand effect (Offerman and Sonnemans, 2004; Stockl, Huber, Kirchler, and Lindner, 2015) and on return chasing behavior (Powdthavee and Riyanto, 2015; Yuan, Sun, and Siu, 2014) in a broad sense.

The remainder of the paper is organized as follows. Section 2 describes our experimental design. The experimental results are presented in Section 3 and Section 4 concludes. Appendices A and B contain the experimental instructions and control questions. Test statistics and other additional informational about the experimental results are collected in Appendix C.

2 Experimental Design

2.1 Summary Information

The experiment took place on December 8 and 9, 2011 at LESSAC, the experimental laboratory of the Burgundy School of Business in Dijon (France). In total 76 subjects participated in three

[2] There is a debate about whether there is persistency in the performance of mutual funds, for example because the fund manager is capable of consistently selecting high performing stocks. The general view is that such a persistency does not exist and that, after controlling for risk and trading costs, the typical manager is unable to consistently generate excess returns (see Carhart (1997)). In addition, Jain and Wu (2000) find that funds that advertise higher past returns attract more money, but do not perform significantly better than other funds in the periods following the advertisement. Hendricks, Patel, and Zeckhauser (1993) and Zheng (1999) find that there may be a "hot hand effect" in fund performance in the short run, but that in the long run there is no significant difference between funds that performed well in the recent past and other funds.

treatments, with 22 subjects in treatment **N**, 19 in treatment **O** and 35 in treatment **F**.[3] All subjects were first year master students at the Burgundy School of Business, with no prior experience with laboratory experiments on a related topic. These students had two years of training in economics, statistics and mathematics before passing the exam to enter the school, and they took many other courses in business economics after entering the school.[4] Subjects could choose to have instructions in English or in French. The duration of the typical session was one and a half hours.

2.2 Subjects' Task

The experiment is an individual choice experiment, divided in three blocks of fifteen periods each.[5] At the beginning of each block the subject is given an initial wealth of $M_0 = 1000$ points. In each period t of that block the subject has to decide where to invest its accumulated wealth M_t: either he/she invests all of his/her wealth in fund A, or all in fund B, or he or she does not invest at all (note that the subject is not allowed to divide his or her wealth more evenly between the different funds). The wealth in the subsequent period of that block, M_{t+1}, is determined by the (exogenously given) stochastic return of the chosen fund (with $M_{t+1} = M_t$ if the subject decided not to invest his/her wealth in either fund A or fund B). The starting wealth is reset to $M_0 = 1000$ at the beginning of every block.

At the end of the experiment, the subjects are paid according to their final wealth from one of the three blocks, where each block has the same probability of being chosen.[6] Appendix A provides the experimental instructions. Before the subjects start the experiment, they have to answer several control questions on paper in order to make sure that they understand the experiment. We start the experiment only when all subjects have answered all control questions correctly. The control questions and correct answers can be found in Appendix B.

[3]The treatments are discussed in detail in Section 2.4. The difference in the number of subjects per treatment is due to variations in the show-up rate.

[4]The students tend to be quite good. From a population of about 4000 students that participate in an entrance exam, the Burgundy School of Business has the right to select about 150, with grades between 14/20 and 17/20. Students with a grade higher than 17/20 go to HEC Paris.

[5]After running the experiment and starting with the analysis of the data, we discovered that there had been an unfortunate error in the experimental software. In particular, the returns for fund A in the third block were not consistent with the prices. Since subjects could see both (see Figure 2 below) some of them may have become confused by the discrepancies, though it seems that no subject identified the inconsistencies (indeed, the differences are small and difficult to spot without additonal calculations). Nevertheless, we decided not to use the results from the third block and the analysis in this paper will therefore be confined to the experimental data from blocks 1 and 2. (Note that the programming mistake cannot have had an impact on subjects' behavior in these first two blocks.)

[6]The experimenter throws a dice separately for each subject. The subject is then paid according to his/her final wealth in the first (second, third) block if the dice shows 1 or 2 (3 or 4, 5 or 6).

2.3 Mutual Funds: Returns and Fees

Consider the (open-end) mutual fund X with a price per share of $P_{X,t}$ at time t. This price evolves according to $P_{X,t} = (1 + g_X + \epsilon_{X,t})\, P_{X,t-1}$, where $g_X > 0$ is a positive *growth constant* and $\{\epsilon_{X,t}\}$ is a white noise process, where $\epsilon_{X,t}$ can take on only two values: $\varepsilon > 0$ or $-\varepsilon$, with equal probability. The (gross) return of fund X is then given by

$$R_{X,t} = \frac{P_{X,t}}{P_{X,t-1}} = 1 + g_X + \epsilon_{X,t} = \begin{cases} 1 + g_X + \varepsilon & \text{with probability } \frac{1}{2} \\ 1 + g_X - \varepsilon & \text{with probability } \frac{1}{2} \end{cases} .$$

Because $\epsilon_{X,t}$ equals zero in expectation, the *expected* one-period return at the beginning of period t (that is, before $P_{X,t}$ is known) is given by $\mathrm{E}_t\left[R_{X,t}\right] = 1 + g_X$. More generally – and for now abstracting from any fees to be paid – the τ-period expected return at time t of investing one unit of money is given by

$$\begin{aligned} \mathrm{E}_t\left[R_{X,t}^{(\tau)}\right] &= \mathrm{E}_t\left[\frac{P_{X,t-1+\tau}}{P_{X,t-1}}\right] = \sum_{s=0}^{\tau} \binom{\tau}{s} \frac{1}{2^\tau} \left(1 + g_X + \varepsilon\right)^s \left(1 + g_X - \varepsilon\right)^{\tau - s} \\ &= \left(1 + g_X\right)^\tau . \end{aligned}$$

For the experimental design we consider two funds, $X = A, B$, with growth constants g_A and g_B respectively. The random components $\epsilon_{A,t}$ and $\epsilon_{B,t}$ are independent but identically distributed (in particular, the absolute size of the random components is equal to ε for both funds). Moreover, we impose that $\varepsilon < g_A < g_B$. The first inequality means that, independent of the realizations of $\epsilon_{A,t}$ and $\epsilon_{B,t}$, the prices of shares of both funds are monotonically increasing over time. The second inequality implies that *expected* τ-period returns for fund B are higher than for fund A (for any $\tau \geq 1$). In addition, by requiring that $g_A + \varepsilon > g_B - \varepsilon$, there is a positive probability that the *realized* return of fund A is higher than that of fund B. However, a rational investor who knows the data generating mechanism will always choose investing in fund B over investing in fund A, since past realized returns do not convey any additional information about future returns and expected returns are always higher for fund B than for fund A. Boundedly rational investors who do respond to past realized returns might now and then switch to fund A.

We consider two types of fees: an *operating expenses fee* and a *front-end load*. The first type of fee, sometimes also referred to as a *management fee*, is a periodic payment that represents the costs for running the mutual fund and providing service to its shareholders. It corresponds to a fraction γ_X of the investment to be paid each period as a fee. That is, the operation expenses fee in period t is $\gamma_X P_{X,t-1}$ per share. The (one-period) return for fund X, net of this fee, then becomes $R_{\mathbf{O},X,t} = 1 + g_X - \gamma_X + \epsilon_{X,t} = 1 + g'_X + \epsilon_{X,t}$, with $g'_X = g_X - \gamma_X$. The expected τ-period return is

$$\mathrm{E}_t\left[R_{\mathbf{O},X,t}^{(\tau)}\right] = \left(1 + g_X - \gamma_X\right)^\tau .$$

Treatment	Fund A		Fund B			
	g_A	$\mathrm{E}_1\left[R_{A,1}^{(14)}\right]-1$	g_B	γ_B	F_B	$\mathrm{E}_1\left[R_{B,1}^{(14)}\right]-1$
N	3%	51.26%	4%	–	–	73.17%
O	3%	51.26%	5%	1%	–	73.17%
F	3%	51.26%	5%	–	13%	72.25%

Table 1: Experimental design.

Alternatively, the investor may be charged with a purchase commission, or a so-called *front-end load*. That is, the investor pays a fixed percentage F_X of his investment M_t as a commission when he invests in fund X. With the remainder of his investment, $(1 - F_X)\, M_t$, shares of the mutual fund are purchased. The front-end load only has to be paid upon purchasing the shares. However, if the investor withdraws his money from the fund and wants to re-invest in the fund at a later stage he has to pay the front-end load again. The expected τ-period return from investing in mutual fund X at time t follows as

$$\mathrm{E}_t\left[R_{\mathbf{F},X,t}^{(\tau)}\right] = (1 - F_X)\, \mathrm{E}_t\left[R_{X,t}^{(\tau)}\right] = (1 - F_X)\,(1 + g_X)^{\tau}\ .$$

2.4 Treatments

We consider three treatments: **N**, **O** and **F**. Subjects only participate in one of the treatments. In each of these treatments subjects can increase their wealth by investing in one of the two funds, A or B, as described in Section 2.2. No fees are required for investing in fund A, but for two of the three treatments a fee is charged when investing in fund B. Table 1 summarizes the design. In addition, we take $\varepsilon = 2\%$.

In the *baseline treatment*, **treatment N**, none of the two funds requires a fee and we set the growth constants to $g_A = 3\%$ and $g_B = 4\%$ (which, given $\varepsilon = 2\%$, implies that the realized return of fund A is going to be either 1% or 5%, and the realized return of fund B is going to be either 2% or 6%). The optimal decision is to invest in fund B in every period (although there is a 25% probability that the *realized* return of investing in fund A is higher than that of investing in fund B, i.e., when $\epsilon_{A,t} = 2\%$ and $\epsilon_{B,t} = -2\%$). Investing in fund B in *every* period gives an expected (net) return of about 73%, whereas the net expected return of always investing in fund A is around 51%.[7]

For the *operating expenses treatment*, **treatment O**, the growth constants are equal to

[7] Note that, although subjects need to make an investment decision for 15 consecutive periods there will only be 14 return rates. It can be easily checked that investing in fund B for all periods gives at least a net return of 32.0% (when all price shocks are negative) and at most a net return of 126.1% (when all these price shocks are positive). The corresponding numbers for fund A are 15.0% and 98.0%, respectively. Moreover, the return of always investing in fund A is going to be higher than the return of always investing in fund B only if fund A experiences at least four more positive price shocks than fund B does.

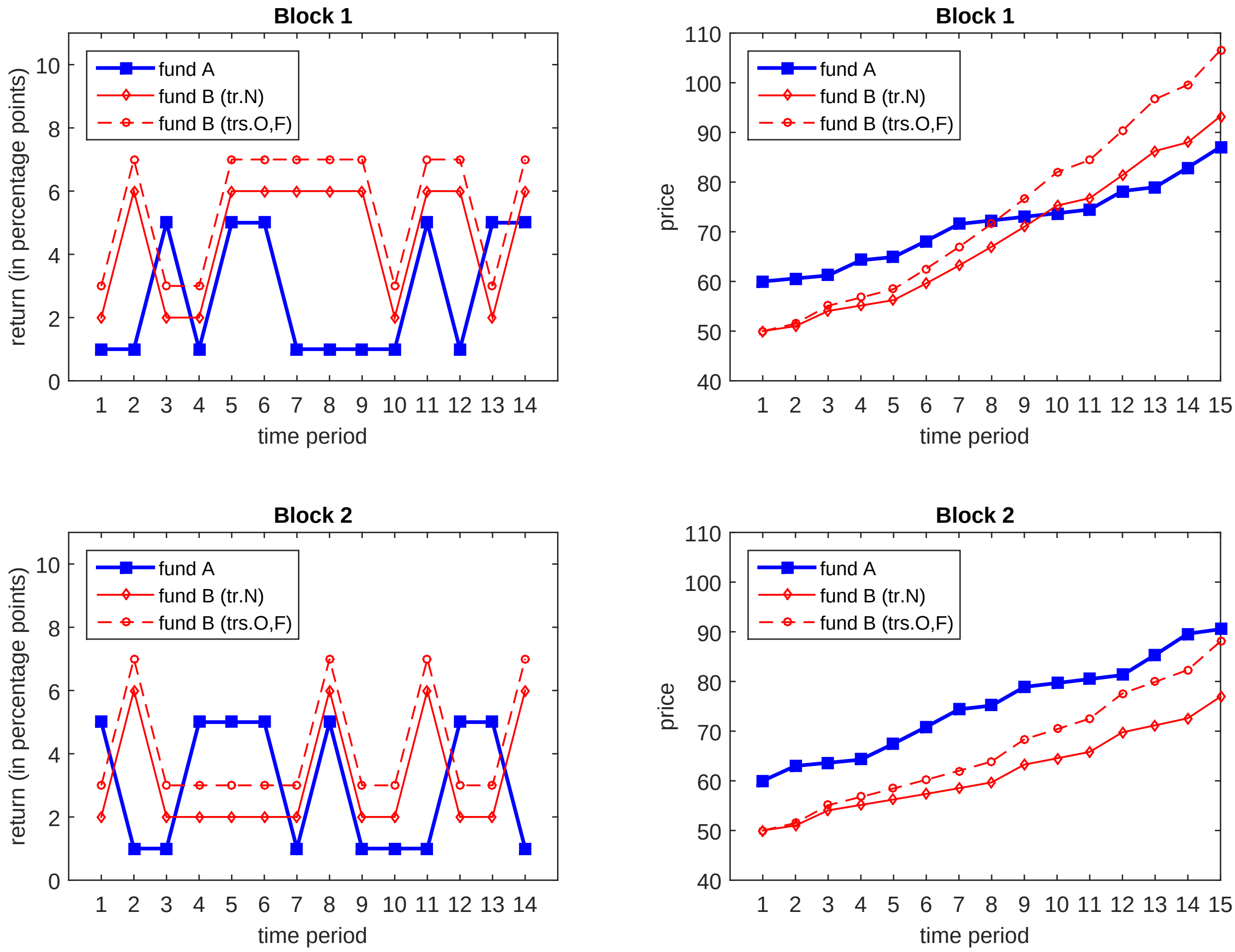

Figure 1: Returns (*left*) and prices (*right*) of funds A (thick line) and B (thin or dashed line) for blocks 1 (*top*) and 2 (*bottom*). Fund A returns (squares) are the same in all treatments. Fund B returns in treatment **N** (diamonds) are one percentage point lower than returns in treatments **O** and **F** (circles). Prices are generated using the returns with initial values 60 and 50 for funds A and B, respectively.

$g_A = 3\%$ and $g_B = 5\%$, but there is an operations expenses fee for fund B equal to $\gamma_B = 1\%$ (and $\gamma_A = 0\%$). Effectively, therefore, expected (and realized) returns of investing in fund B are exactly the same in treatments **O** and **N**, and higher than the expected returns of investing in fund A.

In the third and final treatment, **treatment F**, we impose a *front-end load* on fund B. We take $g_A = 3\%$ and $g_B = 5\%$ again and choose a front-end load of $F_B = 13\%$ (and $F_A = 0\%$). For this value of the front-end load the expected return of investing in mutual fund B from the beginning of the block is (roughly) equal to the expected return of investing in fund B for the other two treatments.[8] Note however that, where for treatments **N** and **O** it is always

[8]To be precise: for the expected returns of fund B to be *exactly* the same in all three treatments, constant F has to satisfy $(1-F)\,(1+g_B)^T = (1+g_B-\gamma)^T$. For $g_B = 0.05$, $\gamma = 0.01$ and $T = 14$ this gives $F^* \approx 0.1254$. We selected $F = 0.13$, because this is the closest integer (in percentage points) to F^*. Note that the difference

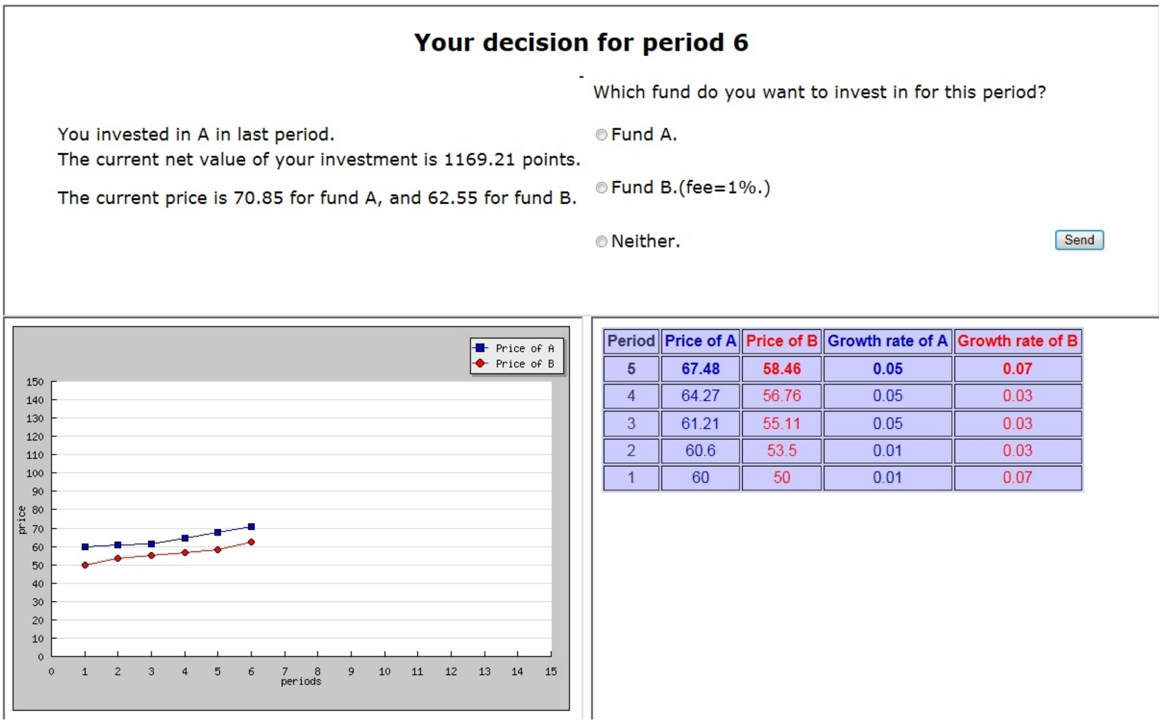

Figure 2: An example of the computer screen for treatment **O**. The subjects make a choice between investing in fund A, fund B or neither of them in the decision box in the upper part of the screen. They can refer to the past prices and returns shown in the left part of the screen. The prices of fund A are shown by squares, and the prices of fund B are shown by diamonds.

optimal to switch from investing in fund A to investing in fund B, for treatment **F** this is only worthwhile if enough periods remain to 'earn back' the front-end load. In particular, switching from fund A to fund B later than period 7 decreases expected returns.[9]

For each treatment the chosen parameters (g_A, g_B, γ and F) are the same in each block, and for each block we generate time series of prices for fund A and fund B, respectively. The only difference between blocks in the same treatment is that different seeds for generating the white noise process are used. Moreover, we use the same realization of the shocks $\epsilon_{A,t}$ and $\epsilon_{B,t}$ in the three treatments. Therefore any difference we observe between treatments can be attributed to differences in the fee structure. Figure 1 shows the generated time series for different blocks. The left panels show the realized returns for A and B in different treatments. The right panels display the prices resulting from these returns, where we set the initial price of funds A and B equal to 60 and 50, respectively.

Each subject has full information about the price generating mechanisms. In the beginning of each block subjects start with an empty screen and make their first choice. Then, as the experiment evolves, subjects are shown a table with past realized returns and the corresponding past prices. They also can see the graph with the time series of past prices and the current net

between expected returns for fund B in the different treatments is very small (see Table 1).

[9] It can be easily checked that $0.87 \times 1.05^t \leq 1.03^t$ for all $t \geq t^* \approx 7.2414$, and choosing fund B (and paying the front-end load) can only be profitable (in expectation) when at least 8 periods remain.

Block	Treatment	Always A	Always B	Minimum possible	Maximum possible	'Return chasing'
1	**N, O**	45.11%	86.53%	36.94%	97.67%	82.96%
	F		85.42%	−37.39%	85.49%	55.23%
2	**N, O**	50.86%	53.90%	26.78%	83.13%	50.92%
	F		53.26%	−39.64%	56.24%	7.37%
Average	**N, O**	47.99%	70.21%	31.86%	90.40%	66.94%
	F		69.34%	−38.51%	70.86%	31.30%

Table 2: Realized returns in different treatments and blocks for different types of behavior. The third and fourth columns show the returns for always choosing fund A and always choosing fund B, respectively. The fifth and sixth columns show the minimum and maximum returns that could be earned in the experiment. The last column gives the return for a subject that always invests in the fund that had the highest return in the preceding period.

value of their portfolio. Figure 2 provides a typical example of the experimental screen.[10]

Table 2 characterizes potential returns for the subjects under different scenarios. The third column of this table shows the return from investing in fund A for all periods. This return is the same for all treatments and, due to the randomness in the realized returns, slightly less than the expected return of 51.26%. The return for always investing in fund B is shown in the fourth column of Table 2. The realizations of returns in the first (second) block lead to a higher (lower) total return than expected.[11] Columns five and six show the *ex post* minimum and maximum possible total return a subject could earn (assuming the subject invests in every period).[12] Finally, the last column of Table 2 gives returns when subjects are "return chasing", that is, always invest in the fund that had the highest realized return in the previous period.[13] In any period there is a 25% probability that the return on fund A is higher than that on fund B and, although this provides no information about future return differences, it may induce subjects to switch to (or remain with) fund A – which is clearly not the (*ex ante*) optimal investment strategy. The last column in Table 2 reveals that the difference between always investing in fund B and chasing returns is limited in treatments **N** and **O**. This is partly due to the fact that there are only a few periods in which fund A does better than fund B.[14]

[10]Figure 2 (with superimposed comments) is shown to the subjects in treatment **O** as part of the instructions. The time series shown in this figure differs from those used in the experiment. The screens in the other treatments are identical to that shown in Figure 2 except that, inside the decision box, the fee information for fund B is absent in treatment **N** and reads 'fee=13%' in treatment **F**.

[11]In block 1 (block 2) the number of positive price shocks for fund B is higher (lower) than expected (9 and 4, respectively). For fund A the number of positive shocks is 6 and 7, respectively.

[12]In treatments **N** and **O**, such a subject would (by sheer bad or good luck) each period choose the fund that will have the lowest, respectively highest realized return in that period. In treatment **F** total return is minimized when a switch between A and B is made every period so that the front-end load fee is paid seven times (in both blocks the worst sequence starts with B). The total return in treatment **F** is maximal when the front-end load fee is paid not more than once. In particular, in block 1 return is maximized by choosing B from the beginning and switching to fund A for the two last periods, whereas in block 2 returns are maximized by starting with fund A in the first period and then switch to fund B for the remainder of the block.

[13]The calculations assume that in the first period the fund B with the highest expected return is chosen.

[14]The return of fund A is larger than the return of fund B twice in block 1 and six times in block 2. In addition, a positive return difference between funds A and B is followed by a negative return difference for both

2.5 Hypotheses

We designed our experiment in such a way that in each treatment subjects face essentially the same choice. In all treatments fund B gives higher expected payoffs than fund A. In addition, past performance of the funds does not influence their future performance, which is known by the subjects. Therefore one would expect that neither the fee structure, nor past realized returns of the funds will have a substantial impact upon the investment choices of the subjects. This leads to the following set of hypotheses, which we will test in Section 3.

First, there should not be a significant difference between treatments **N** and **O**. Although the choice problem is framed differently in the two treatments, expected and realized returns of both funds are the same in these treatments.

Hypothesis 1. *There is not a significant difference in subjects' frequency of choosing fund B (against A) and subjects' earnings between treatments **O** and **N**.*

If we do find a statistical significant difference between these two treatments, it can be attributed to the way the returns of fund B are framed.

Similarly, we do not expect to see a difference between treatments **O** and **F**.

Hypothesis 2. *There is not a significant difference in subjects' frequency of choosing fund B (against A) and subjects' earnings between treatments **F** and **O**.*

Contrary to the comparison between treatments **O** and **N**, there are explanations other than framing for a possible significant difference between treatments **F** and **O**. First, for treatments **O** and **N** it is straightforward to understand which of the two funds generates a higher expected return – 4% is clearly higher than 3%. However, in treatment **F** the comparison between the two funds requires a non-trivial computation, which may lead to uncertainty with the subject about how to evaluate fund B. Moreover, the front-end load in treatment **F** is much higher, and therefore much more salient than the operating expenses in treatment **O**. These two effects might explain *underinvestment* in fund B in treatment **F**. On the other hand, the fact that the front-end load has to be paid every time that the subject starts to invest in fund B (and only then) implies that switching back and forth between fund A and fund B is much more costly in treatment **F** than it is in treatment **O**. In that sense, the front-end load may serve as a commitment device and force the subject to exert more effort into thinking about the investment decision at the start of the experiment, or at the start of a new block. This might increase the fraction of subjects choosing fund B in treatment **F**.

Our last hypothesis focuses on so-called 'return chasing behavior'.

Hypothesis 3. *For treatments **N** and **O** the fraction of choices for fund B in any particular period is uncorrelated with the realized returns of funds A and B in the previous period.*

cases in block 1 and for three of the six cases in block 2.

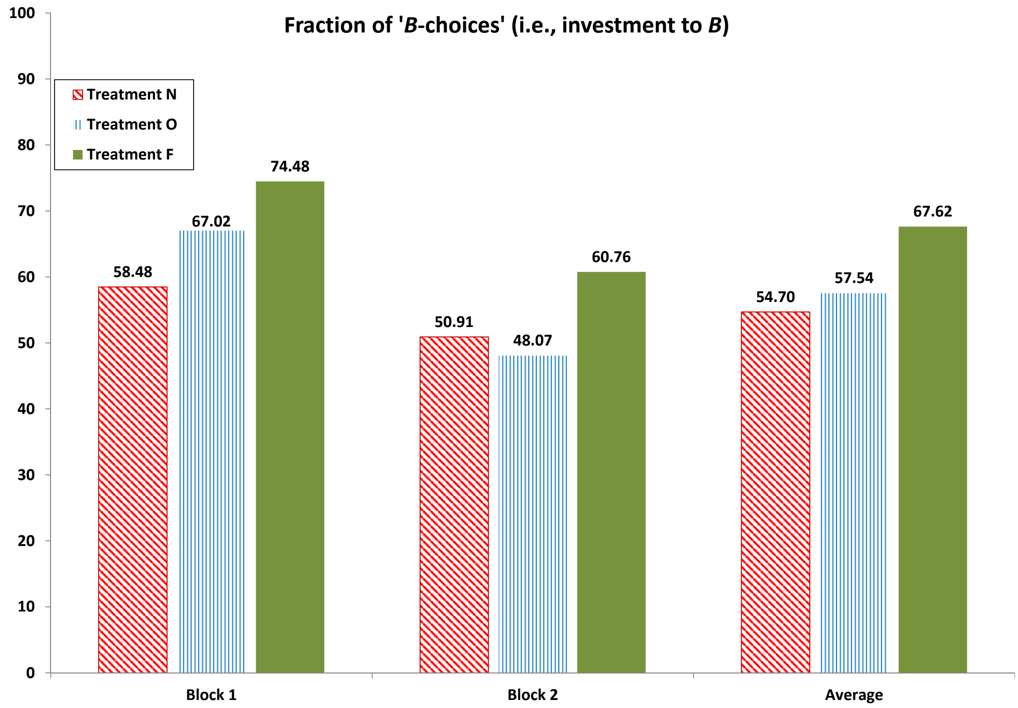

Figure 3: Fractions of investment in fund B by blocks and treatments.

If this hypothesis is rejected, subjects respond to realized returns, although these realized returns do not convey additional information.

3 Experimental Results

We begin with an overview of the experimental data. Figure 3 shows, for each block, the fraction of choices of fund B in each of the three treatments.[15] Note that for none of the treatments and in none of the blocks the fraction of choices for fund B is close to 100%, which it would be under rational choice. Instead this fraction varies from about 75% (block 1, treatment **F**) to slightly under 50% (block 2, treatment **O**). The data also does not suggest that subjects learn to make more rational decisions when gaining experience: the fraction of choices for fund B is higher in block 1 than in block 2 for all three treatments. A possible explanation for this may be the fact that the difference between the realized returns of the two funds is quite small in block 2, see Table 2 and footnote 11. Although past realized returns do not influence *optimal* investment decisions, the data suggest that they are a determinant of *actual* investment behavior in the experiment. We will get back to this issue in Section 3.3.

Figure 3 suggests that there exist differences in subjects' behavior between blocks as well as between treatments. In Figure 4 we present the accumulated earnings, averaged over subjects

[15]See Table 6 in Appendix C for the fraction of subjects choosing fund A, fund B or none of the two. It is quite rare that a subject does not invest in either of the two funds (in particular for treatments **N** and **O**), which is unsurprising as returns for both funds are strictly positive (with the possible exception of fund B in treatment **F**).

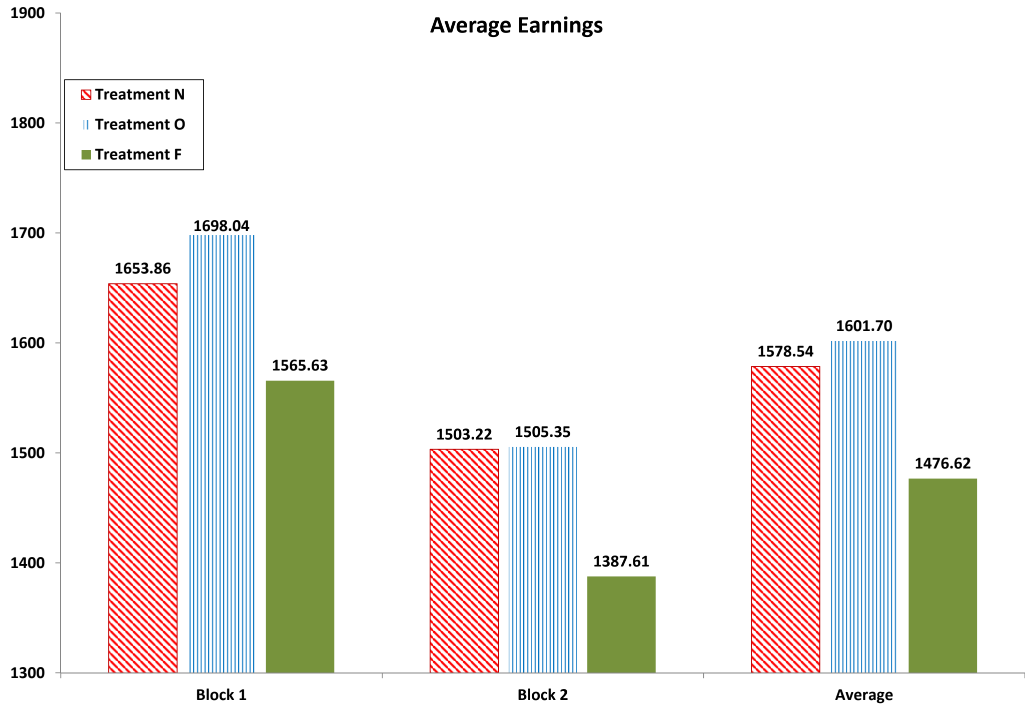

Figure 4: Average earnings (in points) by blocks and treatments.

in different blocks and treatments, to see how these differences translate into the performance of subjects. Average earnings are lowest in block 2 of treatment **F**, and highest in block 1 of treatment **O**. Averaged over the two blocks earnings correspond to returns of 57.85%, 60.17% and 47.66% in treatments **N**, **O** and **F**, respectively. These returns are clearly lower, in particular for treatment **F**, than the returns of about 70% that follow from rational behavior (see Table 2).

The remainder of this section is devoted to testing the hypotheses formulated in Section 2.5. We will consider differences between treatments as well as differences between blocks within treatments. In Section 3.1 we discuss the effect of operating expenses fees and test Hypothesis 1. Hypothesis 2 is tested in Section 3.2, where we focus mainly on the front-end load. Finally, in Section 3.3 we investigate return chasing and test Hypothesis 3. We will apply two types of tests in Sections 3.1 and 3.2. First, we use the Mann–Whitney–Wilcoxon (MWW) test at subject level. This test allows us to determine the statistical significance of the differences in fractions and in average earnings presented in Figures 3 and 4, respectively. The $p-$values of the MWW test for various hypotheses are collected in Table 7 of Appendix C. Second, we compare the empirical distributions of the different variables, represented, for example, in the left panels of Figures 5 and 6. We use the Kolmogorov–Smirnov (KS) test to evaluate whether distributions are statistically different or not. The $p-$values for the KS test can be found in Table 8 of Appendix C. We set the significance level at 5% for all tests.

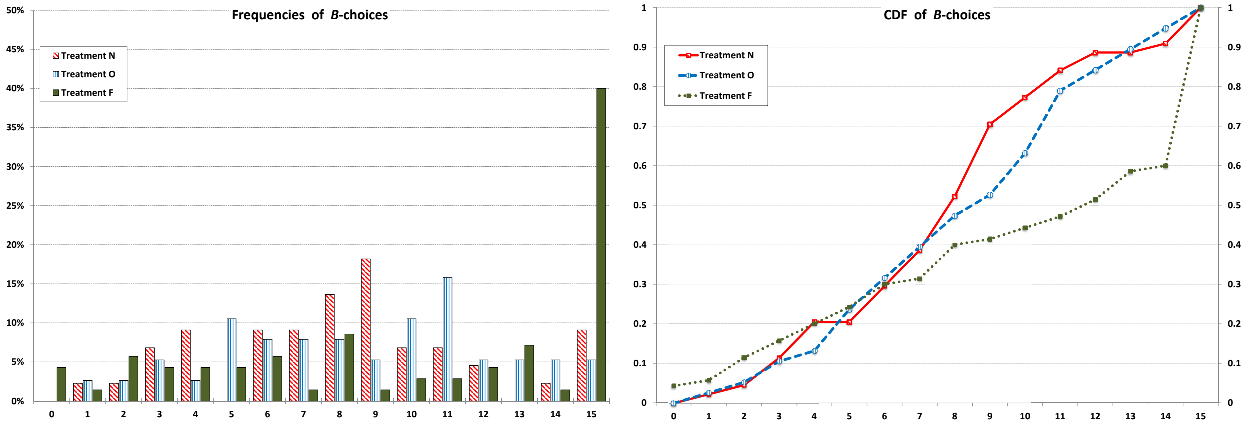

Figure 5: The histogram of individual choices of fund B (*left*) and the CDF of individual choices of fund B (*right*). The data from two blocks in each treatment are pooled together.

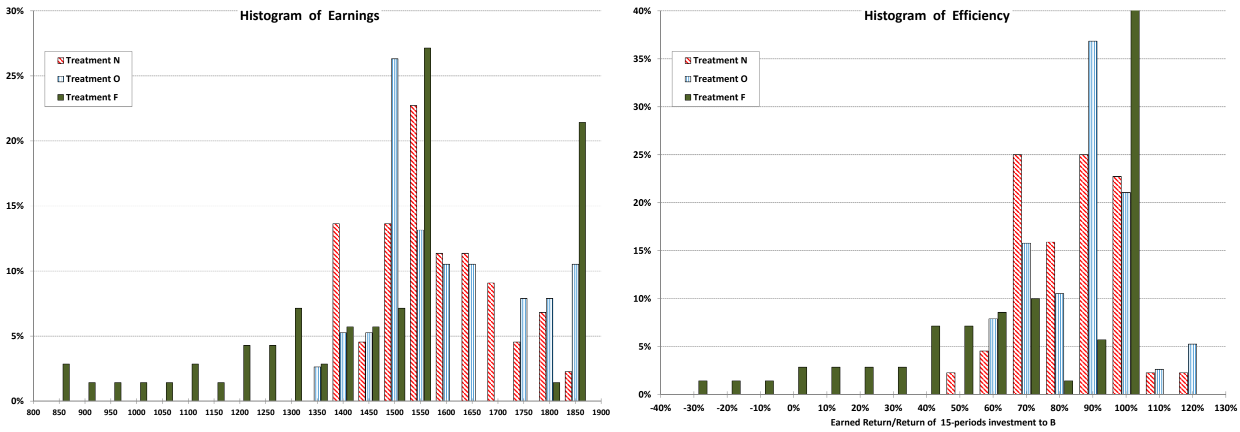

Figure 6: The histograms of earnings (*left*) and efficiency (*right*) per block. The data from the two blocks are pooled together.

3.1 Treatment O: Salience of Operating Expenses

Using Figure 3 to compare treatment **O** to treatment **N** we find that the fraction of choices for fund B is higher for treatment **O** in block 1, but lower in block 2, so that on average the difference is small. A similar picture emerges from the empirical cumulative distribution functions of the choices for fund B, presented in the right panel of Figure 5, and the average earnings, presented in Figure 4. The results of both the MWW and the KS test are consistent with this visual impression: we do not find a significant difference between the mean fraction and the distribution of choices for fund B, nor between the average earnings, when comparing treatments **N** and **O**.[16] Our first result therefore is:

Result 1. *We do not find a significant difference in the fraction of choices for fund B or in earnings between treatment **O** and treatment **N**. Therefore we cannot reject Hypothesis 1.*

The left panel of Figure 6 shows the histogram of points earned by participant per block (that is, each combination of a participant and a block is treated as a separate observation).

[16]See the second and third columns in Tables 7 and 8 for p-values of these tests.

Specific realizations of the shocks may have a substantial effect on the returns (see Table 2 and the two large peaks for earnings in treatment **F**, which occur very close to the maximum possible earnings in the two different blocks). To correct for this, we normalize the earnings of every participant in each block by dividing the realized return by the returns under *ex-ante* optimal behavior of investing in B every period. The histogram of these normalized earnings, which we denote *efficiency*, is shown in the right panel of Figure 6, and they are quite similar for treatments **N** and **O**. In fact, there are no significant differences in the mean or distribution of *efficiency* in all pairwise comparisons between these two treatments.[17] This further supports Result 1, Subjects therefore seem to understand the difference between the gross expected return (which is higher in treatment **O** than in **N**) and the net expected return (which is the same in treatments **O** and **N**), that is, they *do not* systematically ignore the operations expenses fee of 1% in their fund choice.

Finally, note that we can also compare – for each treatment – subject behavior in the first block to that in the second block. We then find a significant difference in the fraction of choices for fund B in treatment **O** and significant differences between average earnings in blocks 1 and 2 for all treatments. Moreover, there is a significant increase of efficiency from block 1 to block 2 in treatments **N** and **O** (average efficiency increases from 0.76 to 0.93 and from 0.81 to 0.94, respectively), but not in treatment **F** (where average efficiency only increases from 0.66 to 0.73).

3.2 Treatment F: Front-End Load and Lock-in

In this subsection we focus on the effect of the front-end load. It is apparent from Figures 3 and 4 that the fraction of choices for fund B in treatment **F** is higher, but average earnings are lower than in the other two treatments. These differences, in means as well as in distributions, are significant when data from both blocks are pooled.[18] Figure 6 suggests that this apparent contradiction between the high fraction of choices for fund B and the low average earnings in treatment **F** may be explained by the large heterogeneity in efficiency in treatment **F**.[19] In fact, although we cannot reject the hypothesis of equal average efficiency for treatment **F** and the other two treatments,[20] we do reject that the *distribution* of efficiencies between these treatments is the same.

It follows from Figure 3 that, although fund B is chosen most of the time, fund A is still chosen quite often, also for treatment **F**. This can be either due to most subjects switching

[17]See the fourth column of Tables 7 and 8.

[18]However, when data are compared per block there are cases where the difference is not statistically significant. See the p-values of the MWW and KS tests in Tables 7 and 8.

[19]On the one hand, pooling all the data from treatments **N** and **O** we find only one case (out of 82 observations) where individual efficiency in a block is smaller than 55%. In treatment **F** there are 21 such cases (out of 70 observations). On the other hand, in treatment **F** there are 31 cases where efficiency in a block is higher than 95%, whereas treatments **N** and **O** combined there are only 23 of these cases.

[20]Except for the comparison between **N** and **F** in the second block.

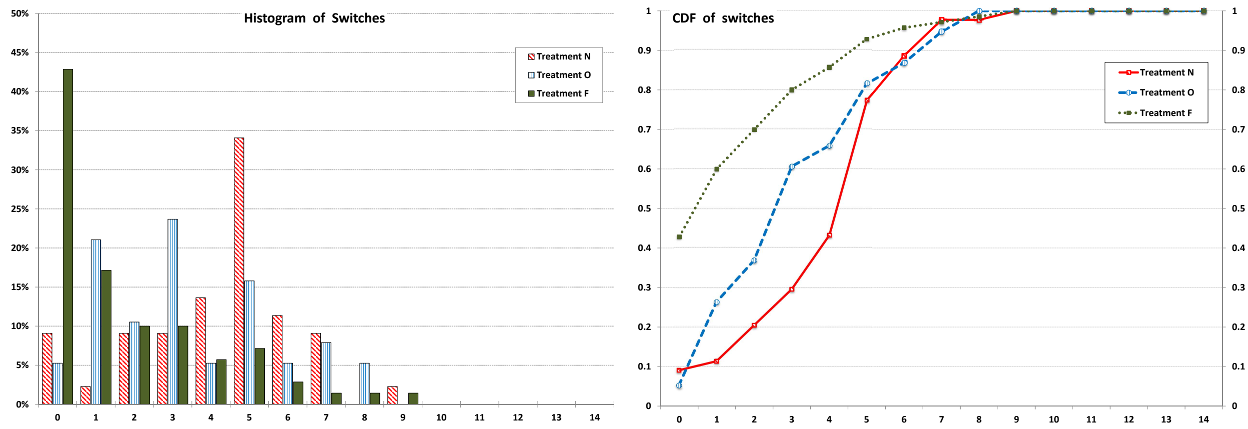

Figure 7: The histogram of switches between funds (*left*) and the CDF of individual switches (*right*). The data from two blocks in each treatment are pooled together.

regularly between the two funds, or due to some subjects almost always choosing fund A. The left panel of Figure 5 sheds some light on this issue: the histograms for treatments **N** and **O** are quite similar, with less than 10% of the subjects in these treatments choosing fund B for all 15 periods, whereas about 40% of the subjects in treatment **F** choose fund B for all 15 periods.

Based upon this analysis we conclude the following.

Result 2. *We reject Hypothesis 2: there is a significant difference of the behavior of subjects and their earnings in treatment **F**, when compared with the other two treatments. In particular, a substantially higher fraction of subjects makes decisions consistent with rational choice (investing in fund B for all 15 periods).*

We propose two explanations for the substantial difference between individual choices in treatment **F** and the other two treatments. First, most subjects understand that they should not pay the front-end load more than once, and that they need to stay with fund B long enough to recover this front-end load. In contrast, in treatments **N** and **O** the cost of switching between funds is small and such a *lock-in* is therefore absent. Another explanation is that subjects, given that they understand that switching between funds is prohibitively costly in treatment **F**, may exert more *cognitive effort* (e.g. Braas-Garza, Garca-Muoz, and Gonzlez, 2012) in that treatment and conclude already at the start of the experiment that they should choose fund B in every period.

Figure 7 shows the histogram of switching frequencies (left panel) and the empirical cumulative distribution function of the number of switches (right panel), for each treatment.[21] The average numbers of switches in treatments **N** and **O** (4.25 and 3.42, respectively) are significantly higher than the average number of switches in treatment **F** (1.77). Iin addition the distributions of the number of switches are significantly different for all three treatments.[22]

[21]Switching is defined as a choice in period $t > 1$ that is different from the choice made in period $t - 1$. The maximum number of switches per block is 14. The average numbers of switches per treatment and per block are shown in Figure 9 in Appendix C.

[22]The p-values of the MWW and KS tests are reported in the fifth columns of Tables 7 and 8, respectively.

Treatment	Block	Number of times the front-load fee was paid						
		0	1	2	3	4	5	6 or more
F	Block 1	0	22	4	6	3	0	0
	Block 2	3	22	8	1	1	0	0
	All	3	44	12	7	4	0	0
	(% out of 70)	(4%)	(63%)	(17%)	(10%)	(6%)	(0%)	(0%)
		Number of B-runs started in block						
		0	1	2	3	4	5	0
N	All	0	6	11	19	7	1	0
	(% out of 44)	(0%)	(14%)	(25%)	(43%)	(16%)	(2%)	(0%)
O	All	0	11	13	8	5	1	0
	(% out of 38)	(0%)	(25%)	(30%)	(18%)	(11%)	(2%)	(0%)

Table 3: The number of times subjects started to invest to fund B by choosing it in the first period of block or by switched from the other choice. For treatment **F**, this is the number of times the subjects payed the front-end load fee. Numbers in brackets show the frequency among all 'individual blocks' in a given treatment.

We delve deeper into this issue and investigate how often subjects in treatment **F** paid the front-end load, that is, how often they started to invest in fund B. This is reported in Table 3 where, for reference, we also include how often subjects in treatments **N** and **O** started to invest in fund B (which they could do free of an explicit charge in these treatments)

From this table we infer that, although the number of times subjects start to invest in fund B in treatments **N** and **O** is typically 2 or 3 in a block (this accounts for 62% of the observations), for a vast majority (63%) of the 70 blocks in treatment **F** the subject only invests in fund B once (but not necessarily in the very first period). This is consistent with the lock-in argument given above. Note that in more than a quarter of the blocks in treatment **F** the subject pays the front-end load at least twice, which is clearly suboptimal and inconsistent with the cognitive effort explanation.[23] Table 3 also presents, for treatment **F**, the results separately for each of the two blocks. There is some evidence that participants make better decisions in the second block: the average number of times the front-end load is paid decreases from 1.72 to 1.29, and the number of subjects paying the front-end load more than twice decreases from nine to two. In addition, three subjects are deterred from investing in fund B completely, possibly due to a disappointing experience with that fund in the first block.

We identified a substantial number of subjects who invest exactly once in fund B in treatment **F**. The next important question is *how long* these subjects invest in fund B. Expected returns are maximized when the subject invests in fund B for all 15 periods and the front-end load is recovered (in expectation) if the subject invests for at least eight consecutive periods in

See Appendix C. Note that within each treatment, the difference between the number of switches, or their distributions, across different blocks is not significant.

[23] In fact, the highest expected payoff for paying the front-end load twice – by investing for only one period in fund A, in between two longer investment runs in fund B – equals 1470 points, which is lower than the expected number of points (1512) from investing in fund A in every period. Clearly, paying the front-end load even more often will decrease earnings even more.

fund B. It turns out that of the 44 cases in treatment **F** where a subject only started to invest in fund B once, 28 (64%) lasted for the full block of 15 periods.[24] This behavior is consistent with the cognitive effort explanation for the results in treatment **F**, but cannot account for all the differences. Of the remaining 16 cases where the front-end load was only paid once, in seven cases the investmented lasted for less than seven periods (with six cases lasting for exactly eight periods, and the other three for 12, 13 and 14 periods, respectively).

Summarizing, those subjects in treatment **F** that understand that they should pay the front-end load not more than once will typically get locked into fund B, resulting in high payoffs. On the other hand, it will be difficult for subjects that pay the front-end load more than once to obtain a good return on their investment. One reason for subjects to switch relatively often in treatments **N** and **O** may also be that, even if a subject understands that choosing B in every period is the optimal decision, he/she is still curious about what happens if A is chosen instead, which is not very costly in these treatments.[25]

3.3 Return Chasing

When discussing Figure 3 above we conjectured that the observation that subjects regularly (suboptimally) choose fund A, may be partially explained by 'return chasing'. In this section we consider this explanation in a bit more detail.

To start with, Figure 8 plots the time series of the fraction of subjects choosing B in the first and second block (separated by the vertical line). The markers in the figure characterize the realized returns of funds A and B *from the previous period*. In particular, the large circles indicate when the return of fund A was higher than that of fund B in the previous period and the filled squares correspond to instances where both returns were low in the previous period (but with fund B still outperforming fund A). The remaining periods, where the return for fund B was high in the previous period, are marked with a hollow square. The figure suggests that the fraction of subjects choosing fund B tends to be small when fund B generated a small return in the previous period, especially when the return was smaller than that of fund A.

This conclusion is supported by Table 4, which shows (for each treatment and block) the fraction of choices for fund B in periods immediately preceded by a period in which the return for fund A was higher than that of fund B. The numbers in parentheses indicate the fraction of choices for fund B in all periods in that block (where we excluded the first period in each block, to facilitate comparisons). Table 4 shows that for each treatment the fraction of choices for fund B is smaller after a positive return difference for fund A, in particular for treatment **N** and, to a lesser extent, treatment **F**. From Figure 8 and Table 4 we conclude that return

[24]These 28 cases correspond to 40% of *all* 70 individual blocks in treatment **F**. In treatment **N** only in four of the 44 blocks (9%) and in treatment **O** only in two of the 38 blocks (5%), the subject invested in fund B for all 15 periods.

[25]See, for example, Blume and Ortmann (2007), who find that subjects may feel curious about other actions and deviate from the efficient equilibrium even after they have played it for a long time.

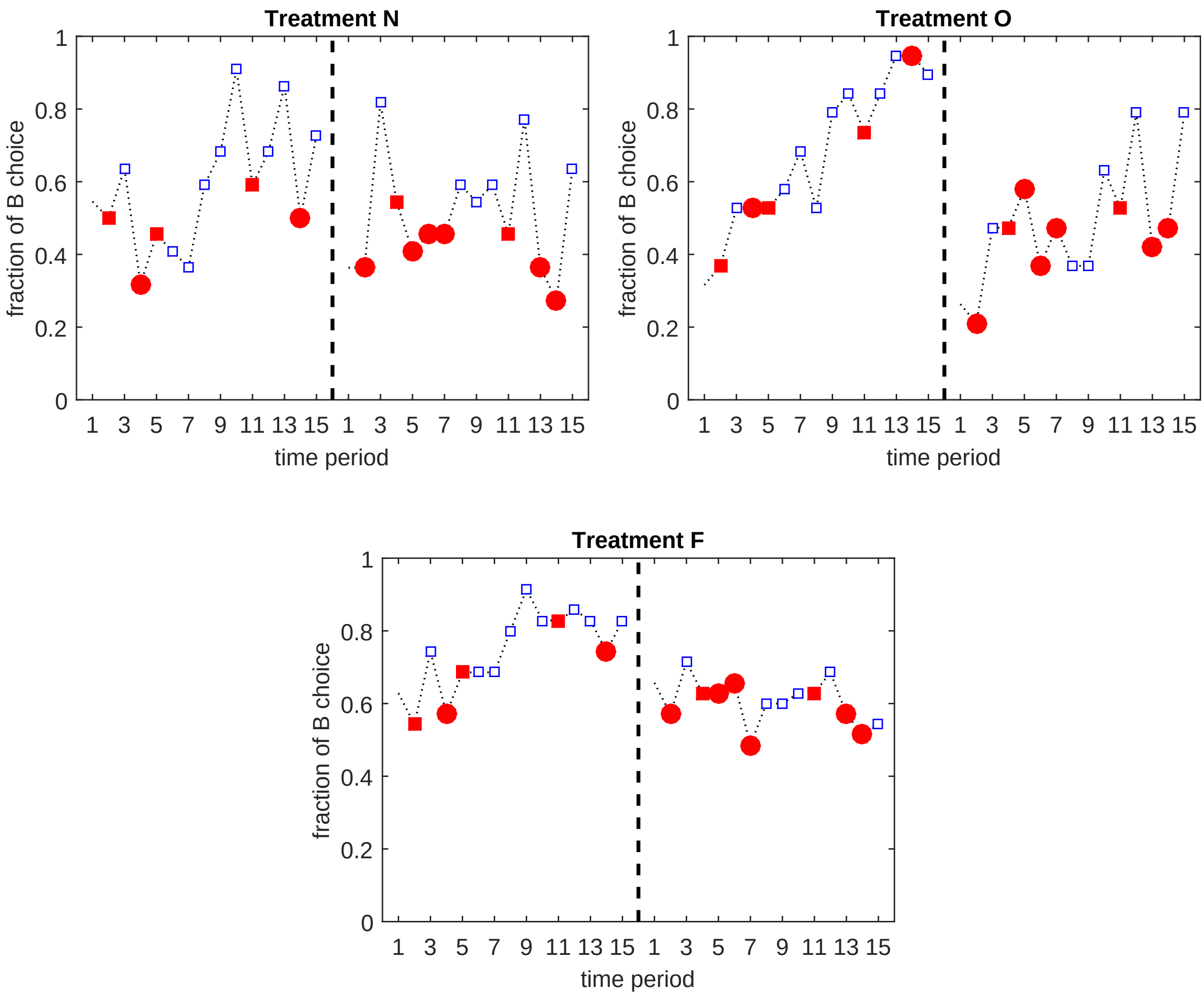

Figure 8: The time series of actual fraction of choice of B in the two blocks (as divided by the vertical dashed line) and all treatments. The large circled markers indicate those instances when in the *previous* period the realized return of A was larger than the realized return of B. These instances are rare with an *ex ante* probability of 25%.

chasing explains, at least partially, the relative high number of choices for fund A.

In order to capture return chasing we estimate a discrete choice model that describes how the fraction of subjects choosing fund B depends on past returns. In particular, we assume

$$n_{B,t} = \frac{\exp\big(\beta_0 + \beta_1 (r_{B,t-1} - r_{A,t-1})\big)}{1 + \exp\big(\beta_0 + \beta_1 (r_{B,t-1} - r_{A,t-1})\big)}. \tag{1}$$

Here $n_{B,t}$ is the fraction of subjects choosing fund B in period t, and $r_{A,t-1}$ and $r_{B,t-1}$ refer to the realized returns (in decimal points) of funds A and B in period $t-1$, respectively. The coefficient β_0 represents a *predisposition* towards choosing fund B and the coefficient β_1, sometimes referred to as the *intensity of choice*, captures how sensitive subjects are with respect to past return differences.[26] Given that the expected return of fund B is higher than that of A in

[26]This terminology is used in the Heterogeneous Agent Models approach to financial markets, see e.g. Hommes

Treatment	N	O	F
Block 1	40.91% (58.77%)	73.68% (69.55%)	65.71% (75.31%)
Block 2	38.64% (51.95%)	42.11% (49.62%)	57.14% (60.41%)
All Blocks	39.77% (55.36%)	57.90% (59.59%)	61.43% (67.86%)

Table 4: The fraction of choices for fund B in periods that immediately follow a period where the realized return of A was larger than that of fund realized return of B. The fraction in parentheses refer to the (unconditional) fraction of choices for fund B in periods $2-15$ of that block.

Treatment	N	O	F
β_0	0.1113	**0.2810**	**0.6708**
	(0.0852)	(0.0922)	(0.0805)
β_1	**6.6233**	3.0363	**4.9629**
	(2.6989)	(2.9078)	(2.2816)
McFadden's R^2	0.0072	0.0015	0.0039
Number of obs.	616	532	980

Table 5: Estimated coefficients of the discrete choice model (1) for the three different treatments. Standard deviations are in parentheses. The bold values are significant at 5% level.

every period, we conjecture that β_0 is positive. Optimal behavior (choosing fund B independent of past returns) corresponds to a high value of β_0, together with $\beta_1 = 0$, whereas return chasing corresponds to a positive value of β_1. When $\beta_0 = 0$ subjects only use past returns to decide in which fund to invest, and do not use information about expected returns.

Table 5 shows the estimated coefficients of model (1), based upon data pooled over blocks. Both coefficients are positive for all treatments, with the parameter β_0, measuring predisposition towards fund B, significant in treatments **O** and **F** and the intensity of choice parameter β_1 significant in treatments **N** and **F**, but not in treatment **O**. The estimated models are consistent with the descriptive statistics in Table 4: return chasing seems to be most prevalent in treatment **N**, and to a lesser extent in treatment **F** (note that return chasing in treatment **F** is remarkable since such a strategy is penalized in this treatment due to the front-end load). On the other hand, and consistent with the analysis in Section 3.2, the predisposition towards fund B is highest in treatment **F**.

Based on the findings in this section we have the following result.

Result 3. *We reject Hypothesis 3. Fund choices are partially explained by past realized returns.*

(2013). There is a growing literature that focuses on fitting the discrete choice model to experimental or empirical data, see, e.g., Branch (2004), Boswijk, Hommes, and Manzan (2007), Anufriev and Hommes (2012) and Anufriev, Hommes, and Philipse (2013). Anufriev, Bao, and Tuinstra (2016) recently estimated the values of the predisposition effect and intensity of choice for a laboratory experiment on fund choice where, as opposed to the present paper, subjects do not know the data generating process.

4 Conclusion

The experiment presented in this paper is aimed at investigating the effect of the fee structure and past returns on mutual fund choice. Subjects have to choose between two experimental funds, where the expected return of fund B is higher than that of fund A. Moreover, expected returns are independent of past returns and subjects know this. We impose different fee structures for fund B in the three treatments, but in such a way that expected returns (over the course of a long-run investment and net of fees) for fund B are the same in each treatment. Our prediction therefore is that investment behavior is the same in the different treatments and, in addition, does not depend upon past returns.

Indeed, there is no significant difference between subject behavior in the control treatment **N** and the operation expenses fee treatment **O**. However, behavior in treatment **F** is significantly different, with the front-end load acting as a commitment device for many subjects and locking them into permanently choosing fund B. Furthermore, in particular for treatment **N**, we find that subject behavior can be, to a substantial extent, explained by past returns.

Since our subjects had to repeatedly make investment decisions in a stationary environment, our findings suggest that bounded rationality in mutual fund choice, as for example also found in Choi, Laibson, and Madrian (2010), can not be easily mitigated by experience and learning. It highlights the desirability for regulatory authorities and other government agencies to exert effort in enhancing the transparency of the mutual fund industry, and the level of financial literacy in society.

We find that although a front-end load fee is more salient than an operation fee, it is not more discouraging to investors *per se*. In fact, it is used a commitment device and leads to a lock-in into the more profitable fund. Obviously, such a lock-in does not necessarily lead to higher payoffs. In fact, our findings raise the question whether we would have a similar lock-in if (net of the front-end load) fund B generates *lower* expected returns than fund A. Another interesting direction for future research is to investigate what happens if, after a number of periods, fund A becomes (much) more attractive than fund B and subjects should switch to fund A. In this way we can test whether the sunk-cost fallacy, see Friedman, Pommerenke, Lukose, Milam, and Huberman (2007) and the status quo bias, see Brown and Kagel (2009), play a role in the choice between mutual funds.

We are aware that several authors documented that subjects in financial market experiments (or even simpler experiments) lack game form recognition, see e.g. Chou, McConnell, Nagel, and Plott (2009). These authors show that, to a surprising degree, subjects seem to have little understanding of the experimental environment in which they participate. This has also been underlined by Kirchler, Huber, and Stöckl (2012), who show that running an experiment with a different context ("stocks of a depletable gold mine" instead of "stocks") reduces confusion and thereby significantly reduces mispricing and overvaluation. In our experiment, however, control questions and after-experimental questionnaires suggest that our subjects fully understood the experiment. Our finding suggests that return chasing behavior may be something deeply built in the "animal spirit" of human beings.

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APPENDIX

A Translated Experimental Instructions

These are the experimental instructions for the different treatments. For this purpose those parts that were shown only in certain treatments are included in squared brackets, preceded by the indication of which treatment this part belongs to. The separate instructions of different treatments, are available from the authors.

General information. In this experiment you are asked to make subsequent investment decisions. You will start with 1000 points which you can invest. In every subsequent period you will have the possibility to reinvest your accumulated points. In every period you can only invest all of your points in fund A, all of your points in fund B, or invest in neither of the two funds. [**Treatments O, F:** Fund B charges a fee for investment, fund A does not.] Your earnings from the experiment will depend upon how well your investments will do.

The funds and their prices. The price of fund A is $P_A(t)$ in period t, and the price of fund B is $P_B(t)$ in period t. Over time prices of the funds grow in the following way. The price of fund A in period $t+1$ is equal to $(1+g_A)$ times the price of fund A in period t, that is

$$P_A(t+1) = (1+g_A) \times P_A(t).$$

The growth rate g_A can only take one of two values. It is either equal to 0.05, or it is equal to 0.01. Both values are equally likely to occur (that is, both occur with the probability equal to 0.5). The history of values of g_A does not influence the probability of either value occurring.

[**Treatment N:** Similarly, the price of fund B grows with growth rate g_B, which could either be 0.06 or 0.02.] [**Treatments O, F:** Similarly, the price of fund B grows with growth rate g_B, which could either be 0.07 or 0.03.] Again both values are equally likely to occur. The price of fund B in period t therefore is

$$P_B(t+1) = (1+g_B) \times P_B(t).$$

Prices of the two funds do not influence each other. Moreover, your decisions will not influence the price of the two funds.

<u>Example:</u> Suppose the price of fund A is equal to 50 in period 1, and the growth rate in period 1 is equal to 0.05. In that case we have $P_A(2) = 1.05 \times 50 = 52.5$. If the growth rate in period 2 is given by 0.01 then the price in period 3 will be given by $P_A(3) = 52.5 \times 1.01 = 53.03$, and so on.

[**Treatment O: Fees for fund B.** Each period that you invest your points in fund B you will have to pay fees to the fund manager. This fee equals 1% of your accumulated points at the beginning of that period. Fund A does not charge any fees.]

[**Treatment F: Fees for fund B.** In each period that you **start** to invest in fund B you will have to pay a fee to the fund manager. This fee equals 13% of your accumulated points at the beginning of that period. Suppose that you invest in fund B from period 1 until period 5, and then invest in A from period 6 until period 10, and then go back to fund B in period 11. Then as a fee you have to pay 13% of your initial points in period 1, you do not have to pay a fee in periods 2 until 10, but in period 11 you then have to pay 13% of the points you accumulated until the beginning of period 11. Fund A does not charge any fees.]

Investing. If you invest your points in one of the two funds, the number of points you have will grow. For example, suppose you invest your 1000 points in fund A in period 1, when the price of fund A is $P_A(1) = 50$, and you keep your points in fund A until period 6. By then the price of fund A has grown to, for example, $P_A(6) = 60$. Then your points will have increased up to

$$1000 \times \frac{60}{50} = 1200.$$

[**Treatment N:** If you then decide to invest these points in fund B for the next two periods and, for example $P_B(6) = 56$, $P_B(7) = 59$ and $P_B(8) = 61$, your total number of points at the end of period 8 will be equal to

$$1200 \times \frac{61}{56} = 1307.14.]$$

[**Treatment O:** If you then decide to invest these points in fund B for the next two periods and, for example $P_B(6) = 55$, $P_B(7) = 57$ and $P_B(8) = 61$, your total number of points at the end of period 7 will be equal to

$$1200 \times \frac{57}{55} - 1200 \times 1\% = 1231.64.$$

Your total number of points at the end of period 8 will be (after subtracting the 1% fee again)

$$1231.64 \times \frac{61}{57} - 1231.64 \times 1\% = 1305.75.]$$

[**Treatment F:** If you then decide to invest these points in fund B for the next two periods and, for example $P_B(6) = 55$, $P_B(7) = 57$ and $P_B(8) = 61$, your total number of points at the end of period 8 will be (after subtracting the 13% fee for fund B that you will have to pay in period 7)

$$(1200 - 1200 \times 13\%) \times \frac{61}{55} = 1157.89.]$$

Note that your points will remain constant in the periods in which you invest in none of the two funds.

Your task. The experiment consists of three parts of 15 periods. In each part you start out with 1000 points, and you can increase the number of points by investing in the two funds A and B. In every period you have three options. Either to invest all of your points in fund A, or to invest all of your points in fund B, or to invest your points in neither fund. You are allowed to switch between funds as often as you want to, but you do not have to.

After the first 15 periods are finished, the experiment will be restarted. Your initial points will be reset to 1000 points and the prices of funds A and B will be reset to their initial values again. The values that the growth rates of the two prices can take are the same again (0.05 and 0.01 for fund A, with equal probability, and 0.06 and 0.02 for fund B, also with equal probability). Because these values are random, the actual growth rates in this second part of 15 periods will, most likely, be different for the actual growth rates in the first part of 15 periods.

After the second part of 15 periods, the experiment will be restarted in the same way as described above for another 15 periods.

Information. The information that you have at the beginning of time t, when you have to make your investment decision for period t, consists of the current prices, all past prices and all past growth rates of both funds. The current prices are shown in the top part of the computer screen. Both past prices and past growth rates are shown in a table on the computer screen. The prices of the funds are also shown in a graph on the screen. Moreover, we show your total accumulated (from the beginning of the current part) number of points in the top part of the computer screen.

Earnings. After the experiment you are paid out according to only one of the three parts. For which part you are paid is determined randomly, and with equal probability. You will be paid for the total number of points, and for each point you will receive 1 euro cent. For example, suppose in the first part your initial number of points increased from 1000 to 1800 points, in the second part your number of points increased from 1000 to 1400 points, and in the final part your number of points increased from 1000 to 1600 points. Then you will earn 18 euros if you are paid according to the first part, and 14 euros if you are paid according to the second part and 16 euros if you are paid according to the final part.

B Control Questions with Answers

B.1 Treatment N

1. Suppose that in the current period the price of fund A is 70 and the price of fund B is 74.1. You have 700 points in the current period and you choose to invest in fund A. Suppose that in the next period the price of funds A and B turned out to be 73.5 and 76.3, respectively. How many points do you have at the beginning of the next period? [735]

2. You have 1100 points at the beginning of the current period and want to invest in fund B. Would your investment decision from the previous period (i.e., in which fund you invested previously) matter for the number of points you will earn? [No]

B.2 Treatment O

1. Suppose that in the current period the price of fund A is 70 and the price of fund B is 74.1. You have 700 points in the current period and you choose to invest in fund A. Suppose that in the next period the price of funds A and B turned out to be 73.5 and 76.3, respectively. How many points do you have at the beginning of the next period? [735]

2. Suppose you have 600 points and you invest your points in fund B whose price in the current period is 57. Fund B charges a fee of 1%. How much fee would you pay for this period? [6]

3. You have 1100 points at the beginning of the current period and want to invest in fund B. Would your investment decision from the previous period (i.e., in which fund you invested previously) matter for the number of points you will earn? [No]

B.3 Treatment F

1. Suppose that in the current period the price of fund A is 70 and the price of fund B is 74.1. You have 700 points in the current period and you choose to invest in fund A for which there is no fee. Suppose that in the next period the price of funds A and B turned out to be 73.5 and 76.3, respectively. How many points do you have at the beginning of the next period? [735]

2. Suppose you invested in fund A in the last period, you have 1000 points at the beginning of this period and want to invest in fund B in this period. Fund B charges a fee of 13%. How much fee would you pay? [130]

3. Recall that fund A does not charge a fee, and fund B charges a fee of 13%. You have 1100 points at the beginning of the current period and want to invest in fund B. Would your investment decision from the previous period (i.e., in which fund you invested previously) matter for the number of points you will earn? [Yes]

C Additional Data and Analysis

Here we collect the results and statistics that have been used for the analysis reported in the main text.

Table 6 shows, for each block and treatment, the fractions of different choices. Note that the total number of choices for a given block in a given treatment is equal to the number of periods (which is 15) times the number of participants (which differed between treatments and is shown in the last column).

Treatment	**Block**	**Fraction of Choosing**			**Number of Participants**
		A	*B*	**Neither**	
N	Period 1	45.45%	54.55%	0.00%	22
	Block 1	41.52%	58.48%	0.00%	
	Block 2	48.79%	50.91%	0.30%	
	Average	45.15%	54.70%	0.15%	
O	Period 1	68.42%	31.58%	0.00%	19
	Block 1	32.63%	67.02%	0.35%	
	Block 2	51.58%	48.07%	0.35%	
	Average	42.11%	57.54%	0.35%	
F	Period 1	37.14%	62.86%	0.00%	35
	Block 1	24.38%	74.48%	1.14%	
	Block 2	37.90%	60.76%	1.33%	
	Average	31.14%	67.62%	1.24%	

Table 6: Fraction of individual choices for different options.

Table 7 collects the p-values of several Mann-Whitney-Wilcoxon tests for comparison between different blocks and treatments. The table is divided into several horizontal parts depending on which experimental sessions are used to test the hypothesis.[27]. The first horizontal part of the table collects the test results for a comparison between the first and second blocks in different treatments. The next three parts (with three rows in each) show the test results for a comparison between different treatments, **N** with **O**, **N** with **F**, and **O** with **F**. In each of these cases we test the results using the data from the first blocks only, from the second blocks only and then for both blocks.

Different columns of the table collect the statistics for the hypothesis about different data. The second column shows the p-values for the test when the number of choices of fund B are compared. The third column shows the p-values for the comparison of earnings. The fourth column shows the p-values for the test for the comparison of efficiencies (defined as the return earned divided by the return that could be earned using the rational strategy of investing every period in fund B). Finally, the last column shows the values for the test for the comparison of frequency of switching.

[27]We use the standard treatments acronyms, **N**, **O** and **F**, to refer to the all data for a given treatments and the letter-digit acronyms to show the treatments and block. For instance, O2 means treatment **O**, block 2.

The superscript ^{a} is used to indicate the occasions when the null hypothesis that the B-choices (resp., earnings) come from the same distributions can be rejected at the significance level of 5%.

Data to compare	p-values for the MWW test for differences in means for: choices of B	earnings	efficiency	switches
N1 vs N2	0.1565	0.0000^a	0.0000^a	0.8475
O1 vs O2	0.0259^a	0.0000^a	0.0062^a	0.2797
F1 vs F2	0.1516	0.0026^a	0.7754	0.5930
N1 vs O1	0.1795	0.2893	0.2655	0.0930
N2 vs O2	0.8749	0.8650	0.9790	0.3174
N vs **O**	0.5287	0.6452	0.5024	0.0655
N1 vs F1	0.0334^a	0.6491	0.7464	0.0007^a
N2 vs F2	0.3926	0.0568	0.0204^a	0.0000^a
N vs **F**	0.0212^a	0.0214^a	0.1102	0.0000^a
O1 vs F1	0.1814	0.3598	0.5313	0.0577
O2 vs F2	0.1735	0.1254	0.0955	0.0002^a
O vs **F**	0.0372^a	0.0201^a	0.1460	0.0001^a

Table 7: p-values for the Mann-Whitney-Wilcoxon tests of various hypotheses analyzed in the paper.

Table 8 displays the p-value of the Kolmogorov-Smirnov test for comparison between different blocks and treatments. It is organized in the same way as Table 7.

Data to compare	p-values for the KS test for differences in distributions for: choices of B	earnings	efficiency	switches
N1 vs N2	0.1746	0.0000^a	0.0015^a	0.5628
O1 vs O2	0.0486^a	0.0000^a	0.0060^a	0.7415
F1 vs F2	0.1676	0.0000^a	0.6403	0.9672
N1 vs O1	0.0993	0.4670	0.4670	0.3540
N2 vs O2	0.9853	0.5170	0.9823	0.1399
N vs **O**	0.4954	0.8616	0.6230	0.0310^a
N1 vs F1	0.0014^a	0.0140^a	0.0140^a	0.0023^a
N2 vs F2	0.1340	0.0093^a	0.0093^a	0.0000^a
N vs **F**	0.0007^a	0.0025^a	0.0007^a	0.0000^a
O1 vs F1	0.1036	0.0118^a	0.0226^a	0.1214
O2 vs F2	0.0496^a	0.0453^a	0.0453^a	0.0053^a
O vs **F**	0.0037^a	0.0067^a	0.0018^a	0.0013^a

Table 8: p-values for Kolmogorov-Smirnov test of individual choices for fund B.

Fig. 9 shows the average number of switches per participant for each block and for each treatment.

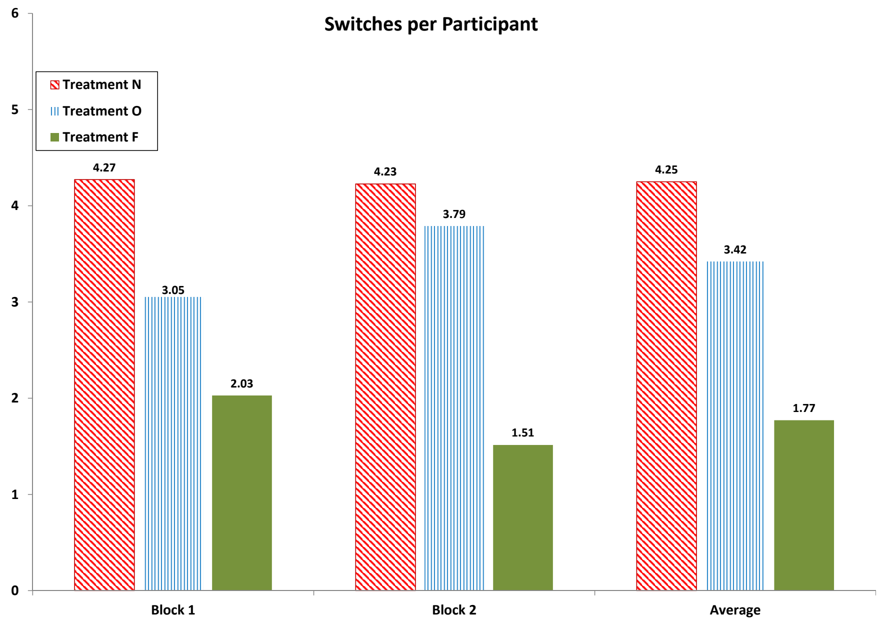

Figure 9: The average number of switches per participant in different blocks and treatments.

APPENDIX NOT FOR PUBLICATION

D Experimental Instructions in Different Treatments

D.1 Treatment N

General information. In this experiment you are asked to make subsequent investment decisions. You will start with 1000 points which you can invest. In every subsequent period you will have the possibility to reinvest your accumulated points. In every period you can only invest all of your points in fund A, all of your points in fund B, or invest in neither of the two funds. Your earnings from the experiment will depend upon how well your investments will do.

The funds and their prices. The price of fund A is $P_A(t)$ in period t, and the price of fund B is $P_B(t)$ in period t. Over time prices of the funds grow in the following way. The price of fund A in period $t+1$ is equal to $(1+g_A)$ times the price of fund A in period t, that is

$$P_A(t+1) = (1+g_A) \times P_A(t).$$

The growth rate g_A can only take one of two values. It is either equal to 0.05, or it is equal to 0.01. Both values are equally likely to occur (that is, both occur with the probability equal to 0.5). The history of values of g_A does not influence the probability of either value occurring.

Similarly, the price of fund B grows with growth rate g_B, which could either be 0.06 or 0.02. Again both values are equally likely to occur. The price of fund B in period t therefore is

$$P_B(t+1) = (1+g_B) \times P_B(t).$$

Prices of the two funds do not influence each other. Moreover, your decisions will not influence the price of the two funds.

Example: Suppose the price of fund A is equal to 50 in period 1, and the growth rate in period 1 is equal to 0.05. In that case we have $P_A(2) = 1.05 \times 50 = 52.5$. If the growth rate in period 2 is given by 0.01 then the price in period 3 will be given by $P_A(3) = 52.5 \times 1.01 = 53.03$, and so on.

Investing. If you invest your points in one of the two funds, the number of points you have will grow. For example, suppose you invest your 1000 points in fund A in period 1, when the price of fund A is $P_A(1) = 50$, and you keep your points in fund A until period 6. By then the price of fund A has grown to, for example, $P_A(6) = 60$. Then your points will have increased up to

$$1000 \times \frac{60}{50} = 1200.$$

If you then decide to invest these points in fund B for the next two periods and, for example $P_B(6) = 56$, $P_B(7) = 59$ and $P_B(8) = 61$, your total number of points at the end of period 8 will be equal to

$$1200 \times \frac{61}{56} = 1307.14.$$

Note that your points will remain constant in the periods in which you invest in none of the two funds.

Your task. The experiment consists of three parts of 15 periods. In each part you start out with 1000 points, and you can increase the number of points by investing in the two funds A and B. In every period you have three options. Either to invest all of your points in fund A, or to invest all of your points in fund B, or to invest your points in neither fund. You are allowed to switch between funds as often as you want to, but you do not have to.

After the first 15 periods are finished, the experiment will be restarted. Your initial points will be reset to 1000 points and the prices of funds A and B will be reset to their initial values again. The values that the growth rates of the two prices can take are the same again (0.05 and 0.01 for fund A, with equal probability, and 0.06 and 0.02 for fund B, also with equal probability). Because these values are random, the actual growth rates in this second part of 15 periods will, most likely, be different for the actual growth rates in the first part of 15 periods.

After the second part of 15 periods, the experiment will be restarted in the same way as described above for another 15 periods.

Information. The information that you have at the beginning of time t, when you have to make your investment decision for period t, consists of the current prices, all past prices and all past growth rates of both funds. The current prices are shown in the top part of the computer screen. Both past prices and past growth rates are shown in a table on the computer screen. The prices of the funds are also shown in a graph on the screen. Moreover, we show your total accumulated (from the beginning of the current part) number of points in the top part of the computer screen.

Earnings. After the experiment you are paid out according to only one of the three parts. For which part you are paid is determined randomly, and with equal probability. You will be paid for the total number of points, and for each point you will receive 1 euro cent. For example, suppose in the first part your initial number of points increased from 1000 to 1800 points, in the second part your number of points increased from 1000 to 1400 points, and in the final part your number of points increased from 1000 to 1600 points. Then you will earn 18 euros if you are paid according to the first part, and 14 euros if you are paid according to the second part and 16 euros if you are paid according to the final part.

D.2 Treatment O

General information. In this experiment you are asked to make subsequent investment decisions. You will start with 1000 points which you can invest. In every subsequent period you will have the possibility to reinvest your accumulated points. In every period you can only invest all of your points in fund A, all of your points in fund B, or invest in neither of the two funds. Fund B charges a fee for investment, fund A does not. Your earnings from the experiment will depend upon how well your investments will do.

The funds and their prices. The price of fund A is $P_A(t)$ in period t, and the price of fund B is $P_B(t)$ in period t. Over time prices of the funds grow in the following way. The price of fund A in period $t+1$ is equal to $(1+g_A\ )$ times the price of fund A in period t, that is

$$P_A(t+1) = (1+g_A) \times P_A(t).$$

The growth rate g_A can only take one of two values. It is either equal to 0.05, or it is equal to 0.01. Both values are equally likely to occur (that is, both occur with the probability equal to 0.5). The history of values of g_A does not influence the probability of either value occurring.

Similarly, the price of fund B grows with growth rate g_B, which could either be 0.07 or 0.03. Again both values are equally likely to occur. The price of fund B in period t therefore is

$$P_B(t+1) = (1+g_B) \times P_B(t).$$

Prices of the two funds do not influence each other. Moreover, your decisions will not influence the price of the two funds.

Example: Suppose the price of fund A is equal to 50 in period 1, and the growth rate in period 1 is equal to 0.05. In that case we have $P_A(2) = 1.05 \times 50 = 52.5$. If the growth rate in period 2 is given by 0.01 then the price in period 3 will be given by $P_A(3) = 52.5 \times 1.01 = 53.03$, and so on.

Fees for fund B. Each period that you invest your points in fund B you will have to pay fees to the fund manager. This fee equals 1% of your accumulated points at the beginning of that period. Fund A does not charge any fees.

Investing. If you invest your points in one of the two funds, the number of points you have will grow. For example, suppose you invest your 1000 points in fund A in period 1, when the price of fund A is $P_A(1) = 50$, and you keep your points in fund A until period 6. By then the price of fund A has grown to, for example, $P_A(6) = 60$. Then your points will have increased up to

$$1000 \times \frac{60}{50} = 1200.$$

If you then decide to invest these points in fund B for the next two periods and, for example $P_B(6) = 55$, $P_B(7) = 57$ and $P_B(8) = 61$, your total number of points at the end of period 7 will be equal to

$$1200 \times \frac{57}{55} - 1200 \times 1\% = 1231.64.$$

Your total number of points at the end of period 8 will be (after subtracting the 1% fee again)

$$1231.64 \times \frac{61}{57} - 1231.64 \times 1\% = 1305.75.$$

Note that your points will remain constant in the periods in which you invest in none of the two funds.

Your task. The experiment consists of three parts of 15 periods. In each part you start out with 1000 points, and you can increase the number of points by investing in the two funds A and B. In every period you have three options. Either to invest all of your points in fund A, or to invest all of your points in fund B, or to invest your points in neither fund. You are allowed to switch between funds as often as you want to, but you do not have to.

After the first 15 periods are finished, the experiment will be restarted. Your initial points will be reset to 1000 points and the prices of funds A and B will be reset to their initial values again. The values that the growth rates of the two prices can take are the same again (0.05 and 0.01 for fund A, with equal probability, and 0.07 and 0.03 for fund B, also with equal probability). Because these values are random, the actual growth rates in this second part of 15 periods will, most likely, be different for the actual growth rates in the first part of 15 periods.

After the second part of 15 periods, the experiment will be restarted in the same way as described above for another 15 periods.

Information. The information that you have at the beginning of time t, when you have to make your investment decision for period t, consists of the current prices, all past prices and all past growth rates of both funds. The current prices are shown in the top part of the computer screen. Both past prices and past growth rates are shown in a table on the computer screen. The prices of the funds are also shown in a graph on the screen. Moreover, we show your total accumulated (from the beginning of the current part) number of points in the top part of the computer screen.

Earnings. After the experiment you are paid out according to only one of the three parts. For which part you are paid is determined randomly, and with equal probability. You will be paid for the total number of points, and for each point you will receive 1 euro cent. For example, suppose in the first part your initial number of points increased from 1000 to 1800 points, in the second part your number of points increased from 1000 to 1400 points, and in the final part your number of points increased from 1000 to 1600 points. Then you will earn 18 euros if you are paid according to the first part, and 14 euros if you are paid according to the second part and 16 euros if you are paid according to the final part.

D.3 Treatment F

General information. In this experiment you are asked to make subsequent investment decisions. You will start with 1000 points which you can invest. In every subsequent period you will have the possibility to reinvest your accumulated points. In every period you can only invest all of your points in fund A, all of your points in fund B, or invest in neither of the two funds. Fund B charges a fee for investment, fund A does not. Your earnings from the experiment will depend upon how well your investments will do.

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The growth rate g_A can only take one of two values. It is either equal to 0.05, or it is equal to 0.01. Both values are equally likely to occur (that is, both occur with the probability equal to 0.5). The history of values of g_A does not influence the probability of either value occurring.

Similarly, the price of fund B grows with growth rate g_B, which could either be 0.07 or 0.03. Again both values are equally likely to occur. The price of fund B in period t therefore is

$$P_B(t+1) = (1+g_B) \times P_B(t).$$

Prices of the two funds do not influence each other. Moreover, your decisions will not influence the price of the two funds.

Example: Suppose the price of fund A is equal to 50 in period 1, and the growth rate in period 1 is equal to 0.05. In that case we have $P_A(2) = 1.05 \times 50 = 52.5$. If the growth rate in period 2 is given by 0.01 then the price in period 3 will be given by $P_A(3) = 52.5 \times 1.01 = 53.03$, and so on.

Fees for fund B. In each period that you **start** to invest in fund B you will have to pay a fee to the fund manager. This fee equals 13% of your accumulated points at the beginning of that period. Suppose that you invest in fund B from period 1 until period 5, and then invest in A from period 6 until period 10, and then go back to fund B in period 11. Then as a fee you have to pay 13% of your initial points in period 1, you do not have to pay a fee in periods 2 until 10, but in period 11 you then have to pay 13% of the points you accumulated until the beginning of period 11. Fund A does not charge any fees.

Investing. If you invest your points in one of the two funds, the number of points you have will grow. For example, suppose you invest your 1000 points in fund A in period 1, when the price of fund A is $P_A(1) = 50$, and you keep your points in fund A until period 6. By then the price of fund A has grown to, for example, $P_A(6) = 60$. Then your points will have increased up to

$$1000 \times \frac{60}{50} = 1200.$$

If you then decide to invest these points in fund B for the next two periods and, for example $P_B(6) = 55$, $P_B(7) = 57$ and $P_B(8) = 61$, your total number of points at the end of period 8 will be (after subtracting the 13% fee for fund B that you will have to pay in period 7)

$$(1200 - 1200 \times 13\%) \times \frac{61}{55} = 1157.89.$$

Note that your points will remain constant in the periods in which you invest in none of the two funds.

Your task. The experiment consists of three parts of 15 periods. In each part you start out with 1000 points, and you can increase the number of points by investing in the two funds A and B. In every period you have three options. Either to invest all of your points in fund A, or to invest all of your points in fund B, or to invest your points in neither fund. You are allowed to switch between funds as often as you want to, but you do not have to.

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After the second part of 15 periods, the experiment will be restarted in the same way as described above for another 15 periods.

Information. The information that you have at the beginning of time t, when you have to make your investment decision for period t, consists of the current prices, all past prices and all past growth rates of both funds. The current prices are shown in the top part of the computer screen. Both past prices and past growth rates are shown in a table on the computer screen. The prices of the funds are also shown in a graph on the screen. Moreover, we show your total accumulated (from the beginning of the current part) number of points in the top part of the computer screen.

Earnings. After the experiment you are paid out according to only one of the three parts. For which part you are paid is determined randomly, and with equal probability. You will be paid for the total number of points, and for each point you will receive 1 euro cent. For example, suppose in the first part your initial number of points increased from 1000 to 1800 points, in the second part your number of points increased from 1000 to 1400 points, and in the final part your number of points increased from 1000 to 1600 points. Then you will earn 18 euros if you are paid according to the first part, and 14 euros if you are paid according to the second part and 16 euros if you are paid according to the final part.

E Experimental Screen in Different Treatments

Fig. 2 in the main text illustrates the screen in treatment **O**. Fig. 10 shows the screens for the other two treatments.

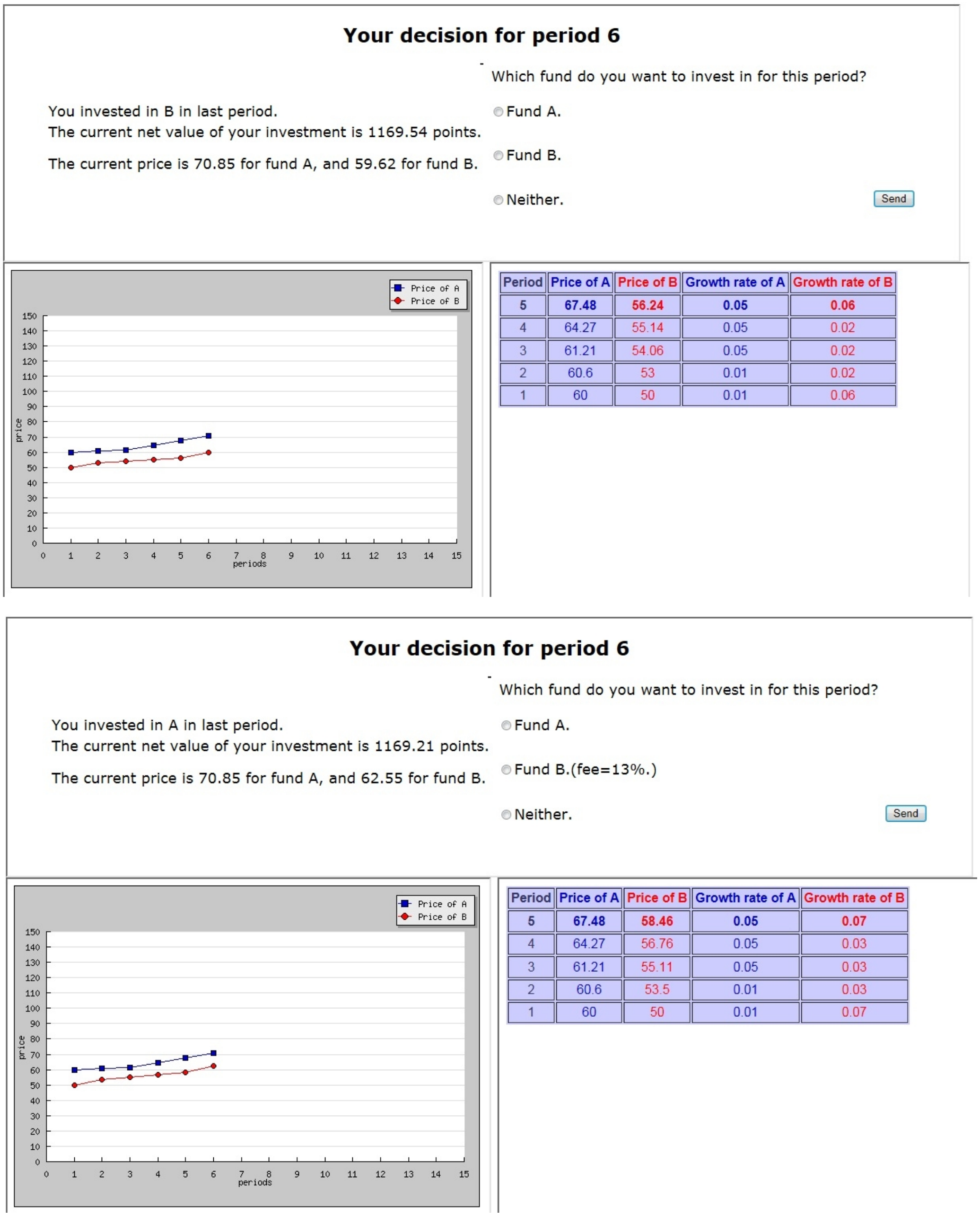

Figure 10: Examples of computer screens used in treatments **N** (above) and **F** (below). The subjects make a choice between investing in fund A, fund B or neither of them in the decision box in the upper part of the screen. They can refer to the past prices and returns shown in the left part of the screen. The prices of fund A are shown by squares, and the prices of fund B are shown by diamonds. In case if choice of fund B implies some fee, this is reminded in the decision box.