UNDER-DIVERSIFICATION AND THE ROLE OF BEST REPLY TO PATTERN

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Under-diversification and the Role of Best Reply to Pattern

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Abstract

Three experiments are presented that compare alternative explanations to the coexistence of risk aversion and under-diversification in investment decisions. The participants were asked to select one of several assets under two feedback conditions. In each case, one asset was a weighted combination of the other assets, allowing for lower volatility. The frequency of choice of the composite asset was highly sensitive to feedback condition. The composite asset was the least popular asset when the feedback included information concerning forgone payoffs, and increased in frequency when the feedback was limited to the obtained payoff. These results support the assertion that under-diversification can be a product of learning from feedback and in particular best reply to pattern.

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Key words: Risk; Diversification; Learning

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1. Introduction

Standard portfolio theory suggests that investors facing two portfolios with equal expected returns will prefer the portfolio with the lower volatility. This assertion is consistent with common applications of expected utility theory (e.g., Tobin 1958, Sharpe 1964, 1966) and with experimental studies of choice behavior and portfolio allocation over safe and risky assets (e.g., Kahneman and Tversky, 1979; Thaler et al., 1997; Gneezy et al., 2003). However, there are exceptions to this predictable and robust pattern. One important exception is the empirical observation that many individual investors hold fewer individual stocks than necessary to eliminate idiosyncratic risk (e.g., Blume and Friend, 1975; Statman, 1987, 2004; Kelly, 1995; Odean, 1999; Polkovnichenko, 2004; Goetzmann and Kumar, 2004). Statman (1987) and Goetzman and Kumar (2004) show empirically that failure to diversify is costly. This under-diversification contradicts standard portfolio theory in cases where diversification can reduce volatility without reducing expected returns.[1] The main goal of the current paper is to compare two explanations to this seemingly risk-seeking behavior and its inconsistency with the commonly accepted risk-averse preferences of investors.

The first explanation, referred to as the "*contingent risk attitude hypothesis*", suggests that the empirical results reflect large differences between different classes of investors. One class (the majority) of investors consists of risk-averse[2] investors

[1] Uppal and Wang (2003) have a framework that explains underdiversification with a model that allows for ambiguity regarding the joint distribution of returns.

[2] The term "risk-averse" can be problematic. Works such as Rabin and Thaler (2001) and Khaneman and Lavallo (1993) question whether risk aversion can even be applied to small stake decisions. They bring up alternative explanations and biases for seemingly risk averse behavior. There are other explanations as well that one could think of. The goal of this paper is not to explore these explanations but instead to focus on under diversification. As such, the risk aversion term here could be thought of

who prefer safe assets over stocks. A second smaller class of investors consists of risk-seeking investors who prefer individual stocks over a diversified portfolio. Thus, the empirical exception described above reflects the risk tendencies of a small minority that is over-represented in analysis of the behavior of private stock market investors.

Under a second explanation, referred to as the "*best reply to pattern hypothesis*," under-diversification is a result of a tendency to select the best alternative under the belief of some sequential pattern. Under this belief the outcomes at time t can be predicted by a weighted average of the returns in "similar" previous trials. The current hypothesis implies high sensitivity to the available feedback. Under-diversification is predicted when the decision makers have complete information concerning the performance of the different alternatives (in the relevant similar previous trials). The logic behind this prediction is simple: The return of the diversified alternative is close to the mean. Thus, the availability of full information implies that the diversified alternative is not likely to be associated with highest weighted average.

The opposite tendency is predicted when the feedback is limited to the obtained payoffs. Limited information is likely to create a hot stove effect (Denrell and March, 2001): Bad experience reduces the effect of repeated choices, and for that reason its effect lasts longer. Thus, under limited feedback, experience should increase diversification.

Note that the set of rules that imply best reply to pattern, as defined above, is very large. A particularly important subset of this set involves belief learning models. For example, under the fictitious play rule (Brown, 1951) all previous trials are

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as an umbrella term for explanations that approximate risk aversion. The common characteristic to all

assumed to be "similar" and the outcome in trial t is predicted based on the average outcome in all previous trials. Variants of the fictitious play rule (see Fudenberg and Levine, 1998) and other learning models (see Camerer, 2003) that allow for the possibility of recency or forgetting remain examples of “best reply to pattern”. Another important set involves models that generalize probability-matching (Estes, 1950, and see Erev & Barron, 2005; Kallir and Sonsino, 2005). Under these models the decision maker recalls a small set of m previous trials and selects the alternatives that performed best in those trials. A one-parameter generalized probably matching is evaluated in Section 5.

The current hypotheses cannot be easily compared based on evaluation of sequential dependencies in the stock market. Neither hypothesis has clear predictions concerning sequential dependencies.[3] This observation led us to focus on controlled experiments.

Two laboratory experiments and one web experiment were run in order to evaluate the two hypotheses. Each experiment involved a choice over several alternatives. One of the alternatives was a composite of the other alternatives and therefore involved reduced volatility. The choice was repeated for many rounds following feedback about the previous round. Each experiment was divided into two treatments—full information and limited information. In the full information treatments, participants received feedback at the end of each round about the performance of all alternatives, whereas in the limited information treatments, participants received feedback only about the performance of the alternative most recently selected.

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these alternative explanation is that they do not predict differences between the information conditions studied in this work.

[3] The best reply to pattern hypothesis allows for the possibility of positive recency, but does not require it. Indeed, negative recency (see, Kroll, Levy & Rapoport, 1988) can be predicted under certain

The results of all three experiments demonstrate that participants exhibit behaviors that might appear to be risk seeking in the full information condition but risk averse in the limited information condition. These patterns cannot be consistently explained by risk preferences but are consistent with the best reply to pattern hypothesis.

2. Experiment 1

2.1. Method

Participants were 40 undergraduate subjects who had taken at least one course in statistics. The experiments took place at a computer laboratory in a major Israeli university and lasted approximately half an hour. The average payment was 25 NIS, or approximately $5.5. The experiment focused on a simplified investment task. In each of 100 trials, participants were asked to choose one of three assets: A, B and M.

Assets A and B represented stocks with the same expected return and with high negative correlation between their returns (-0.977). Asset M represented a diversified fund. The return from asset M was the mean of the returns from A and B. Thus, it had the same expected return as assets A and B and lower dispersion.

The asset returns were constructed on the bases of two variables, U and ε that were independently drawn from uniform distributions in each trial in the ranges of 0% to 100%, and -5% to 5% respectively. The distributions' equations and implied means and standard deviations are summarized in Table 1.

<Insert Table 1>

abstractions of this hypothesis.

The choice task was presented as an investment problem. The participants were asked to invest 100 tokens in one of the assets in each trial. They were told that the tokens they earn would be converted to money at the end of the experiment. The conversion rate was 1 NIS = 100 tokens. Ten practice trials were conducted before the 100 experimental trials.

The instructions (Appendix A) spelled out, in a simple and non-technical way, the experimental procedure with no information about the actual payoff distribution of each asset. After handing out the written instructions, we gave participants time to carefully review and understand the experimental procedure and ask questions.

The participants were divided into two information conditions—Full Information and Limited Information-- of 20 subjects each. The groups differed with respect to the feedback provided after each trial. After each trial in the Full Information condition, participants observed their earnings from all assets. In the limited information condition, the feedback was limited to the payoff obtained from the selected asset only.

2.2. Experiment 1 Results

Figure 1 presents the choice proportions as a function of experience in the two conditions. The diversified option was selected if 14% of the trials in the full Information condition, and in 39% of the trials in the limited information conditions. This difference, predicted under the best reply to pattern hypothesis, is significant ($t[38] = 4.9,\ p < 0.01$).

<Insert Figure 1>

In order to evaluate the role of individual differences we computed a recency index for each participant in the full information condition. The index was defined as the proportion of times that the option with the highest recent payoff was selected conditional on the fact that Option M was not selected. Figure 2 presents the proportion of under-diversification (selection of A or B) as a function of the recency index for each participant. The results show that most participants (18 of 20) exhibit positive recency (the probability of selecting the option with higher recent payoff is higher than 50%). In addition, the data reveal large between-participant differences. The correlation between the recency index and under- diversification is positive (r=0.32) but insignificant.

<Insert Figure 2>

3. Experiment 2

3.1. Method

Experiment 2 was conducted to examine the robustness of the results of experiment 1 in settings where the less volatile asset has a higher expected return. Under the best reply to pattern hypothesis, information concerning forgone payoff is expected to impair earning in this setting.

The design of experiment 2 closely follows the design of experiment 1. That is, 40 undergraduate students with training in statistics are divided into two information conditions of 20 participants each. Each group chooses one of three assets, A, B and M+, repeatedly 100 times and receives feedback either for the asset chosen (Limited Information Condition) or for all assets (Full Information Condition).

We replace asset M of experiment 1 with asset M+, which has 2% higher return. The return distribution is shown in Table 2.

<Insert Table 2>

3.2 Experiment 2 Results

Figure 3 presents the choice proportions as a function of experience in the two conditions. The diversified option was selected in 27.8% of the trials in the full Information condition, and in 43.4% of the trials in the limited information conditions. This difference, that reflects a negative effect of information on earnings as predicted under the best reply to pattern hypotheses, is significant ($t[38] = 4.9$, $p < 0.01$).

4. Experiment 3

4.1. Method

Experiment 3 was designed to examine the robustness of the current results in a more realistic investment scenario. It focuses on investment decisions of upper-division (juniors and seniors) economics students and MBA business students in a online environment over time. The subjects had all taken courses in finance and statistics.

In addition to the main study, the participants were asked to answer a short optional survey (appendix B) that examined their investment experience and risk attitude. The results (appendix C) show that 40% of the participants own stocks or mutual funds, and the vast majority (95.6%) exhibit risk aversion in portfolio choices based on a description.

Of the subjects who completed the experiment, 36 subjects participated in the limited information condition and 42 participated in the full information condition.

Participants were asked to log in to an investment web site and to make investment choices among five Vanguard mutual funds: Vanguard Total Stock Market Index Fund, Vanguard Total Bond Market Index Fund, Vanguard European Stock Index Fund, Vanguard Pacific Stock Index Fund, and Vanguard Target Retirement 2015 Fund. The last fund was a composite of the other funds with the following percentages: 51.2% in Total Stock Market Fund, 36.0% in Total Bond Market Fund, 7.4% in European Stock Index Fund, 3.4% in Pacific Stock Index Fund and 2.0% in other. The composition of each of the funds was available in each fund's prospectus, which was available via a link to the Vanguard site.

To complete the experiment, participants had to make 30 separate investment decisions on 30 different days. Each day they logged in they received feedback regarding the most recent previous decision. The feedback on that decision was determined by the actual stock market performance of the different funds. There were two treatments: Limited Information and Full information. The feedback common to the two treatments was the percentage return from the last decision, the cumulative return, and the number of periods remaining. In the Full information treatment, subjects received feedback on the main screen about the returns on all five mutual funds on the last day visited, whereas in the Limited information condition, subjects received information on the main screen only about the return on the mutual fund last chosen. The mutual fund choices on the experiment's main screen all contained links to the prospectus and historical performance of the funds.

Subjects received payment upon completion of the experiment for the returns they made in the experiment. To avoid wealth effects and also scale effects (1% return

could be different depending on the capital it is multiplied by), we paid subjects the sum of the percentage daily returns instead of the multiplicative returns (so returns of 1%, 3% and 2% on consecutive days would give a payoff of 6% instead of 6.1%). This took away some of the realism but helped make the incentives comparable across subjects.

4.2. Experiment 3 Results

Over the duration of the experiment, the best performers were the stock funds. The best performing fund was the European Stock Index Fund (average daily return of 0.12%), followed by the Total Stock Market Index Fund (0.11%) and the Pacific Stock Index Fund (0.07%). The most volatile by a large difference was the Pacific Stock Index Fund (std. dev of 0.82% compared to the second highest std. dev. of 0.66% for the European stock index fund). In the limited information condition, the Total Stock Index and European Stock Index were most popular. In the full information condition, the Total Stock Index and Pacific Stock Index were most popular.

Figure 4 presents the choice proportions as a function of experience in the two conditions. The diversified option, Vanguard Target Retirement 2015 Fund, was selected in 10% of the trials in the full Information condition, and in 13% of the trials in the limited information conditions. This difference, while in the predicted direction, was not significant.

The biggest difference between the conditions occurred in the demand for the Pacific Index Fund. In the limited information condition the volatile Pacific Index Fund was unpopular in the fourth place in terms of demand (16%), whereas in the full information condition it was the most popular (32%), particularly following strong

performances. This difference, as predicted under the best reply to pattern hypotheses, is significant (*t[76] =2.6, p = 0.01)*. Hence, investors appeared risk averse in the limited information condition and risk seeking in the full information condition.

5. A simple descriptive model

As noted above, the observed experimental pattern is predicted under a wide class of models that assume best reply to pattern. In order to clarify the intuition behind this observation we chose to derive the prediction of a representative model of this class. We consider one of the simplest members of this class: a "sample-of-one" model (see related ideas in Osborne and Rubinstein, 2005; Erev & Barron, 2005).

The model assumes that the decision maker begins the experiment with a short exploration period. This period includes only one random choice when full information is available. When the information is limited to the obtained payoffs, an individual samples each alternative once. After this exploration period, the decision maker is assumed to recall one experience with each of the alternatives, and select the alternative that led to higher payoff in the recalled trial (random choice is assumed in the case of a tie).

The model has a single free parameter $0<\beta<1$ that determines the dependencies between the recalled trials in the full information condition. With probability β the sampling of the recalled trials for each of the alternatives is independent (3 independent observations). A full dependency is assumed otherwise. Under full dependency, a single observation is sampled to determine the recalled payoff of all the alternatives[4].

[4] Note that this model approximates a generalization of the predictions of the probability matching rule (Estes, 1950): When $\beta=0$ it implies probability matching in the full information condition.

In order to estimate the free parameter of the model we ran computer simulations in which virtual agents behaved according to the model in each of the six experimental conditions presented above. The virtual experiments included the same number of trials as the original studies, and were summarized by the same statistics (choice probabilities). The mean squared deviation between the observed and reproduced choice proportions was minimized with $\beta=0.6$.

The graphs in Figure 5 present the simulated choice proportions.

<Insert Figure 5 here>

Figure 5 demonstrates several important patterns. First, in experiment 1, the diversified choice denoted by M is most popular in the Limited Information condition, whereas it is the least popular in the Full Information condition. The proportion of choice of this alternative is more than double in the Limited Information condition relative to the Full Information condition. The predictions, in both direction and magnitude are remarkably similar to the actual patterns shown in figure 1. Experiment 2 is similar to experiment 1, except that M is replaced by M+ and now has the highest expected return. Since the differences in returns for M are small, the payoff patterns are similar and the simulations for experiments 1 and 2 have negligible prediction differences. The actual patterns of figure 3 show an increase over time in the proportion of M+ choices in both conditions and M+ surpasses the proportion of B choices in the Limited condition. This pattern is missed by the simulations, although the overall differences in the frequency of M+ between the two conditions is predicted.

Experiment 3 is more complex than the other two and involves many more possible strategies and patterns. As such, the predictions are not impressive. However, two patterns were captured fairly well: (1) the diversified choice—the retirement fund—is predicted to drop in the Full Information condition relative to the Limited Information condition. The Pacific Fund is predicted to increase in popularity in the Full Information Condition relative to the Limited Information Condition. The model over-predicted the effect of bad experience, resulting in under-predicting the success of the Pacific Fund in the Full Information condition and over-predicting the success of the retirement fund in the Limited condition. Nevertheless, the directions of the differences between the two treatments are captured and are important. In both cases, they demonstrate that subjects appear more risk averse in the Limited Condition and that this seeming risk aversion is due to different feedback in the two information environments.

6. Summary

Previous studies of investment decisions highlight two robust but apparently inconsistent behavioral tendencies: Investors tend to exhibit strong risk aversion in demanding higher returns for risky assets, but they also tend to prefer under-diversified portfolios, a behavior consistent with risk-seeking behavior. The current work compares alternative explanations to this puzzle. The results demonstrate under-diversification that can be described as a product of learning from feedback, in particular best reply to pattern.

We studied two information conditions: A Limited Information condition where feedback was limited to payoff from the chosen alternative, and a Full Information condition where payoff was shown for all possible alternatives.

Comparison of these conditions shows that in the Limited Information conditions subjects appeared to prefer less risky choices and to avoid more risky choices relative to the Full Information model. This difference, observed under distinct environments in all three studies, is consistent with the predictions of a wide class of learning models that assume best reply to pattern. A simple member of this class, the one-parameter "sample-of-one" model presented above, simply assumes that the agents based their decision on one randomly selected experience with each asset. While this model captures the main patterns of interest, clearly it is too simple. In additional analyses we examine more sophisticated members of the "best reply to pattern" family. These analyses highlight two observations. First, as asserted above, the success of the sample-of-one model is not unique. All the models we consider captured the main qualitative results. Second, it is possible to find best reply to pattern models that fit the current data better than the sample-of-one model. Yet, it seems that additional data is needed to allow serious model comparison.

It is important to caution that the current research does not conclusively prove that under-diversification in the stock market is exclusively driven by learning from feedback. The main contribution of the current research is rather the demonstration that under-diversification could be a product of robust learning principles.

Another interesting implication of the current results involves the role of information. Previous experimental research (Thaler et al., 1997; Gneezy et al., 2003) suggests that complete information enhances myopic loss aversion that can lead investors to prefer low risk assets even if they are associated with low expected return. The current research suggests that complete information can trigger the opposite pattern-- bias toward high variability and low return options. We believe

that this interesting difference suggests that future research should consider the joint effect of loss aversion and the best reply to pattern assumption studied here.

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Table 1. The three assets examined in Experiment 1.

Asset	Asset return	Mean return	Standard deviation.
A	$R_A = U$	50%	29.3%
B	$R_B = (75\%-0.5*U)+ \varepsilon$	50%	14.92%
M	$R_M = 0.5* R_A +0.5* R_B$	50%	7.46%

Table 2. The three assets examined in Experiment 2.

Asset	Asset return	Mean return	Standard deviation.
A	$R_A = U$	50%	29.3%
B	$R_B = (75\%-0.5*U)+ \varepsilon$	50%	14.92%
M+	$R_M = 0.5* R_A +0.5* R_B + 2\%$	52%	7.46%

Figure 1: The observed choice proportions of the three options of Experiment 1 as a function of experimental condition and time (5 blocks of 20 periods).

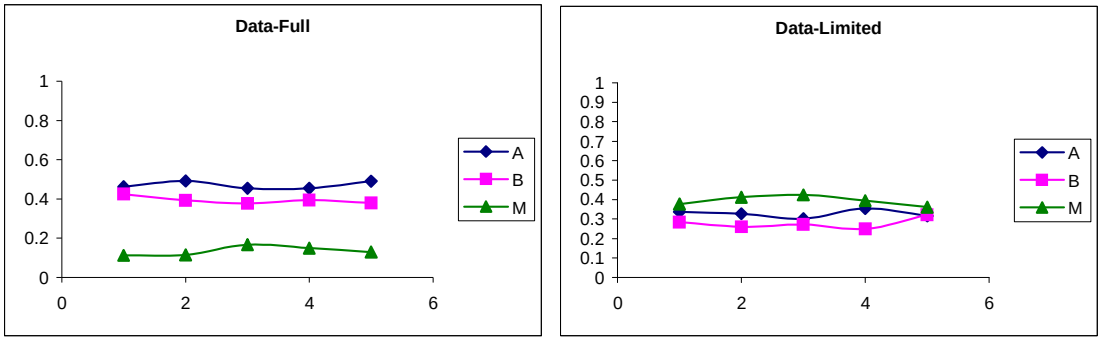


Figure 2: The proportion of under-diversification—selection of option A or B-- as a function of the recency index-- the proportion of times that the option with the highest recent payoff was selected conditional on under-diversification. Each data point presents one of the 20 participants in Experiment 1.

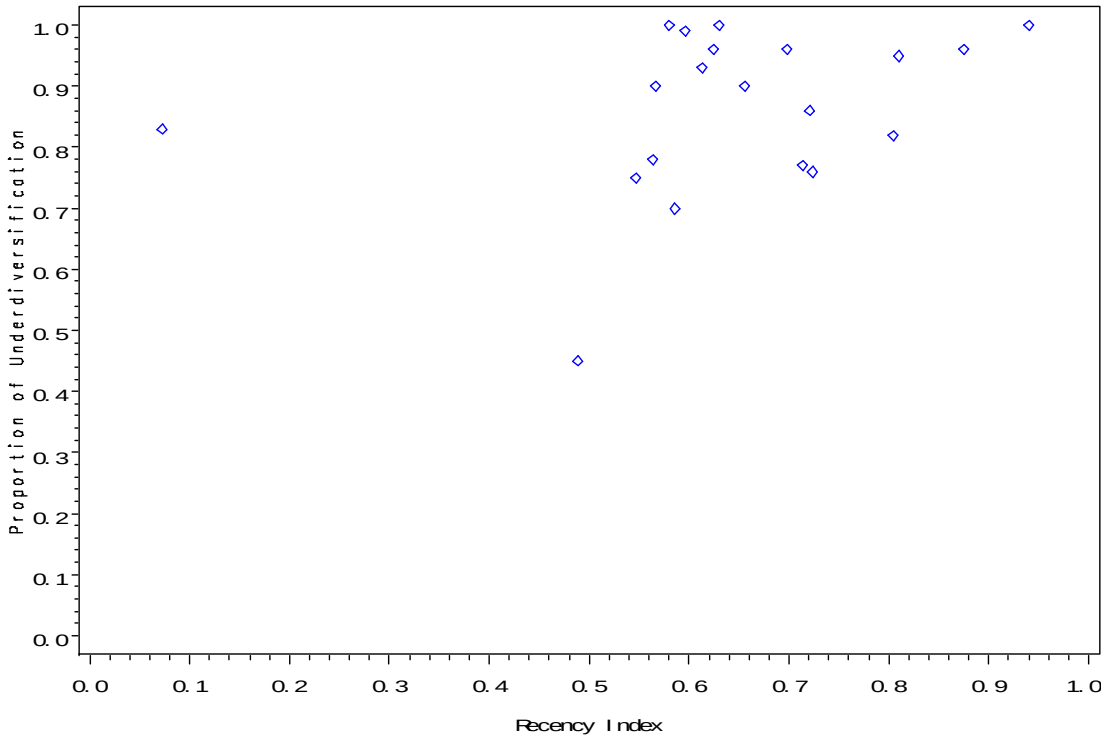


Figure 3: The observed choice proportions of the three options of Experiment 2 as a function of experimental condition and time (5 blocks of 20 periods).

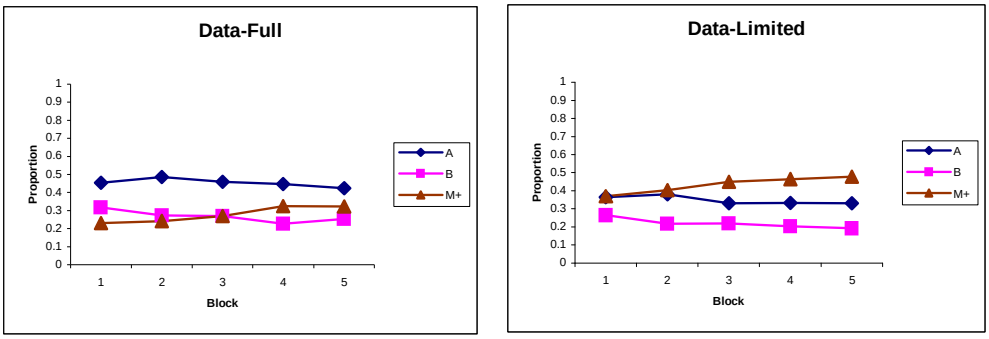


Figure 4: The observed choice proportions of the five assets of Experiment 3 as a function of experimental condition and time (3 blocks of 10 periods).

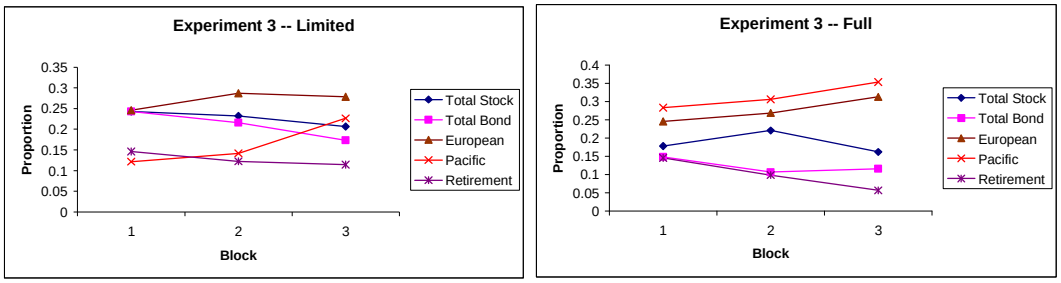
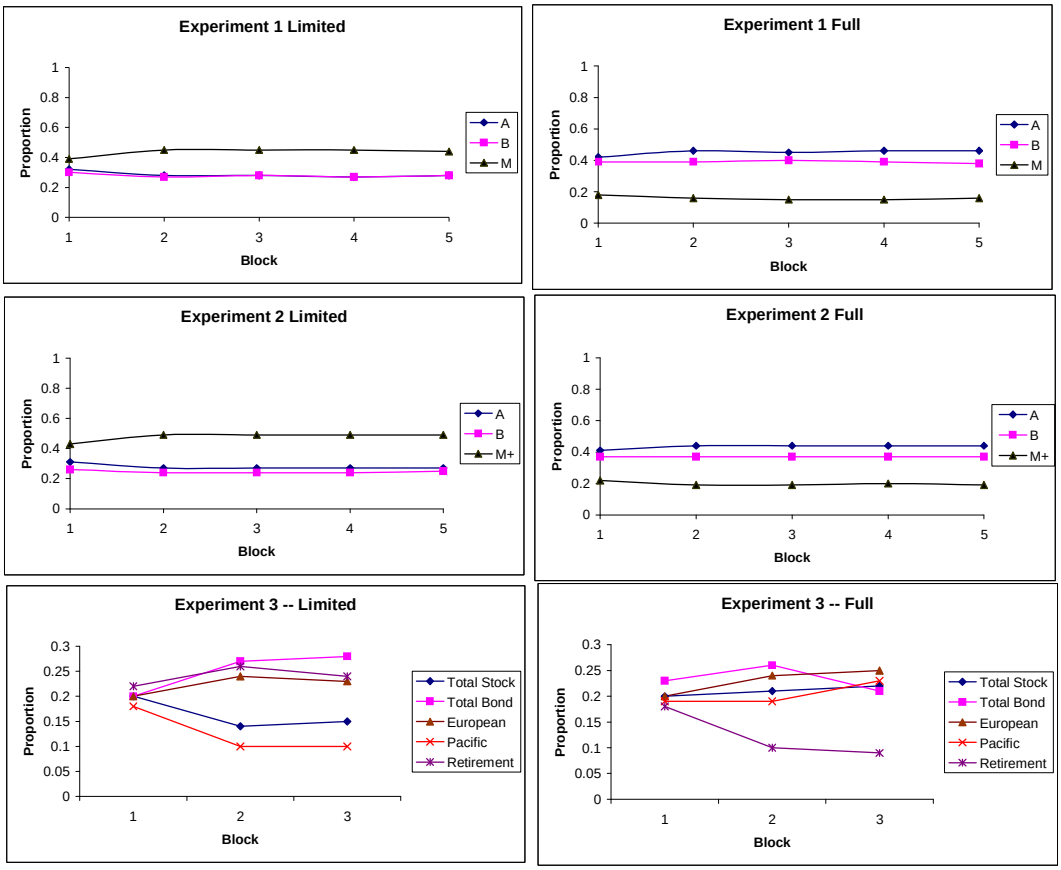


Figure 5. Simulated proportions of choices in the three experiments.



Appendix A – Experiment Instructions (translated).

- *Welcome to an experiment in decision making.*
- *The experiment includes 100 rounds. In each round you will get 100 tokens and will be asked to invest all your tokens in one of three assets.*
- *The asset returns come from a distribution that is unknown to you.*
- *The profit in each round is calculated as follows: Profit = Rate of return on the chosen asset *100*

Hypothetical example:

You have 100 tokens to invest in one of the assets A, B or C. Select one of the assets:

A	***B***	***C***

Stage 2: the feedback.

- *After choosing the asset, you will see the following information:*

ASSET	*Investment*	*Rate of Return*	*Profit for 100 token investment*	*Profit In N.I.S for this round*
A				
B				
C				

** After receiving the feedback you will begin a new round with 100 tokens. You are not able to reinvest your profit.*

** In each round you will know your cumulative profit.*

Payment for participation in the experiment:

200 tokens = 1 N.I.S.

The payment is cumulative.

Appendix B. Questionnaire given to subjects

Thank you for agreeing to participate in this survey. We will ask you to answer a few questions regarding an investment choice. We are grateful for your time in completing this survey.

1. Are you an MBA student?
2. Last degree completed _____
3. Do you have any work experience in investment or banking? Yes / No
4. Have you ever invested in stocks or mutual funds? Yes / No
5. How frequently do you make investment choices?
   (a) daily (b) weekly (c) monthly (d) yearly

6. Investments that have historically produced higher long-term returns have also tended to have higher degrees of risk of loss of principal. For these types of investments, the magnitude of extreme losses increases significantly.

   The table below demonstrates this trade off between average return and the likelihood of losing money in any **one year, and** shows how extreme declines may be.

	Potential Average Return	Chance of Losing $ In Any One Year	Worst Year of 70 Years	Worst Year of 20 Years
Portfolio A	17.6%	1 in 3	-58%	-33%
Portfolio B	13.3%	1 in 4	-43%	-18%
Portfolio C	11.7%	1 in 5	-27%	-9%
Portfolio D	8.5%	1 in 6	-19%	-5%
Portfolio E	6.2%	1 in 10	-6%	-1%
Portfolio F	5.0%	1 in 50	-2%	0%

Please select the portfolio that, for you, best balances these tradeoffs between risk and return.

○ Portfolio A ○ Portfolio B ○ Portfolio C
○ Portfolio D ○ Portfolio E ○ Portfolio F

7. Which of the following best describes your attitude towards balancing a desire for returns relative with the risk you feel you can tolerate?

☐ My primary goal is preservation of principal and risk avoidance. I will accept lower returns in an effort to avoid investment risk.

☐ I want to avoid risk, but will accept a relatively small amount to achieve a slightly higher return.

☐ I can tolerate a moderate amount of risk in an effort to achieve a moderate amount of growth.

☐ I want to achieve potentially high returns, and I am willing to accept the high amount of risk associated with this goal.

8. To achieve your investment objectives, it is important that you continue with your strategy even in periods of severe short-term price swings (volatility) as well as in prolonged down markets. If your portfolio fell by 20% over a short period, assuming you still had several years before you needed the money, how do you think you would respond?

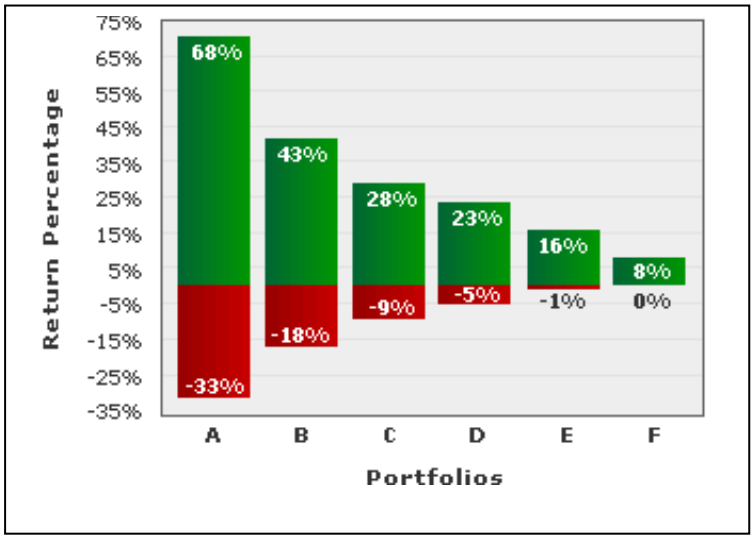
   ☐ I would not make any changes since I anticipated this sort of volatility.

   ☐ I would want to reconsider my portfolio allocation, but if the overall market decline for portfolios like mine were similar, I would likely stick to my strategy.

   ☐ I would want to reconsider my portfolio allocation and cautiously adjust my portfolio towards more conservative investments over time.

   ☐ I would immediately move my investments to very safe and conservative alternatives.

9. The following graph shows the potential range of results of six portfolios in any **one** year. The best potential (top 5% return) and worst potential (worst 5%) returns are represented.



Please note that the highest potential returns also have the greatest potential losses. Which of these portfolios would you prefer to hold?

- ☐ Portfolio A
- ☐ Portfolio B
- ☐ Portfolio C
- ☐ Portfolio D
- ☐ Portfolio E
- ☐ Portfolio F

10. To summarize your objectives, which statement below best describes your overall attitude towards the trade-off between short-term risk and the possibility of achieving your long-term investment goals?

    ☐ I can accept short-term losses to maximize the potential that I will achieve long-term investment goals.
    ☐ I am equally concerned with avoiding short-term losses and meeting my long-term investment goals.
    ☐ Avoiding short-term losses is more important to me than achieving my long-term investment goals.

11. Your initial balance is 100.

What is the maximum price you are willing to pay for buying the following

lottery ticket:

Probability	Payoff
50%	100
50%	20

Price_____.

12. Your initial balance is 100.

What is the maximum price you are willing to pay for buying the following

lottery ticket:

Probability	Payoff
50%	80
50%	40

Price_____.

13. Your initial balance is 100.
What is the maximum price you are willing to pay for buying the following lottery ticket:

Probability	Payoff
50%	100
50%	50

Price_____.

14. We will now ask you to select an allocation of funds between three assets: (1) the XYZ Principal Protected Fund, (2) the SPY index fund, which tracks the S&P index, (3) a put option at a strike price of the 5% below the SPY at the beginning of the year with one year maturity.

SPY is a real traded index fund and the returns we use here are actual returns for the past five years. The put options returns are computed under the assumption that the put options are priced at Black-Scholes prices in the beginning of the year. The XYZ fund is a fictitious fund we created for the purpose of this survey, but it operates similarly to some Principal Protected Funds. It uses 3% of the fund to buy put options

with a strike price of 5% below the SPY price at the beginning of the year. The fund holds the options to expiration date. In addition, it charges a 1% annual management fee.

Historical returns for the past five years are shown below for each asset

Put Option	SPY	XYZ
95.50%	-10.31%	-8.14%
502.69%	-21.17%	-6.46%
-100.00%	22.14%	17.47%
-100.00%	8.15%	3.91%
-100.00%	5.94%	1.76%

Your allocation:

ABC Principal Protected Fund	_____%
SPY index fund	_____%
Put option on SPY	_____%
Total	100%

Appendix C. **Survey Results**

USER	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*XYZ*	*SPY*	*PUT*
Pres1		MBA														
Pres3	1	MBA	2	1	3	1	2	2	2	1	70	60	70	25	70	5
Pres5		MBA														
Pres6	1	MBA	2	2	4	4	3	2	4	1	50	40	50	30	60	10
Pres9	2	Econ	2	2	3	4	3	2	4	1	40	50	60	80	15	5
Pres10	2	Econ	2	1	3	3	3	2	3	1	40	50	60	35	65	0
Pres11		Econ														
Pres12	2	Econ	2	2	4	3	3	2	3	1	60	60	75	25	45	30
Pres13	2	Econ	2	2	4	4	3	2	4	2	45	55	70	0	90	10
Pres14	2	Econ	2	2	4	4	2	2	4	3	20	40	50	40	60	0
Pres15	2	Econ	2	2	4	4	2	2	4	3	50	55	70	80	15	5
Pres21	2	Econ	2	1	3	5	2	1	5	1	20	30	35	60	30	10
Pres22	2	Econ	2	2	3	4	2	2	4	3	40	40	50	60	30	10
Pres23	2	Econ	2	2	4	4	2	2	4	2	50	40	60	50	35	15
Pres27		Econ														
Pres28	2	Econ	2	1	4	3	3	1	4	1	40	40	50	70	15	15
Pres30		Econ														
Goal3	1	MBA	2	2	4	3	2	1	3	1	20	20	20	30	50	20
Goal6	1	MBA	2	1	4	5	3	2	3	3	80	70	90	20	40	40
Goal8	1	MBA	2	1	4	1	3	1	3	1	30	45	55	35	35	30
Goal9	2	Econ	2	1	3	2	3	2	2	3	50	55	70	0	95	5
Goal10	2	Econ	2	1	3	3	3	2	5	1	59	59	74	40	50	10
Goal13		Econ														
Goal14	2	Econ	2	2	2	3	3	2	1	1	65	65	85	40	50	10
Goal15	2	Econ	2	2	4	3	2	2	5	1	50	60	70	60	30	10
Goal16	2	Econ	2	2	4	2	4	2	3	1	40	55	65	5	35	60
GOAL21	2	Econ	2	2	4	3	2	2	3	3	21	41	51	20	70	10
GOAL22	2	Econ	2	2	4	5	1	2	6	3	20	40	50	75	15	10
GOAL23	2	Econ	2	2	4	4	2	2	4	3	10	20	30	60	10	30
GOAL25	2	Econ	2	2	4	5	2	2	5	3	40	50	70	40	40	20
GOAL30		Econ														
expert1	2	Econ	2	1	3	4	2	1	4	2	20	40	50	40	40	20
expert3	2	Econ	2	1	3	3	3	2	2	1	30	30	40	30	60	10
expert4	2	Econ	2	1	4	5	2	2	4	1	60	50	70	40	60	0
expert6	2	Econ	2	1	4	6	3	3	4	1	60	60	75	50	40	10
expert7	2	Econ	2	2	4	3	2	2	4	1	60	60	75	15	75	10
expert8	2	Econ	2	2	4	6	2	2	5	1	60	60	75	45	25	30
expert9	2	Econ	2	1	2	6	3	2	4	1	20	20	30	15	85	5
expert11	2	Econ	2	2	1	3	3	1	2	2	60	40	60	0	100	0
expert13	2	Econ	2	2	3	6	2	2	5	3	80	60	50	80	15	5
expert17		Econ														
expert18		Econ														
expert23	2	Econ	2	1	4	5	2	2	5	3	50	50	60	90	0	10
expert24	2	Econ	2	1	4	4	2	2	4	1	50	40	60	60	30	10
expert27	2	Econ	2	1	3	3	3	2	5	1	40	30	37.5	80	17	3
expert28	2	Econ	2	1	1	6	2	2	4	1	50	50	70	0	100	0
expert30	2	Econ	2	2	4	3	2	2	2	2	50	60	75	20	20	60
expert32	2	Econ	2	2	4	3	3	2	4	1	50	45	60	30	55	15
expert34	2	Econ	2	2	4	2	3	2	1	2	20	40	50	30	60	10
expert35	2	Econ	2	2	4	4	2	2	5	1	20	40	50	30	60	10
expert36	2	Econ	2	1	1	5	3	2	4	1	20	16	20	0	97	3
expert37		Econ														

expert38		Econ														
Smart1	2	Econ	2	2	4	6	2	2	4	3	30	60	50	40	40	20
Smart2	2	Econ	2	1	4	5	2	2	4	1	70	60	75	60	25	15
Smart4	2	Econ	2	1	3	4	3	2	2	1	60	60	75	0	99	1
Smart6	2	Econ	2	2	3	4	2	3	1	1	40	50	60	25	40	35
Smart7	2	Econ	2	2	4	3	3	1	3	1	20	30	30	25	50	25
Smart9	2	Econ	2	2	3	5	2	2	5	1	40	50	60	0	90	10
Smart10	2	Econ	2	2	4	4	2	2	4	2	40	45	60	0	85	15
Smart12	2	Econ	2	2	4	3	3	1	5	1	45	50	65	0	97	3
Smart13	2	Econ	2	1	3	3	4	2	4	1	60	60	75	60	30	10
Smart16	2	Econ	2	2	3	3	2	2	3	2	20	40	55	60	35	5
Smart17		Econ														
Smart18	2	Econ	2	1	4	3	3	2	2	2	50	40	75	30	50	20
Smart19	2	Econ	2	1	3	2	3	2	2	1	60	60	75	40	55	5
Smart20	2	Econ	2	2	3	4	2	3	4	3	25	50	60	40	40	20
Smart21	2	Econ	2	1	4	5	2	1	5	1	45	60	70	80	10	10
Smart22		Econ														
Smart23	2	Econ	2	1	3	6	2	2	3	2	50	50	70	0	90	10
Smart24	2	Econ	2	1	4	5	3	2	2	1	20	30	40	50	25	25
Smart25	2	Econ	2	2	4	6	2	1	4	1	50	40	50	40	50	10
Smart26		Econ														
Smart27	2	Econ	2	2	4	1	2	1	3	3	60	60	75	0	97	3
Smart29	2	Econ	2	2	4	3	3	2	3	1	50	40	60	0	90	10
Smart33	2	Econ	1	2	4	3	3	3	4	2	40	40	60	30	50	20
Smart34	2	Econ	2	2	4	6	2	1	5	1	60	60	75	40	50	10
Smart35	2	Econ	2	1	3	3	3	3	4	2	50	40	50	35	50	15
Smart37	2	Econ	2	2	4	6	2	1	5	1	30	45	60	0	99	1
Smart38	2	Econ	1	2	4	5	2	3	4	3	15	35	45	20	79	1
Smart39	2	Econ	2	2	4	3	3	2	4	3	20	40	50	40	50	10
Smart40	2	Econ	2	2	1	2	3	2	2	1	15	20	22	40	50	10