# Risk aversion, Under-diversification, and the Role of Recent Outcomes

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# Portfolio theory

Standard portfolio theory (e.g., Markowitz, 1952) suggests that investors require higher returns for assets with higher volatility.

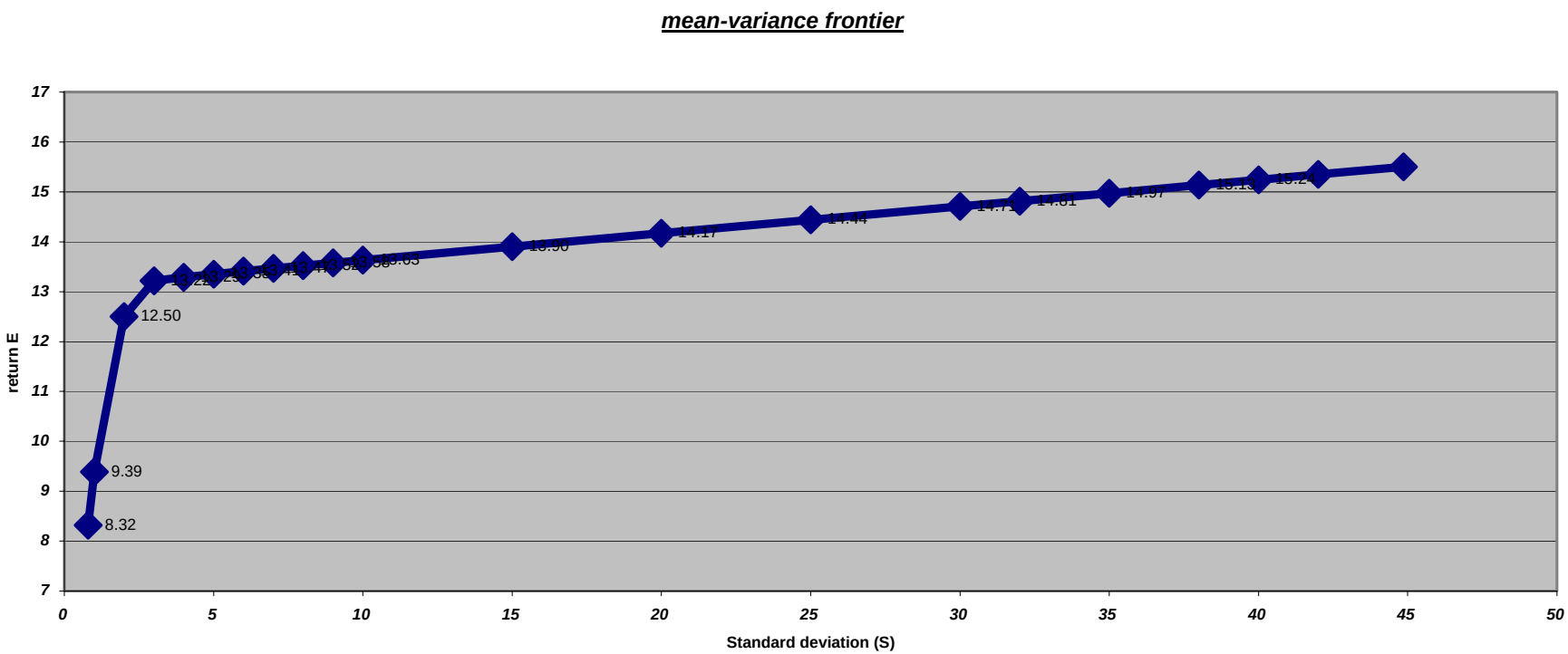
when two portfolios have the same expected return, the one with the lower volatility is expected to be preferred, by risk averse investors.

# For example

| Asset | Mean return | Standard deviation. | Range |
|---|---|---|---|
| A | 50% | 29.3% | 0%-100% |
| B | 50% | 14.92% | 20%-80% |
| M | 50% | 7.46% | 35%-65% |

Subjects prefer asset M with the lowest volatility

# Mean – Variance frontier




For each risk (STDV) there is one portfolio with the highest expected value.

there are exceptions to this predictable and robust pattern.

One important finding is the empirical observation that **many individual investors hold small number of stocks** than necessary to eliminate idiosyncratic risk (e.g., Blume and Friend, 1975; Statman, 1987; Kelly, 1995; Odean, 1999; Polkovnichenko, 2004; Goetzmann and Kumar, 2004)

Meulbroek (2002), Statman (1987), and Goetzman and Kumar (2004):
show empirically that investor failure to diversify leads to inefficient portfolio.
This failure is not consistent with economic Theory, since a diversification can reduce volatility holding the same expected returns.

**The recency** approach defined by Barron and Erev (2003), suggest that investor will be influenced by the recent outcome and will tend to choose the "winner" and the "loser" of previous round.

In this case he will tend to choose one asset (or small number) and not the market portfolio (under the recency approach investors will not invest in a fully diversified portfolio)

This approach is related to momentum behavior suggested by Grinblatt (1995).

This tendency can trigger behavior that appears “risk seeking” because strategies that minimize variance (like diversification) are rarely associated with the highest recent outcomes.

If, investors tend to prefer the alternative
with the highest recent record, he will end up with single stock and under diversified portfolio.

# The current research

The purpose of this study is to see if under well control experimental conditions, individuals learn to choose the optimal diversified portfolio, suggested by finance theory or whether they follow the alternative behavioral approach (“Recency effect”)

To simplify the experimental analysis we consider only 3 individual assets.

The first two assets ( A, B) have the same mean, and they are highly negatively correlated.

The third assets (asset M), who is equal weighted combination of the two assets, has the same mean but lower volatility.

The finance theory suggests that investors will learn to invest in asset M (Market portfolio)

The recency effect suggests that investor choose individual asset and not the market portfolio (M).

# Alternative Hypotheses

***<u>Hypothesis 1</u>: Mean-Variance.***

*Given a choice of one out of three assets presented above, individual will choose the diversified portfolio (Asset M).*

***Hypothesis 2*: The recency effect**

*Given a choice of one out of three assets and information on forgone payoff, subjects prefer the alternative with the higher return or lower return rather than the market portfolio (M).*

***Hypothesis 3*: Learning**

If the returns are I.I.D rational individual will learn to choose one asset rather than switching the choice in different rounds.

According to recency approach individual are affected by recent outcome and they will not converge to single (optimal) choice.

# The Experiment

*The experiment focused on a simplified investment task.

* We conducted two similar experiments (1 and 2), which are described below.

*In each of the 100 trials, participants were asked to choose one of three assets: A, B and M.

*The participants in each experiment were 40 subjects (second or third year students that had taken at least one course in statistics).

*The experiments took place at a computer Laboratory at Ben-Gurion University, and lasted approximately half an hour.

*The participants were informed that they would be asked to invest 100 experimental tokens in one of the assets in each trial.

*To provide concrete incentives, subjects were told that the return in tokens in each round would be converted into Israeli money (NIS) at a rate of 1 NIS for 200 tokens.

*They were also told that their profit from previous trials could not be used for reinvestment in the assets.

# The treatments

We conducted two experiments including 40 subjects each.

The participants in each experiment were divided into two equal groups (of 20 subjects): Full and Limited information.

The groups differed with respect to the feedback provided after each trial.

In the **Full Information group** the participants saw after each trial their return and earning from the asset they choose and the forgone payoffs (the return of the other assets).

In the **Limited Information group** the feedback after each round was limited to the obtained payoff (i.e, the return from the asset they choose in previous trial).

# The Assets

The assets' returns are constructed on the basis of two independent variables:

**U** was drawn from uniform distributions in each trial in the range 0% to 100%.

**ε** was drawn from uniform distributions in each trial in the range -5% to 5% .

# Assets

| Asset | Asset return | Mean return | Standard deviation. | Range |
|---|---|---|---|---|
| A | $R_A = U$ | 50% | 29.3% | 0%-100% |
| B | $R_B = (75\%-0.5*U)+ \varepsilon$ | 50% | 14.92% | 20%-80% |
| M | $R_M = 0.5* R_A +0.5* R_B$ | 50% | 7.46% | 35%-65% |

The correlation between assets A and B is –0.977. Asset C's return was always between assets A and B returns.

# Risk attitude

To obtain risk attitudes, we used the certainly equivalence (CE) approach. We asked the subjects to bid the maximal price they were willing to pay in three second price sealed bid auctions for lotteries. Subjects were provided with initial endowment of 100 tokens and were asked to bid on the following lotteries.

| **Probability** | Outcome | | |
|---|---|---|---|
| | Lottery 1 | Lottery 2 | Lottery 3 |
| 0.5 | 100 | 80 | 100 |
| 0.5 | 20 | 40 | 50 |
| ***Expected return*** | ***60*** | ***60*** | ***75*** |
| ***Standard deviation*** | ***40*** | ***20*** | ***25*** |

The risk attitude from each lottery was defined by the ratio of the subjective bid to the expected value of the lottery.

The average risk attitude measure in the full information group was 0.82, meaning that on average the subjects are risk averse in this group.

Only 20% of the subjects had a risk attitude Index higher than 1.

The finding that most subjects are risk averse is consistent with the assumption of the finance theory and suggests that most participants will choose the market portfolio.

# Results

## *Frequencies of choice in Experiment 1*

| ***Group*** | ***Asset A*** | ***Asset B*** | ***Asset M*** |
|---|---|---|---|
| Full Information | **46.65%** | **39.70%** | **13.65%** |
| Limited Information | **33.15%** | **27.45%** | **39.4%** |

in the Full Information condition, on average, subjects chose asset M less frequently than in the Limited Information condition ($t = 4.9,\ p < 0.01$).

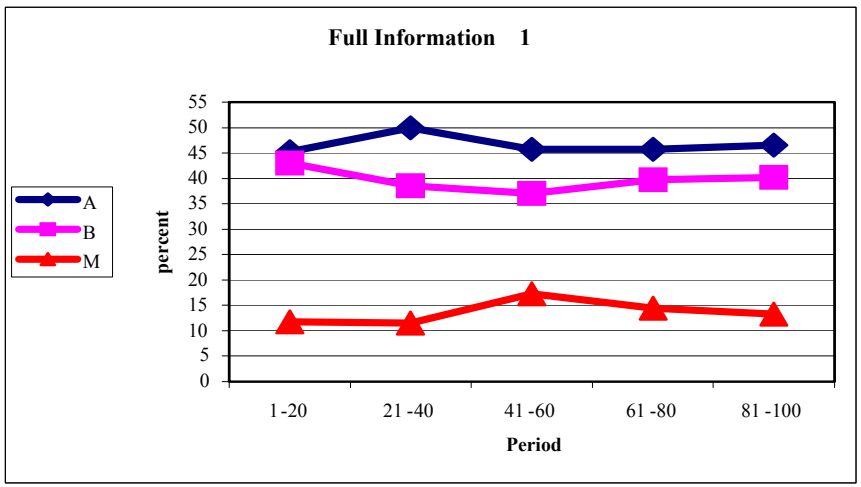
That is, when participants observed the forgone payoffs, asset M's frequency decreases. The recency effect (hypothesis 2) predicts this pattern due to decision makers choosing the recent best outcome.

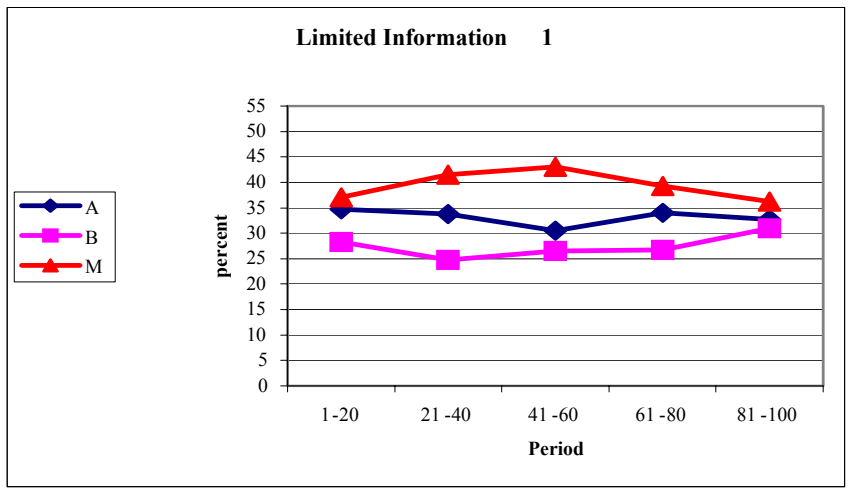
Participants chose the asset with the highest return in the previous round 57% of the time and asset with the lowest return in the previous round 24% of the time in the Full Information condition

*The results contradict hypothesis 1.

* In the limited information condition the choice of each asset was close to random with some preference to the market portfolio M and asset A with the highest range.

# *Average Relative Frequencies –Experiment 1.*



# Learning

## *Choice frequencies in the first and last 20 rounds*

| *Group* | | *Asset A* | *Asset B* | *Asset M* |
|---|---|---|---|---|
| **Full Information** | ***First 20 periods*** | 45 | 43 | 12 |
| | ***Last 20 periods*** | 47 | 40 | 13 |
| **Limited Information** | ***First 20 periods*** | 35 | 28 | 37 |
| | ***Last 20 periods*** | 33 | 31 | 36 |

On average we didn't find any significant learning

# Experiment 2

We replace asset M of experiment 1 with asset M+, which has 2% higher return.

This change is expected to encourage individuals to move to asset M+, which has higher return and lower volatility.

# *Choice frequencies in experiment 2*

| ***Group*** | ***Asset A*** | ***Asset B*** | ***Asset M+*** |
|---|---|---|---|
| Full Information | **45.4** | **26.8** | **27.8** |
| Limited Information | **34.4** | **22.1** | **43.4** |

Compared to experiment 1, in experiment 2 asset M+ was chosen more frequently than asset M in the Full Information Condition (t =2.14, p = 0.02).

As in experiment 1, the full information condition lowered the proportion choosing asset M (*t =2.17 p = 0.02)*.

It seems that increasing asset M's return by 2% increased preference for this asset.

# Learning and individual differences - simulation

To allow for quantitative tests we chose to study a simple adaptive learning model. The choice rule is stochastic, and beliefs are updated with depreciation of past beliefs by a constant. The model has two parameters: $\lambda$ -- payoff sensitivity parameter and $\beta$ -- the belief adjustment parameter. The equations are

(1) $A_{njt} = (1-\beta) A_{njt-1} + \beta X_{njt-1}$, if the payoff to action j was observed in period t-1

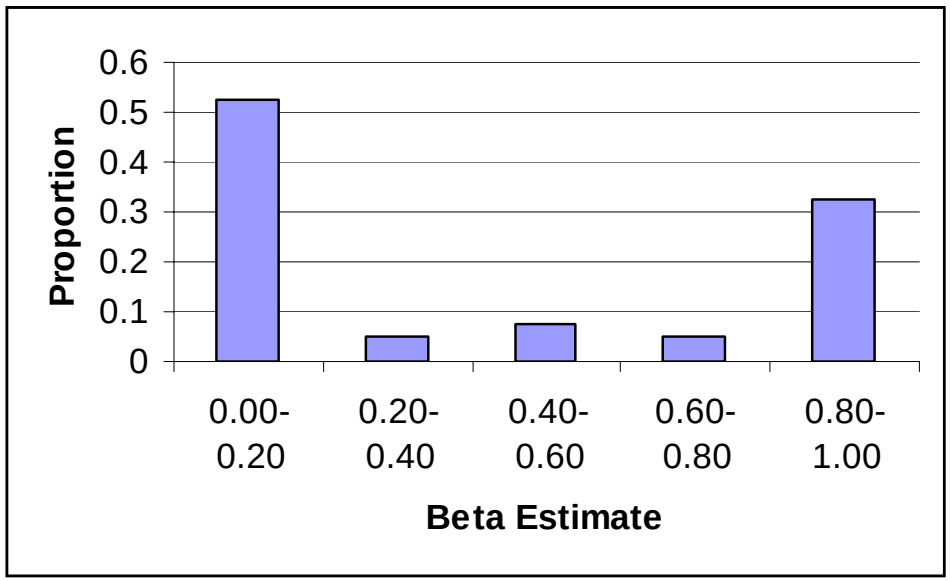
$A_{njt} = A_{njt-1}$ otherwise

$$P_{njt} = \frac{\exp(\lambda A_{njt})}{\sum_{j \in J} \exp(\lambda A_{njt})}$$

If $\beta$ is close to 1, we say the subject exhibits a strong recency effect. For each individual we estimate the model separately.

# A histogram of beta estimate values

**Equation 1 is estimated for each subject**



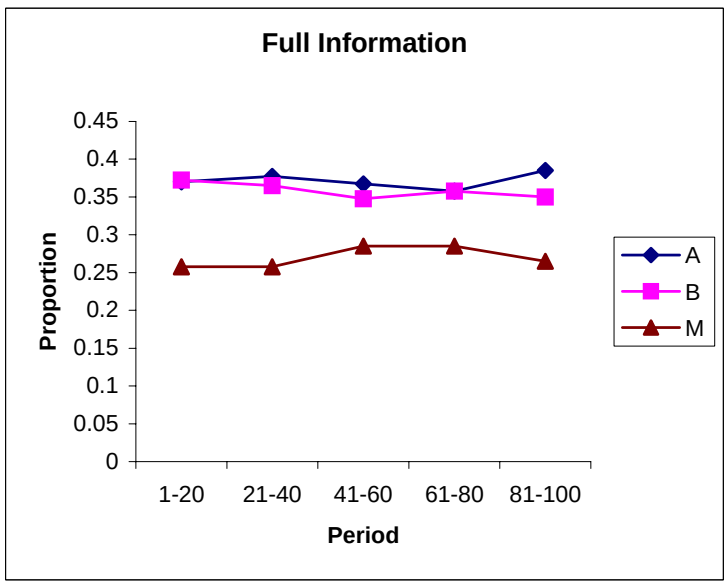

We see that over half of the subjects do not exhibit strong recency tendency. Yet roughly a third of the subjects exhibit very high recency effect

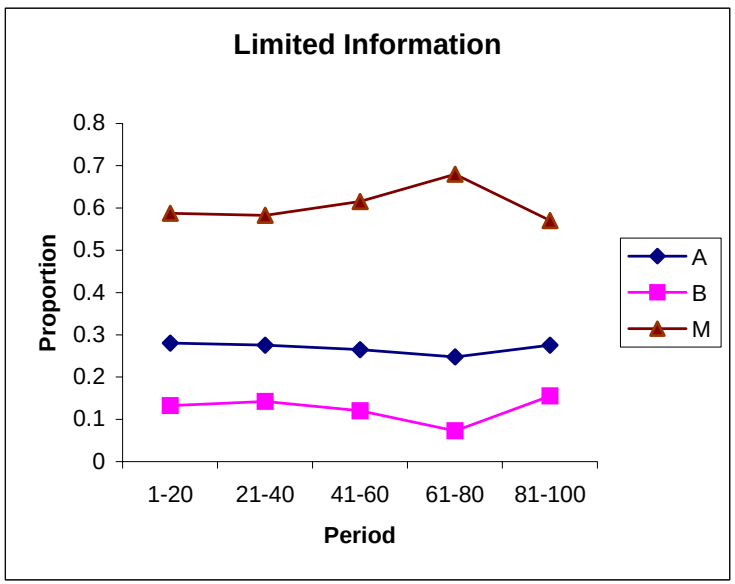
# Simulations

Using simulations, we can show that the subjects with the strong recency effect may be responsible for the difference between the full information and limited information conditions.

We simulate choices for subjects with $\beta=0.8$ and $\lambda=0.05$ (the average $\lambda$ for the subjects in the high recency group)

The graphs below represent averages for 20 simulated subjects with the parameters:



We see that whereas the diversified fund is least preferred in the full information condition, it is strongly the most preferred in the limited information condition. This reversal is due to recency.

Whereas these differences are much more pronounced in the simulation than in the experiment averages, note that these simulations represent only a third of the subjects.

If we add the remainder of the subjects who had weak recency effects and were therefore likely to choose more uniformly, the simulations replicate the experiment remarkably well

# Summary and Conclusions

First, we show that when the feedback was limited to the obtain outcome, the choice of assets was close to random, while in the full feedback condition most investors preferred the two risky assets on the third assets (the diversified asset) even when the combined asset (M+) has higher expected return than the original assets (assets A and B).

The analysis of learning behavior indicates that individuals are different. Some tend to converge to the optimal portfolio, while others do not learn.

The results support the recency hypothesis. They show that in the context of simplified investment tasks, the tendency to select the diversified option can be predicted based on the assertion that many investors “chase” recent outcomes.

The above results can provide at least a partial explanation to the observation that investors in the stocks market invest in under diversified portfolios rather than the efficient market portfolio. However, different investor may behave differently.

Previous studies of investment decisions highlight two robust but apparently inconsistent behavioral tendencies: Investors tend to exhibit strong risk aversion, but they also tend to prefer underdiversified portfolios.

**The current work attempts to offer a possible explanation to this puzzle**.

## **Future work needed**.

(1) Portfolio and stocks with return in the negative range (possible losses).

(2) Allocation of endowment between 2 stocks out of several and market portfolio.

(3) Alternative incentive system.