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30. September 2009

Online at <http://mpra.ub.uni-muenchen.de/17835/>  
MPRA Paper No. 17835, posted 12. October 2009 / 21:29

## HOW TO ADAPT TO CHANGING MARKETS:

## EXPERIENCE AND PERSONALITY IN A REPEATED INVESTMENT GAME

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**ABSTRACT:** Investment behavior is traditionally investigated with the assumption that risky investment is on average advantageous. However, this may not always be the case. In this paper, we experimentally studied investment choices made by students and financial professionals under favorable and unfavorable market conditions in a multi-round investment game. In particular, the probability of winning was set so that investment in one condition was advantageous, and in one condition was disadvantageous.

To investigate who is more likely to adapt their investment behaviors to the changing market conditions, we also measured personality and self-efficacy. We expected that investment behavior in changing markets could be predicted by a combination of experience (students, professionals), personality (anxiety, optimism, impulsivity, and Openness to Experience), and self-efficacy (belief in one's ability to make good decisions in an investment task).

Results indicate that professionals do not significantly differ from students in their decisions. Personality and self-efficacy both predicted investment behavior. In particular, we found that optimism and anxiety were a liability in unfavorable markets, leading to unreasonable levels of risk. Impulsivity was a liability in both favorable and unfavorable markets, leading to high risk on unfavorable markets, and low risk in favorable markets. Openness to experience was an asset in unfavorable markets, leading to adjusted risk taking. Finally, self-efficacy was generally related to higher levels of risk.

**JEL:** D14, D53, D81, G11, C91, C93

<sup>#</sup> Please send all correspondence to both authors. This is an interdisciplinary project between economics and psychology, and both authors contributed equally to the research.

\* We would like to thank Michel Odehnal and Stephane Peysson for help with programming the experimental interface and Marina Bianchi-Galanti and Cristina Rivera for the excellent help running the experiments. Financial support through a NETSPAR research grant awarded to Astrid Hopfensitz and Tanja Wranik is gratefully acknowledged.

## 1 Introduction

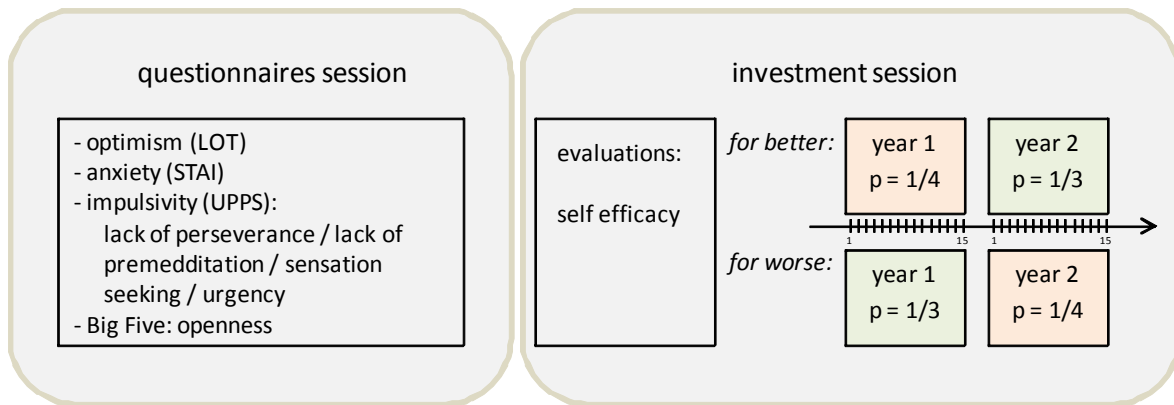
A large body of research in economics and finance has focused on understanding risk taking behaviors in financial markets. Much of this research has been motivated by the observation that stocks have significantly higher average long term returns than bonds (Mehra and Prescott, 1985).<sup>1</sup> Thus, a major research question has been to understand why investment in stocks is not as high as risk aversion would predict. Accordingly, most experiments have been constructed in such a way that investments are made between a risky and a safe project, and returns from the risky project are on average higher than returns from the safe project.

In real life, the observation that returns from stocks are higher than returns from bonds are long term averages, and obviously investment in stocks might be more or less advantageous during certain periods compared to others. Unfortunately, there has been little research to examine how investors react during unfavorable or changing market periods. While unfavorable market conditions are rarely studied by economists, psychologists have developed the "Iowa Gambling Task", which represents a gambling situation where one option is on average disadvantageous. This task has been used with emotionally impaired brain patients to confirm that lack of emotional competence can lead to long term disadvantageous investment decisions (Bechara et al., 1997). However, such patients also invest more than controls in situations where investment is advantageous for them (Shiv et al, 2005a/2005b). Thus a lack of emotions generally leads to more risk taking and gambling, independent of whether the participant is in a good or a bad market condition. The aim of our study was to understand how investor reactions and behaviors differ in advantageous and disadvantageous market conditions and how these are related to experience and personality.

In this paper, we present results from an economic experiment investigating behaviors when market conditions change. Specifically, we compare behaviors of naive investors (i.e. students) with experienced investors (i.e. professionals of the financial industry). Previous research has shown that professionals often show the same biases as naive investors, and also that professionals can sometimes have stronger biases than non-professionals (Haigh and List, 2005).

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<sup>1</sup> Specifically: "Over the ninety-year period 1889-1978 the average real annual yield on the Standard and Poor 500 Index was seven percent, while the average yield on short-term debt was less than one percent".



**Figure 1: Sessions of the experiment. Note that for students the questionnaire session took place about one week before the investment session. For professionals the questionnaire session followed immediately the investment session.**

Clearly, there are many reasons (training, experience, etc.) why professionals might react differently from students (e.g. Burns, 1985, Potters and van Winden, 2000). Another important reason might be the self-selection of people with specific personality profiles into certain professions. For example, previous research has shown that entrepreneurs (Brandstaetter, 1997) and financial traders (Lo et al., 2005) are characterized by specific personality traits. When comparing behavior between experienced and inexperienced investors, we therefore also took into account their specific personality profile. Consequently, we will explore the relationship between experience, personality, and investment behavior.

## 2 Methods and Predictions

In this paper, we present an experiment in which students and finance professionals participated in a repeated investment game. The game consisted of two years of 15 rounds each. In one year investment was advantageous, and in the second year investment was disadvantageous. In addition to investment behavior, we also report a number of personality traits that were measured in a separate session (see Figure 1).

The investment task is based on the type of repeated investment task generally used to study myopic loss aversion (Gneezy and Potters, 1997; Thaler et al., 1997; Bellmare et al., 2005). In this task, participants repeatedly make decisions concerning the allocation of points into two projects. In our case, participants received 100 points each period, which they could use for

investment. Note that previous earnings could not be used for investment, and that the budget available therefore stayed constant throughout the task. Participants could choose to invest their budget into a “safe” project, in which each point invested was simply added to the cumulative earnings, or a “risky” project. The risky project was a project in which the participant had a probability  $p$  of receiving the invested amount multiplied 2.5 times plus the initial investment, and a probability  $(1-p)$  that the total amount invested into the project during the round would be lost. In past studies the probability of winning was set to  $p = 1/3$ , which meant that investment was on average advantageous ( $EV = 1.17$ ), because it was larger than returns from the safe project ( $EV = 1$ ).

In our study, participants had to make investment decisions in two different market conditions. The risky option in the first market had a probability of winning of  $p = 1/3$ , and in the second market a probability of winning of  $p = 1/4$ . We will call the year with a probability of  $p = 1/3$  the “good year” since investment was on average advantageous ( $EV = 1.17$ ). In contrast, investment in the year with  $p = 1/4$  was in expected terms disadvantageous ( $EV = 0.875$ ), and we will refer to it as a “bad year”. The first treatment variable was the order in which the participant entered into the good versus the bad year (see Figure 1: ‘for better’ and ‘for worse’).

To control for personality differences, participants also filled out a number of standardized personality scales during a second session. Variables of interest included trait optimism, trait anxiety, impulsivity, and openness to experience. Trait optimism was measured with the 10-item LOT-R (Carver and Scheier, 2001), which includes four filler items, three positively-worded items, and three reverse-coded items. Respondents indicate their degree of agreement with statements such as, “In uncertain times, I usually expect the best,” using a five-point response scale ranging from “strongly disagree” to “strongly agree.” Negatively-worded items are reversed, and a single score is obtained indicating the degree of optimism. Anxiety was measured with the 20-item STAI-Trait questionnaire (Spielberger, 1972). This instrument assesses the relative frequency of general nervousness or anxiousness in different contexts, and participants rate the relative frequency with which they engage in the described behavior on a four point scale (1 = almost never; 4 = almost always). General personality was measured using the Big Five Personality Inventory (BFI) developed by John and Srivastava (1999). The “Big Five” are

broad categories of personality traits thought to be the most parsimonious in describing inter-individual variation in behavioral propensities. The BFI includes items pertaining to Extraversion (e.g., talkative, energetic), Agreeableness (e.g., kind, warm), Conscientiousness (e.g., efficient, organized), Neuroticism (e.g., moody, touchy), and Openness to Experience (e.g., imaginative, complex). The 44-items are presented as a series of affirmations, and participants are asked to indicate the extent to which they agree or disagree with them, using a 1 (disagree strongly) to 5 (agree strongly) response format. For this study we only examined Openness to Experience. Finally, we measured impulsivity using the UPPS Impulsive Behavior scale (Whiteside and Lynam, 2001). This instrument measures four distinct traits related to impulsivity: (a) lack of premeditation; (b) urgency; (c) sensation-seeking; and (d) lack of perseverance. The 45 items are presented as a series of affirmations, and participants are asked to indicate the extent to which they agree or disagree with them, using a 1 (agree strongly) to 4 (disagree strongly) response format.

## **2.1 Procedures**

The experiment was conducted in Spring 2009 at the University of Geneva, Switzerland. Student participants were recruited by announcements promising a monetary reward and were asked to sign up for two one-hour sessions. The first was a questionnaire session; the second was the experimental session in which participants completed the investment task. Professionals were invited by their HR Manager per e-mail (see Appendix B). For them, monetary rewards were not explicitly mentioned in the invitation, and they accepted in order to help the research of the HR manager who invited them. For practical reasons, professionals were only required to come to the University laboratory once, and to complete both sessions on the same day. To avoid carry over effects from the personality questionnaires, professionals first participated in the experimental session and then filled out the personality questionnaires. Both students and professionals were paid their earnings from the investment task at the end. Average earnings for students were around 31.3 CHF (approx. 27 USD) and for professionals 58.9 CHF (approx. 52 USD). In total, 31 professionals (22 men, 9 women; mean age 43.9, std. dev. 9.25) and 46 students (25 men, 21 women; mean age 27.0, std. dev. 8.02) participated in the study.

Professionals came from a small private bank in Switzerland. The bank employs around 100 people in four different locations in Switzerland. The areas of expertise are: private banking, institutional asset management, fund administration and management and services for independent asset managers. The aim of the bank is to "apply advanced financial techniques to client service, to protect their assets from the hazards of speculation, and to ensure regular returns over the medium and long term". The size of the bank requires small teams to work in close liaison with the asset managers. The proximity also allows them to share information with respect to financial markets and sectors of particular interest. The 31 professionals participating in the experiment came from various sites of the bank. They also represent a variety of nationalities: the majority was born in Switzerland, but three Italians, one Spanish, one German, one Swedish, two Japanese, and one Canadian also participated. The professional's education background included: practical banking training completed by theoretical courses (5 participants), commercial diploma (8 participants), and university graduates in political economy, economics, commercial and industrial sciences, mathematics, engineering and econometrics. The average length of service in the same bank was 11 years for women and 9 years for men. For more details on the participants see Table I.

**Table I: Area of responsibility of professionals**

	Female	Male	Total
Senior asset and relationship managers	5	13	18
Junior asset managers	2		2
Financial Analyst (some of them also Investment funds managers)	2	7	9
Trader	1		1
Chief financial officer	1		1

Even though the order or the two sessions varied for professionals and students, the same protocol was applied for each of the two sessions. At the beginning of the questionnaire session, participants were informed that they would have to fill out a number of questionnaires concerning their personality. It took participants between 40 to 60 minutes to answer all the questionnaires. At the beginning of the investment task, participants were informed that they would participate in an investment game in which they could earn points that would be converted to real money at a specified exchange rate at the end of the session. Students received 30 CHF and professionals 60 CHF (equivalent to 3000 points) as initial capital and were handed the money in envelopes.

This money was the capital that could be used for investment in the two years of 15 rounds each. In each round, participants made decisions concerning 100 points from their initial capital. Points had to be distributed between two projects: a safe project and a risky project. In one of the two years the risky project had an expected value higher than the safe project in the other year the value was lower. Specifically in 'good' years investment in the risky project resulted in gains of 2.5 times the investment with probability  $p=1/3$  and in bad years the probability of gains was  $p=1/4$ . The order of 'good' and 'bad' years was counterbalanced across participants.

After participants had read the instructions, they answered a number of control questions and were invited to address any remaining questions to the experimenter. To keep feedback comparable across treatment, outcomes from investment were predetermined by random sequences that were equally distributed across treatments.

## 2.2 Predictions and Hypothesis

Our first question will focus on whether the probability of the risky project will indeed influence investment amounts. Given that the expected value of risky project is larger than the safe project for good markets, and lower than the safe project for bad markets, we expect a risk neutral decision maker to invest fully in good markets and not to invest in bad markets. Risk aversion might lead to intermediate investment for good markets, but certainly investment should be higher for good markets than for bad markets. Predictions could differ if risk aversion depends on how earnings are evaluated with respect to some reference point (Kahneman and Tversky, 1979). In such cases, a within-subject comparison for investment in different markets might be problematic, since risk taking behavior will always be influenced by previous outcomes and probabilities. Our first hypothesis is therefore:

HYPOTHESIS 1: Investment is on average and for each subject higher for good market conditions than for bad market conditions.

Past studies have already confirmed that previous outcomes will influence future choices. Examples are the "hot hand effect" and "gamblers fallacy" (Tversky and Kahneman, 1971; Croson and Sundali, 2005). However, it is not known whether these effects are influenced by the specific probabilities of winning. We thus wished to investigate the presence of these effects and



their relative strength given the two probability conditions within our repeated investment data. If probabilities are reflected in the gamblers fallacy (which has been labeled as the "law of small numbers"), we expect this effect to be influenced by market conditions and to be weaker for bad markets.

HYPOTHESIS 2: If the gambler's fallacy occurs, the effect should be weaker for bad markets than for good markets.

Our final question concerns whether professionals show significantly different trading strategies than students. If we observe differences, we will explore whether these are due to different personality profiles or due to experience and training specific to professionals. As previous research has suggested (Sjöberg and Engelberg, 2009), professionals in the financial industry tend to be a self-selected sample characterized by certain personality traits enabling them to take high risks. Thus, we expect professionals to be less anxious and more optimistic than our student population. In addition, previous exposure to investment situations in the real world might lead professionals to react differently to the situation at hand and feel more comfortable with the task. Thus, another possibility is that not training but the participant confidence during the task will impact behavior. We will therefore also control for participants' perceived self-confidence or "self-efficacy" in the task.

Concerning our personality variables we have the following hypothesis:

HYPOTHESIS 3: Professionals show a personality profile different from students. Namely they are characterized by less anxiety and more optimism.

We further predict that personality will influence investment behavior for the two different markets. Specifically optimism will be related to more risk taking, leading to higher investment for both market conditions. Trait anxiety can be related to the anticipation of anxiety in which case economic models of anticipatory emotions predict less risk taking (Wu, 1999; Caplin and Leahy, 2001). However studies on gamblers have shown a link between high trait anxiety and an urge to gamble (Zangeneh et al., 2008). Thus, we might expect anxiety to have either a negative or positive impact on risk taking. Impulsivity (and its subscales: lack of perseverance, lack of premeditation, sensation seeking and urgency) can be linked to more impulsive reactions to

outcomes. This might imply a tendency to give in to risk aversion once small gains are made and to a tendency to continue gambling once losses are encountered (Lynam and Miller, 2004). Impulsivity might therefore show a very different impact for good or for bad markets. For good markets it might lead to less risk taking while for bad markets it might increase risk taken. Finally, we also include Openness to Experience, to allow for a personality trait related to curiosity and novel approaches to new situations. Previous research mostly focused on why real stock investment is 'not high enough' given the long term observation that returns from stocks are on average higher than returns from bonds (e.g. Mehra and Prescott, 1985). This very often leads to a general tendency to consider risk taking as advantageous, and especially so if it is presented as an investment setting. Consequently, unfavorable probabilities might be ignored. We predict that participants high in Openness will be more likely to adapt to a novel situation and be more likely to react appropriately to the low probability of winning in the bad market.

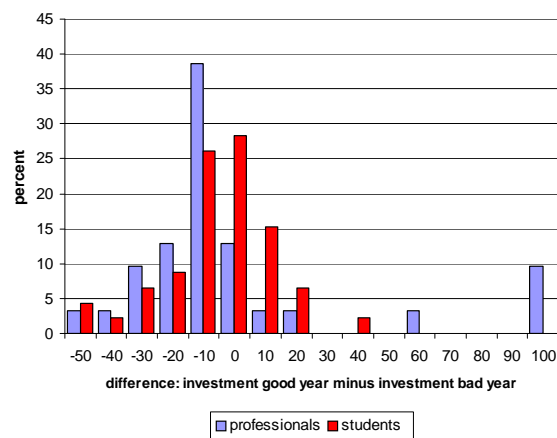
HYPOTHESIS 4: We expect investment behavior to be influenced by personality. The influence on risk taking will differ between good and bad market years.

### **3 Results**

We now come to a presentation of the results. In the next section, we will give general descriptive statistics concerning investment behavior across the different treatments. In sections 3.2 and 3.3, we will then investigate the impact of markets, experience, and personality on investment choices.

#### **3.1 General descriptive statistics**

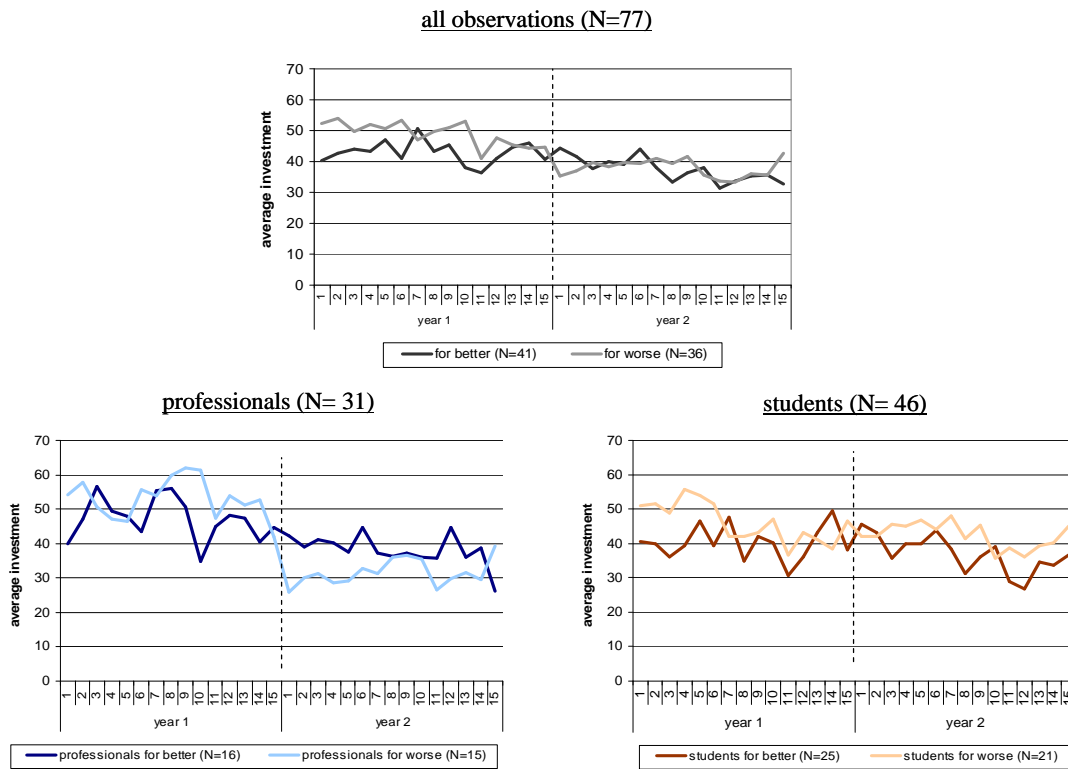
Overall investment over treatments and rounds is at 42.1%, with average investment in good years at 42.9% and in bad years at 40.6%. Investment in good years is thus slightly higher, however this difference is not significant (Wilcoxon sign-rank test,  $p=0.978$ ). Moreover, this difference is mainly due to the professional's behavior. While professionals invested 45.4% in good markets and 39.6% in bad markets (Wilcoxon sign-rank test,  $p=0.616$ ), students had an average investment of 41% in both market conditions. The difference for professionals is mainly due to four out of 31 participants (i.e. 13 %) who invest on average at least 60 units more in good years than in bad years (see also Figure 2). Ignoring these few observations, we even observe a



**Figure 2: Histogram of investment difference between good and bad years for professionals and students.**

slight bias to lower investment for good than bad years. Overall, our results therefore show that investment is largely unaffected by probabilities of winning.

This result is further confirmed if we consider investment over rounds in each year (Figure 3). In this figure, we present the investment time line for investors who first face a good and then a bad year ("for worse") and for investors who first face a bad and then a good year ("for better"). It is striking that we do not observe a strong difference for the treatment order. Specifically, although we observe slightly higher investments during the first years for investors in a good market, investments are very similar in the second year. This tendency is stronger for professionals (bottom, left panel) than for students. Students show almost no difference in investment for the two years. For professionals, we observe that the order of the years matters. Overall, we observe a clearly negative time trend concerning investment. Investment in the first year is significantly higher than investment in the second year, independent of whether a good year was followed by a bad year or the other way round. Specifically, investment decreased from 43.0% to 37.4% when markets changed for better, and investment decreased from 49.1% to 37.9% when markets changed for worse. In both cases this difference is significant (Wilcoxon signed-rank test: "for better"  $p = 0.027$ ; "for worse"  $p = 0.064$ ).



**Figure 3: Investment over rounds and years. Top panel: all observations. Bottom left: professionals. Bottom right: students.**

RESULT 1: Independent of training, investment is similar for good and for bad market conditions. Over years we observe a significant negative time trend on investment.

### 3.2 Investment dynamics

To further investigate the previously observed negative time trend on investment, we will examine behavioral dynamics over rounds and years. In Table II (columns (1) and (4)) we present results from a random effects tobit regression of investment at time  $t$  on previous outcomes and relative earnings<sup>2</sup> as well as dummies for student, year (and period), and sex. We show separate

<sup>2</sup> Relative earnings at time  $t$  are the aggregate earnings of all previous time periods. Counting a positive outcome for an investment of level  $x$  as a gain of  $2.5*x$  and a negative outcome as a loss of  $x$ . Thus relative earnings can be seen as a deviation of the current budget level from a references point. The reference point is taken as possible earnings if no investment would have been made so far.

regression results for investment made under bad market conditions (column 1) and good market conditions (column 4). As earlier results have shown (cf. Hopfensitz, 2009), both previous gains (i.e. having won in the previous rounds) and relative earnings (i.e. deviations from a reference point) have a significant impact on investment. We observe evidence of the gambler's fallacy, namely that investment is reduced after a lucky round, as well as a general reduction in investment for higher levels of earnings. Across the periods of each year we observe a general positive time trend. These effects are quite similar for good and bad market conditions. Across the two market conditions, we observe differences concerning both professional experience and investment year. Students generally invest less than professionals, but the difference is larger for bad market conditions. The general tendency to reduce investment from year one to year two is mainly due to investment in good markets being low when previously an unfavorable market condition was experienced. This tendency to reduce investment is also true for professionals under bad market conditions. Students invest more in a bad market when it came second, while professionals still invest less in this case (see the impact of year and the interaction effect of year and professional). Finally, we observe no gender effect concerning investment.

**RESULT 2:** Results from a random effects tobit regression show that winning and relative earnings have a negative impact on investment for both market conditions. We further observe that students and professionals react differently to market conditions and that this interacts with the order in which markets are experienced.

**Table II: Random effects tobit regression of investment for good and bad market conditions**

	"bad" market			"good" market		
	(1) investment	(2) investment	(3) investment	(4) investment	(5) investment	(6) investment
win previous round (dummy)	-6.331 (2.34)**	-6.364 (2.34)**	-6.917 (2.57)**	-4.764 (1.82)*	-4.308 (1.65)*	-4.089 (1.57)
total relative earnings at time t	-0.080 (7.42)***	-0.081 (7.23)***	-0.070 (6.75)***	-0.091 (9.25)***	-0.098 (10.43)***	-0.100 (10.92)***
period (1 to 15)	0.664 (2.61)***	0.700 (2.72)***	0.724 (2.86)***	1.087 (3.67)***	1.167 (3.99)***	1.193 (4.08)***
student (dummy)	-31.794 (3.03)***	-35.634 (2.95)***	9.883 (0.98)	-4.860 (0.36)	31.121 (2.55)**	20.667 (1.63)
year (1 or 2)	7.784 (1.67)*	6.240 (1.29)	-5.852 (1.52)	-27.643 (5.24)***	-22.654 (4.83)***	-20.283 (4.08)***
year x professional (interaction between year and being professional)	-20.039 (2.98)***	-28.346 (3.32)***	2.318 (0.36)	3.292 (0.32)	15.876 (2.05)**	3.329 (0.43)
sex (1 male; 2 female)	-2.518 (0.69)	-23.812 (5.28)***	-1.805 (0.44)	-9.361 (1.36)	-23.151 (5.32)***	-25.412 (5.73)***
optimism (LOT)		27.673 (6.65)***	20.452 (5.79)***		8.158 (1.84)*	12.245 (3.14)***
anxiety (STAI)		24.604 (3.58)***	48.348 (7.75)***		17.461 (2.53)**	35.311 (4.96)***
lack of perseverance (UPPS)		2.792 (0.52)	16.686 (3.30)***		-15.053 (2.85)***	-12.059 (2.06)**
lack of premeditation (UPPS)		13.717 (2.68)***	14.297 (3.24)***		-5.294 (0.99)	1.537 (0.24)
sensation seeking (UPPS)		-0.223 (0.05)	-7.300 (1.94)*		-16.250 (3.51)***	-18.106 (3.68)***
urgency (UPPS)		25.077 (6.31)***	7.577 (1.85)*		6.048 (1.14)	-3.909 (0.69)
openness (Big Five)		-23.279 (4.91)***	-30.456 (8.56)***		4.365 (0.99)	2.608 (0.56)
self efficacy (self report)			0.980 (9.54)***			0.456 (2.94)***
Constant	53.529 (5.68)***	-54.345 (1.80)*	-137.475 (4.68)***	107.837 (5.67)***	73.940 (2.12)**	19.932 (0.56)
Observations	1155	1155	1155	1155	1155	1155
Number of id	77	77	77	77	77	77
Wald Chi 2	117.84	283.97	338.61	178.39	203.70	239.66

*Absolute value of z statistics in parentheses*

*\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%*

### 3.3 Personality and investment

Having observed that students and professionals react differently to the two market conditions, we explored if these differences are due to personality or to experience. Professionals in the financial sector might be self-selected and have a specific personality profile. Alternatively, professionals might have gained experience that makes them feel more competent and therefore to react differently in a task that resembles an investment situation than students.

We first compared personality scores for professionals and students. Table III gives an overview of mean ratings for optimism, anxiety, impulsivity (with the subscales: lack of perseverance, lack of premeditation, sensation seeking and urgency), and openness. Professionals score higher on optimism and lower on anxiety and lack of perseverance compared to students (Wilcoxon rank sum test,  $p < 0.052$ ). We observe no other significant differences.

We also show ratings by professionals and students concerning their self-efficacy, namely their belief that they will do well in the proposed investment task.<sup>3</sup> Earlier results have shown a strong correlation between self-efficacy and investment (Hopfensitz and Wranik, 2008). As expected, professionals report significantly higher levels of self-efficacy than students (Wilcoxon rank sum test,  $p = 0.001$ ).

**Table III: Overview of personality variables for students and professionals.**

	professional (N=31)		student (N=46)		Wilcoxon rank sum test
	Mean	Std. Dev.	Mean	Std. Dev.	
optimism (LOT)	3.75	0.46	3.46	0.62	$p = 0.052$
anxiety (STAI)	1.73	0.33	2.21	0.49	$p = 0.000$
lack of perseverance (UPPS)	1.82	0.37	2.08	0.41	$p = 0.008$
lack of premeditation (UPPS)	2.09	0.35	2.05	0.44	$p = 0.794$
sensation seeking (UPPS)	2.74	0.50	2.64	0.44	$p = 0.405$
urgency (UPPS)	2.21	0.39	2.38	0.45	$p = 0.115$
openness (Big Five)	3.72	0.45	3.72	0.53	$p = 0.859$
self-efficacy (self report)	75.00	15.73	59.28	22.47	$p = 0.001$

<sup>3</sup> Specifically self-efficacy is the answer to: "How confident are you in your ability to generally make good decisions?" which was rated on a scale from 0 (not very confident) to 100 (very confident).

Given these differences in personality and self-efficacy, we included personality measures in the tobit regressions (Table II, columns (2) and (5)). The effect of previous wins, relative earnings, and period in the year remain unchanged. However, the student dummy now shows a positive coefficient for good markets. In addition, women invest significantly less than males. Thus, the effect of being a student and a female seem to be related to the included personality variables.

Overall, we observe that personality variables have a significant impact on investment behavior. Optimism and anxiety are significant for both market conditions. Optimism generally leads to higher investment, and especially so under bad market conditions. Given that participants lose money (on average) under bad market conditions, optimism leads to a stronger effect in bad than in good markets. In good markets optimism is less influential because investment is in itself advantageous (on average). Anxiety has a similar effect. What might be surprising is that anxiety is positively related with investment. Thus, trait anxiety is related to taking more risk and investing more, as predicted by the literature on gambling (Zangeneh et al, 2008).

Impulsivity shows a differential effect on behavior for good and bad markets. While impulsivity leads (on average) to more investment for bad markets, it leads (on average) to less investment for good markets. Since investment is favorable in good markets and unfavorable in bad markets, this implies that high levels of impulsivity will lead to unfavorable investment decisions and therefore losses in both market conditions. Looking at the subscales of impulsivity, we see that lack of perseverance and sensation seeking are responsible for low investment in good markets and lack of premeditation and urgency lead to high investment for bad markets. Although it is not clear why higher sensation seeking is related to lower investment in good markets (we would expect the opposite), lack of perseverance could reflect a tendency to be less implicated in the task, and simply chose a middle of the road investment strategy without considering the probabilities. However, both these relationships could simply be spurious and further research is necessary. The results in the bad markets are congruent with past research. For example, lack of premeditation indicates the tendency not to delay action until careful thinking and planning can occur. Those who are higher on this trait act on the spur of the moment without regard to the consequences. Lack of premeditation has also been linked to disadvantageous decisions on the Iowa Gambling Task (Zermatten et al., 2005). The urgency subscale refers to the difficulty in



controlling or coping with urges to act in response to unpleasant emotions. Since the bad market probably induced stronger unpleasant emotions in the participants than the good markets (because there are more losses), this trait would be more activated in the bad market and could lead to unreasonably high risk. This is also the component of impulsivity most strongly associated with problem gambling (Whiteside et al., 2005).

Finally, we observe that openness has no effect on investment for good markets; however, it reduces investment in bad markets. People high in Openness to Experience have a stronger preference for novelty, variety, and complexity (McCrae, 1996) and to be less conventional and think more deeply about new information than those low in Openness to Experience (McCrae, 1987). Therefore, those high in this trait may have been more attentive to the probabilities presented and considered the implications of these probabilities for investment in the bad market than those low on this trait. We can conclude the Openness to Experience might favor investment behaviors in changing markets, because new information is more likely to be integrated and used in decision-making.

Our final extension includes self-efficacy in the model (Table II, column (3) and (6)). As expected, self-efficacy is significantly related to higher investment for both market conditions. The effects of previous outcomes, gains, and personality are qualitatively not affected. However, the student dummy loses significance. We can therefore conclude that personality and self-efficacy are the main factors influencing investment and that the initially observed significant effect of being a student is mainly due to differences in these variables.

**RESULT 3:** We observe significant differences in the personality profile of professionals and students. Moreover, personality variables significantly influence investment behavior and the specific impact depends on the market condition. Finally, we observe that personality variables and self-efficacy mediate the previously observed significant effect of being a student.

#### **4 Summary and conclusions**

Real markets are variable, and risk taking and investment in stock will be more advantageous in some periods rather than others. We wanted to determine if and how investors would adapt to changing market conditions, and to examine if professional experience or personality could help

predict the capacity to adapt. Surprisingly, professional investors did not show more adaptive responses to changing markets, and in some cases showed less adaptive responses, than students. Professionals invested in general more than students, however this effect can be explained by their training and resulting changes in attitude towards the task, and by self selection concerning personality characteristics.

Personality plays a role in risk taking and adaptation. Openness to Experience could help investors to take into account new information to challenge dominant responses to risk taking. Being open to variable market conditions and alternative investment strategies could be an asset, and this capacity can be both selected and trained. Impulsivity, on the other hand, is unfavorable in all accounts. This was also found in an examination of long term investment strategies for clients in regards to their retirement investment (Ameriks et al., 2009). Thus, impulsivity and sensation seeking, which often characterize trader personality (Sjöberg and Engelberg, 2009), may have to be reconsidered. Finally, both optimism and anxiety have more complex relationships to risk taking and adaptation than previously thought, and the widely held belief that optimism is a positive and anxiety a negative trait for investment may prove to be false. Moderated levels of anxiety have also been shown to be an asset for long term investment decision-making (Ameriks et al., 2009). Given the current financial crisis, and the repeated demonstration that many financial institutions collectively take unreasonable levels of risk, a discussion on how professionals are selected and trained may warrant further exploration and discussions.

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## **Appendix A: Instructions**

### **General instructions [for year 1 - good market; values for bad market in brackets]**

Welcome: you are about to take part in a decision making experiment, in which you can earn real money. The experiment has 2 parts, which we will call years. The amount of money you can earn will depend on the decisions you make.

Dependent on your decisions, you can earn a significant amount of money.

During the experiment your earnings will be calculated in Unige Francs (UGF). At the end of the two years, these UGF will be converted into CHF and your earnings will be paid out to you in CHF using the following exchange rate:

$$100 \text{ UGF} = 1 \text{ CHF}$$

At the beginning of the experiment you will receive from us 30 CHF, which = 3000 UGF. This is your capital stock. You will have access to 1500 UGF of your capital stock at the beginning of each year. You can decide to either keep these UGF or to invest them in the experiment and try and earn more money. The details of this investment procedure will be explained to you below. At the end of the experiment we will pay you any earnings that you accumulated from the two years in addition to your 3000 UGF capital stock. If you lose money during the experiment, you will have to pay us back the losses from your capital stock at the end of the experiment.

During the experiment we will also ask you to answer a number of questions. These questions concern what you think and how you feel.

There are no right or wrong answers. You need to follow the decision strategy that feels right to you and to make those choices that come natural and that seem like the best choices for you. In addition, you should report those evaluations and emotions that are closest to your real thoughts and feelings. All answers are completely anonymous and confidential.

### **General instructions**

During this experiment you will have to make investment decisions for 15 rounds in two investment years. This means that you will be making decisions for 30 rounds in total. In each of these rounds, you can invest 100 UGF from your capital stock of 3000 UGF.

We will now explain to you your options in year 1. After the 15 rounds of year 1 we will explain to you the situation in the second year.

#### Instructions for year 1

In year 1 you will have to make investment decisions for 15 rounds. In each of these rounds, you can invest 100 UGF from your capital stock. Each round you have to decide how you want to split these 100 UGF over two investment options.

We will call the two options: option A and option B.

Option A: In this option you will neither gain nor lose money. In other words, will always keep the number of UGF you put into option A.

Option B: The outcome from this option will be determined at the end of each round. In particular, we will pick one random number between 1 and 100. This is equivalent to picking a ball from an urn.

Imagine an urn with 100 balls in it, 33 [25] of these balls are orange, 67 [75] of these balls are blue.

- If the ball that is picked is orange (that is in 1/3 [1/4] of the cases) the UGF you placed in this option will be multiplied by 2.5. You will then receive 2.5 times the number of UGF you put into option B, in addition to the number of UGF you originally place into this option.
- If the ball that is picked is blue (that is in 2/3 [3/4] of the cases) you will lose the number of UGF you put into option B.

**Note:** For all fifteen rounds of year 1 we will always use the same urn. The number of orange and blue balls in this urn represents the market conditions of year 1.

### Example

Imagine that in one round, you decide to split your 100 UGF by placing 50 UGF into option A and 50 UGF into option B.

If the randomly picked ball is orange (i.e. if the random number is smaller or equal to 33 [25]), you will receive  $2.5 * 50 = 125$ , in addition to your 100 UGF for that round. Your capital stock will therefore increase by 125 UGF.

If the randomly picked ball is blue (i.e. if the random number is larger than 33 [25]), you will lose the 50 UGF you put in option B. Your capital stock will therefore decrease by 50 UGF.

### Summary for year 1

- Year 1 is made up of 15 investment rounds.
- In each round, you can decide how to split 100 UGF of your capital stock between two options.
- At the end of each round we will pick a random number between 1 and 100.
- If the randomly picked ball is orange (i.e. if the random number is smaller or equal to 33 [25]) your earnings will be:  $100 \text{ UGF} + 2.5 * \text{the number of UGF you placed into option B}$
- If the randomly picked ball is blue (i.e. if the random number is larger than 33 [25]) your earnings will be:  $100 \text{ UGF} - \text{the number of UGF you placed into option B}$

**Appendix B: Recruitment letter for professionals**

Dear all,

Today I need your collaboration to help me with the research that is part of my master thesis in human resources, which I have been following by now for 18 months.

Do you know ‘behavioral finance’? This is the study of investors’ behavior in financial markets from a ‘psychological’ perspective or as stated by the American economist Richard Thaler, following an open minded approach.

Individual differences (personality, training ...) play an important role in everyday decisions and studies have shown that they are also important in financial investment decisions.

[...] I would like to investigate with an experimental study the importance of personality differences for financial decisions. To conduct this research your professional help will be indispensable. You just have to give me 2 and a half hour of your time [...].

The study will be conducted in small groups: each of you will work individually and completely anonymous (not only will you be protected by our professional vow of silence but we will also sign an individual declaration with each of you promising complete confidentiality). It is neither an exam nor an evaluation and our bank will only be informed about the aggregate results from this study, thus this research will be fully anonymous.

I am sure that this study will interest you ... and it will even hold some small and nice surprises.  
[...]