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Adaptive behavior leads to under-diversification

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ABSTRACT

In a given period, a diversified fund, by virtue of being a weighted average, will perform somewhere in the middle range of its components' respective performances. This means that adaptive investors who look to the past to adjust expectations about future returns will shun diversified funds. That is, adaptive reaction to feedback implies under-diversification when the investor gets complete feedback on the performance of the diversified fund as well as its components in a given period. Three laboratory experiments and one quasi field experiment explore this possibility and its implications. We find that the availability of complete feedback drastically reduces diversification. Under-diversification is observed even when the decision makers receive a complete description of the payoff distributions and when under-diversification lowers expected return.

1. Introduction

Studies of adaptation in economic settings have resulted in different models (see overview in Erev & Haruvy, 2010) that are based on different assumptions and processes, but the common element to nearly all adaptive models is the law of effect (Thorndike, 1898). The law of effect states that choices that have led to good outcomes in the past are more likely to be repeated in the future, whereas choices that have led to unpleasant outcomes in the past are likely to decline in the future. We use the term adaptive behavior in this work to describe behavior that follows the law of effect.

In environments with probabilistic outcomes, it is not necessarily the case that the adaptive behavior guarantees maximization of expected return. This is most likely to be the case when the payoff-maximizing choice has a low variance and the alternative choices have high variances. This type of scenario is especially prevalent in financial markets where risky assets can lead to really high payoffs for a time and individual investors or even institutions that exhibit adaptive behavior will invest in these assets (e.g., subprime mortgage pools), sometimes resulting in a global financial meltdown as happened recently.

In financial markets, adaptive behavior is sometimes referred to as chasing of past returns. There is extensive evidence that investors chase past returns (Chevalier & Ellison, 1997; Hendricks, Patel, & Zeckhauser, 1993; Ippolito, 1992; Sirri &

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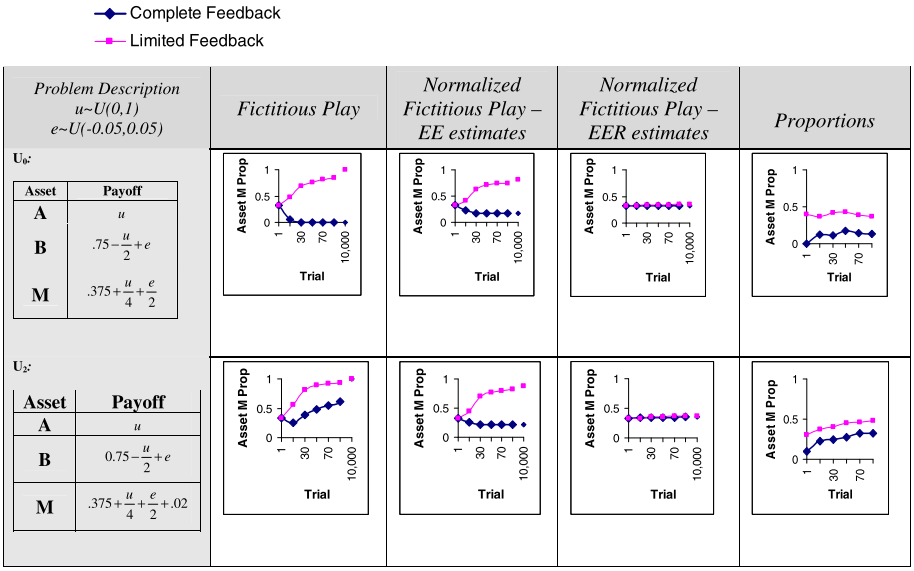

Fig. 1. Conditions U_0 and U_2. Choice proportions of diversified fund *M*. The left-hand column presents the three alternatives. The central columns present the predicted choice proportions of *M* under two learning models as a function of feedback and time. The right column present the results of Experiments 1 and 2 described below.

Tufano, 1998). Recent advances in behavioral finance (e.g., Choi, Laibson, Madrian, & Metrick, 2009) have established adaptive behavior as a key factor in such behavior. Specifically, Choi et al. (2009) showed that investors who experience higher returns on their retirement savings increase those savings more than investors who experience less rewarding outcomes and that the link between returns and adaptation is independent of competing explanations that invoke rationality. Chasing of past returns is also closely related to market overreaction (Chopra, Lakonishok, & Ritter, 1992; De Bondt & Thaler, 1985, 1990; Nosic and Weber, 2009; Offerman & Sonnemans, 2004) where demand overshoots in response to positive recent returns.

A pattern of adaptive behavior can potentially resolve various investment puzzles. For example, Choi, Laibson, and Madrian (2010) showed that the willingness to pay excessive fees was driven by the chasing of returns. The main goal of the current paper is to highlight the role of adaptive behavior in under-diversification. Under-diversification is commonly observed (e.g., Blume & Friend, 1975; Goetzmann and Kumar, 2004; Jacobs, Muller and Weber, 2009; Kelly, 1995; Odean, 1999; Polkovnichenko, 2005; Statman, 1987, 2004) but contradicts standard portfolio theory since diversification can reduce volatility without reducing expected returns.[1]

The reason adaptive behavior, particularly chasing of returns, leads to under-diversification is that a diversified asset (yielding a weighted average of other assets' returns) can never have a greater yield than the maximum of its components. Note that the implication that return-chasers will shun the diversified funds depends on the assumption of a particular feedback structure. Specifically, if an investor receives feedback each period about the returns on all investment alternatives, then the diversified fund will never be the "winner" in any one period. However, if the investor pays attention to returns only on assets that he owns, then the diversified fund may look much more attractive. This prediction about the relationship between feedback and diversification is what we set out to test in this work.

In a series of experiments, we show that investors are indeed adaptive and that adaptive behavior leads to more under-diversification when feedback is given over all alternatives relative to when feedback is limited to purchased alternatives. Experiments 1 and 2 examine this pattern under imperfect information conditions, where investors learn about asset returns by observing period-by-period outcomes. Experiment 3 examines an environment in which decision makers receive a complete prior description of the payoff distributions, and complete feedback (about the performance of all alternatives) after each trial. We find that the pattern predicted by the adaptive models emerges even under this setting: experience was found to decrease diversification. Experiment 4 highlights the robustness of the results in a quasi field experiment.

2. A simplified problem and adaptation

The current analysis focuses on a simplified multi-period investment problem. In each period, a single investor is asked to invest one unit is one of three assets: *A*, *B* or *M*. Assets *A* and *B* represent stocks with the same expected return and negative

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