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IRRATIONAL EXUBERANCE IN ONLINE INVESTING: AN EXAMINATION OF THE ROLE OF SELF-EFFICACY IN ONLINE INVESTOR OVERCONFIDENCE

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Abstract

Empirical evidence suggests that online investing can be hazardous to one's wealth. Through analyses of historical data acquired from a large online brokerage firm, Barber & Odean (2001) propose that a variety of forces lead to undesirable investment outcomes. Although these studies provide compelling correlational evidence linking factors such as overconfidence and attribution biases, little is understood about the causal agents underlying these relationships. The proposed program of study endeavors to fill this void. This research intends to build and test theory by utilizing a Web-based information system as a basis for controlled empirical study. The brokerage simulator, designed for versatility, allows researchers to reproduce realistic situations that online investors typically confront. By combining a socio-technical approach to theorization, a robust technology, and a free simulation experiment, causal influences can emerge that would otherwise remain undiscovered in archival data. With this understanding, we can better equip investors, prescribe technological designs to facilitate quality decision making, and influence public policy.

Introduction

Undeniably, the Internet and World Wide Web (Web) have altered our society. We now communicate interactively and instantaneously over vast distances, receive a wide array of information tailored to our unique needs, and conduct our business remotely without human assistance. One such area that has been significantly impacted is the investment of our financial resources. While in the past individuals have relied on trained investment professionals to assist them in planning for their futures, today individual investors are taking personal control over their financial destinies by investing their money online.

In a series of studies utilizing historical data from a large online brokerage firm, Barber & Odean (2001) suggest that online trading can be hazardous to your wealth. Using mathematical modeling techniques, these studies offer convincing circumstantial evidence that a number of factors contribute to sub-optimal online investment performance. For instance, overconfidence is suggested to result in active trading, reducing portfolio value due to transaction costs. Other factors include gender effects, self-attribution biases, illusions of control, illusions of knowledge, as well as a variety of important variables that lead investors to believe they can enact favorable outcomes by investing online.

Although these studies provide compelling evidence of significant correlations amongst various factors, little is understood about the mechanisms underlying these relationships. How do online investors become overconfident? Why do men trade more frequently than women? By what means do self-attribution biases arise? Why do investors operate under the illusion that the environment can be controlled? What are the factors leading to illusions of knowledge and what role does technology play in its formation? This research focuses on the aspect of investor overconfidence, shedding light on the manner in which overconfidence develops and affects investing behavior. More specifically, the proposed research intends to address the following general research questions:

RQ_1: What factors lead to overconfidence in online investors?
RQ_2: How does overconfidence influence trading behavior and, ultimately, performance?

To accomplish these objectives, a robust, realistic, and flexible technology in the brokerage simulator will be utilized as a basis for controlled experimentation. This proposal first describes the theoretical underpinnings that drive this effort and an explanation of the general research framework. A course of study is proposed that builds and tests the theoretical model. Finally, the potential contributions this study will make are discussed.

Theoretical Underpinnings

From a socio-technical perspective, it is critical to examine technological phenomena within the contexts in which they are embedded (Orlikowski & Iacono 2001). Investor behavior does not exist in isolation. Rather, behaviors are the result of a complex interplay amongst an investor's self-perceptions, the environment (including technologies), and behavioral outcomes. Personal, environmental, and behavioral factors are interwoven, mutually and reciprocally influencing one another. Accounting for each aspect and examining their structural relationships provides a deep, cohesive understanding of events as they occur.

Using the above perspective, Bandura's Social Cognitive Theory (Bandura 1986) will be utilized, which facilitates the viewing of psychosocial phenomena as a set of interdependent, reciprocal influences among personal, environmental, and behavioral factors (see Figure 1).

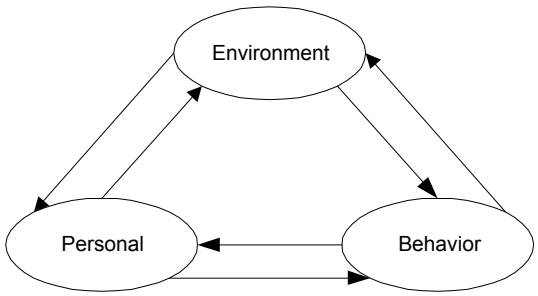

Figure 1. Social Cognitive Theory (Bandura 1986).

Social Cognitive Theory (SCT) has proven to be a powerful mechanism for explaining, predicting, and controlling behavior, receiving empirical support across a variety of domains including education, health, clinical psychology, athletics, and organizational functioning (Bandura 1997). Specific to information systems (IS) research, SCT constructs have been successfully applied in studies related to training (Agarwal, Sambamurthy, & Stair 2000), technology acceptance (Venkatesh 2000), and virtual organizations (Staples, Hulland, & Higgins 1999) to name a few.

SCT is based on the premise of "triadic reciprocality" (Bandura 1986), which proposes that personal, environmental, and behavioral factors are reciprocally determined. Individuals choose environments to which they belong. They bring to these environments a set of abilities, traits, and cognitive resources to deploy during their interaction with the environment. Situational factors influence one's assessments of his or her capabilities to attain outcomes. Behavior in a given situation is, therefore, mutually determined by environmental and personal components. Behavioral outcomes provide feedback about one's capabilities and beliefs. In addition, the environment can be transformed as a result of one's actions.

Central to Bandura's (1986) conceptualization of SCT is the concept of self-efficacy. Self-efficacy refers to personal judgments of how well one can execute courses of action to accomplish a given task (Bandura 1986). In an online investing context, self-efficacy refers to personal perceptions of one's capabilities to invest online. Collectively, IS research suggests that self-efficacy plays a critical role when one interacts with IT (Argarwal, Sambamurthy, & Stair 2000, Compeau & Higgins 1995, Marakas, Yi, & Johnson 1998, Venkatesh 2000).

Referring to Figure 2, self-efficacy functions as a basis for undertaking specific tasks, whereas performance expectations serve to spur or thwart action. Situations in which individuals exhibit strong self-efficacies are not consistent in predicting behavior. Unless one expects tasks to result in favorable outcomes, the person is unlikely to undertake them (Bandura 1986). Self-efficacy is widely acknowledged as the critical determinant of performance expectations. Individuals who possess robust beliefs regarding their capabilities expect higher levels of performance. A number of IS scholars have substantiated this relationship (see Markas, Yi, & Johnson 1998 for a complete review). Hence, in the context of online investing, online investing self-efficacy will likely shape performance expectations related to investing online.

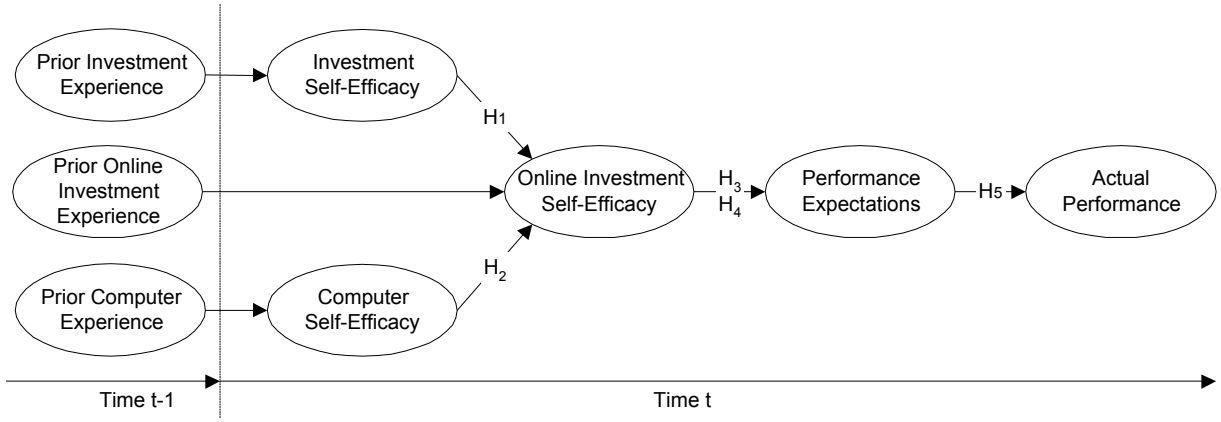

Figure 2. Theoretical Framework

Overconfidence develops when individuals expect levels of performance that exceed what objective probabilities warrant (Langer 1975). Overconfidence is believed to spawn hyperactive trading through increased effort, resulting in poor portfolio performance (Barber & Odean 2001). The role of performance expectations and its influence on user behavior has been empirically established in IS research (Compeau & Higgins 1995). As self-efficacy elevates, investors are likely to become more confident concerning their abilities. In turn, individuals who are more confident tend to exert greater effort to achieve.

Overconfidence can be identified by comparing performance expectations to objective probabilities of attaining the level of performance. Malkiel (1973) was among the first to suggest that short-term stock prices cannot be predicted. Since prices have no memory, financial markets randomly oscillate as new information becomes available. Moreover, news and events are impossible to foresee, indicating that short-term investing will only result in a lesson of futility. Supporting this notion, Barber & Odean (2001) determined that online investors who trade frequently sharply underperform investors opting for long-term buy-and-hold strategies, mainly as a result of inflated transaction costs. Hence, overconfident individuals will expect their investments to perform at a higher level of return compared to the overall market.

Overconfidence, in general, has been empirically established in across a variety of tasks including answering trivia questions, words and sound identification, medical diagnosis, and most salient to the present study, the prediction of random events (Langer 1975). In light of the generalizability of overconfidence in various domains, it is likely that online investors will expect their performances to surpass objective probabilities. As a result of overconfidence, it is reasonable to conclude that these investors will exert more effort through frequent trading and, as Barber & Odean (2001) have demonstrated, experience adverse consequences.

Marakas, Yi, & Johnson (1998) were among the first to distinguish between general self-efficacy and task-specific self-efficacy in the IT domain. General computer self-efficacy is defined as an individual's judgment of ability across multiple computer application domains, whereas task-specific computer self-efficacy is defined as perceptions of ability to perform specific computer related tasks within the domain of general computing. Agarwal, Sambamurthy, & Stair (2000) provided evidence for this general-specific link, establishing a connection between general computer self-efficacy and Windows 95 self-efficacy. Based on these findings, it is likely that general computer self-efficacy will influence other types of computer-related self-efficacies including online investing.

Computer self-efficacy is a necessary but not a sufficient cause in the formation of beliefs that an individual will be capable of investing online. Online investing requires both computing and investing skills. Although the behavioral finance literature has been relatively quite concerning the role of self-efficacy in investing, the general-specific self-efficacy link has been verified in other domains (Bandura 1997) and, therefore, it is reasonable to conclude that general investment self-efficacy will influence specific types of investing self-efficacies such as the online variety.

In addition, self-efficacies develop gradually and dynamically through experience. Mastering tasks and integrating environmental and behavioral feedback influence perceptions of ability over time (Bandura 1986). Individuals do not come to investing, computing, and online investing with a clean slate. Prior exposure to these domains and the experiences acquired within them shape initial self-efficacy perceptions. Agarwal, Sambamurthy, & Stair (2000) discovered that, in an IT training environment,

initial self-efficacy perceptions successfully predicted outcomes after controlling for prior computing experience. Thus, we expect that these relationships will hold in the case of online investing self-efficacy as well as its determinants.

Based on the arguments above, the following hypotheses are offered:

H_1: After controlling for prior investment experience, investment self-efficacy will have a significant influence on online investment self-efficacy.

H_2: After controlling for prior computing experience, computer self-efficacy will have a significant influence on online investment self-efficacy.

H_3: After controlling for prior online investment experience, online investment self-efficacy will have a significant influence on performance expectations.

H_4: For high self-efficacious individuals, performance expectations will significantly exceed the expected return of the overall market.

H_{5a}: Performance expectations will have a significant influence on trading activity.

H_{5b}: Performance expectations will have a significant influence on portfolio performance.

Methodology

To establish the validity of the proposed framework, a dual phased approach will be utilized. The initial phase of the research will involve instrument development and validation. In this phase, all instruments to be utilized in this research will be psychometrically established. The nomological validity of the prior experiences, initial self-efficacy perceptions, and performance expectations will then be tested. The second phase will involve a free simulation experiment (Fromkin & Streufert 1976), where subjects will access the brokerage simulator outside of the laboratory via the Internet. This approach places the subjects in a real-world situation that investors typically confront while they complete the experimental task. In free simulation experiments, there are no treatment groups. Rather, interaction is controlled through the application. The experimental task induces subjects' responses, which are subsequently measured through instrumentation.

Prior to the final study, a pilot test will serve as a trail run and used to test and refine the sequence of events and mechanics of the study, as well as provide preliminary indications of the veracity of the proposed hypotheses. Based on the refinements made as a result of the pilot study, a full-scale study will be undertaken to formally test the hypotheses. This process will involve the measurement of self-efficacy, performance expectations, and actual performance in a trial of the brokerage simulator.

Measures. A total of nine measures will be required to conduct the study – prior investment experience, prior online investing experience, prior computer experience, investment self-efficacy, computer self-efficacy, online investment self-efficacy, performance expectations, and two measures of actual performance. The three prior experience measures will be developed by adapting Agarwal, Sambamurthy, & Stair (2000) instruments, which measured prior experience with Windows 95 and Lotus 1-2-3. The computer self-efficacy scale (Compeau & Higgins 1995) can be leveraged without modification (Agarwal, Sambamurthy, & Stair 2000). Investment self-efficacy and online investment self-efficacy scales do not currently exist and will need to be developed by the researcher. Performance expectations will be adapted from Compeau, Higgins, & Huff (1999). Actual performance will be measured by the number of trades executed. In addition, overall performance will be assessed by comparing portfolio values at the end of the trial to the S&P 500 index. Both measure of actual performance can be obtained directly from the brokerage simulator database.

Instrument Development. To ensure appropriate domain specificity, measures requiring adaptation to the online investing context will be modified and subsequently checked for appropriate levels of reliability and validity (Straub 1989). For the investment self-efficacy and online investment self-efficacy constructs, proven methodological techniques will be followed as outlined by leading scholars (Chin, Gopal, & Salisbury 1997, Compeau & Higgins 1995, Straub 1989). These works prescribe rigorous guidelines for creating reliable instruments and meeting the requirements of content, construct (convergent and divergent), internal, and statistical validity. Based on the statistical analysis to be employed at each stage, appropriate sample sizes will be drawn to ensure suitable power and effect sizes.

Once the instruments have been validated, a representative sample of approximately 100 subjects will be drawn from a business student population, who will be asked to participate in a training session involving the brokerage simulator. Referring to Figure 2, the purpose of this exercise is to establish the nomological validity of the self-efficacy antecedents and consequents. More specifically, measurements will be taken for the prior experience constructs, self-efficacies, and performance expectations. The relationship between performance expectations and actual performance is dependent on actual use of the brokerage simulator and will, therefore, be assessed in the pilot and final studies. The theoretical model will be analyzed using structural equation modeling techniques, which will allow the researcher to confirm factor loadings, latent variables, and structural relationships as a comprehensive whole.

Pilot Study. Prior to the full-scale experiment, a pilot study will be conducted to confirm the proposed sequence of events, measures, procedures, and statistical analyses to be used in the final study are sound. The pilot study will allow the researcher to identify any weaknesses in the proposed methodology and make the necessary adjustments and enhancements prior to commencing the full-scale study. Since the steps involved in the pilot study include all steps of the final study, the steps will be discussed in the description of the final study below. At the conclusion of the pilot study, statistical analyses will be performed using structural equation modeling techniques. Due to sample size, significant relationships are unlikely to be uncovered, although the analysis will provide preliminary indications of directionality.

Final Study. To ensure sufficient statistical power, approximately 150 students will be recruited from upper-division electronic commerce courses. Participation over the course of a semester will be required as part of the course requirement. To increase involvement, $20-$50 prizes will be given to participants, which will include three prizes for the highest portfolio values at the end of the study and three randomly distributed prizes.

The first step in the final study will involve initial measurements of the prior experience, investment self-efficacy, and computer self-efficacy constructs. The purpose of the initial measurement is to capture time *t-1* constructs, which are hypothesized to influence initial beliefs concerning online investment self-efficacy. Following the initial measurements, participants will attend a training session where they will be introduced to the task and the brokerage simulator. The task for this study will involve building a portfolio of stock investments with the goal to maximize portfolio value over a 12-week trial. Hypothetical accounts with beginning account balances of $100,000 will be created for each investor. Potential stock investments will be limited to stocks in the S&P 500 index, which represents approximately 72% of the overall market. The brokerage simulator will be configured to process live market data to simulate a realistic online investment environment.

The researcher will conduct the training session, which will provide an overview of the brokerage simulator. Each feature of the brokerage simulator will be demonstrated, followed by a question and answer period to address potential misunderstandings. At the end of the training session, pre-trial measurements will be taken to assess time *t* constructs. More specifically, online investment self-efficacy, and performance expectations will be measured.

Subjects will then participate in a 12-week trial of the brokerage simulator, where they will be asked to perform the require task outside of class. This approach will be adopted in an attempt to add realism to the study since most investors manage their portfolios outside of normal working hours. As part of the free simulation experiment (Fromkin & Steufert 1976), the brokerage simulator will serve as the interface through which subjects will interact, yet subjects are free to interact with the system at their convenience.

At the completion of the 12-week trial, students will be asked to submit a writing report describing their experiences with the brokerage simulator, as well as provide a critique of the site as part of the course requirement, analogous to the approach adopted by Agarwal, Sambamurthy, & Stair (2000). Actual performance will be measured by the number of trades executed and portfolio performance in relation to the S&P 500 index. The overall model will be subjected to structural equation modeling techniques and goodness of fit indices will be calculated to ensure the model's validity.

Importance of Research

The determinants of overconfidence and its evolving role have yet to be examined in the context of online investing. This research has the potential to add to the scientific literature across various disciplines including Information Systems, Finance, Social Psychology, Decision Theory, and Sociology. The foremost contribution to academia comes in the form of theory to explain and predict online investing behavior. In the process, various psychometrically sound instruments will be made available to measure constructs related to online investing and investing in general. In addition, this study will offer novel conceptualizations such

as the manner in which overconfidence develops in online investors, as well as the examination of investor perceptions of ability and its impact on subsequent behavior.

This research will also make a significant contribution to our society at large. A major segment of our population, the "baby boomers," is fast approaching retirement. In light of recent proposals to privatize Social Security, as well as the false sense of confidence developed during the steep market advance of the late 1990s and its subsequent collapse that resulted in a painstaking deterioration of retirement savings, it is imperative to more fully understand online investing behavior. This research will serve as a foundation upon which we can educate individual investors about the potential hazards of online investing, protecting their financial interests. Furthermore, we will be able to offer prescriptions to regulatory agencies, policy makers, and brokerage firms to protect and inform individual investors.

Conclusion

As more and more Americans move toward retirement and engage in online investing, it is paramount that we gain a better understanding of why investors do what they do and how online investment environments can be optimally designed to facilitate effective decision making. This unique program of research will make important contributions to a variety of academic literatures as well as inform regulatory agencies, policy makers, and brokerage firms how to maximize investor prosperity. Without gaining this understanding, we lose the opportunity to better equip investors and influence public policy.

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