THE EFFECTS OF OVERCONFIDENCE, FINANCIAL LITERACY, AND RISK VISUALIZATION ON TRADING ACTIVITIES

Korkusol Pravakho
Kittiyanee Ruang-on
Isariya Suttakulpiboon

ABSTRACT

The objectives of this study were to study the effects of overconfidence, financial literacy, visualization in histogram and table on trading activities, portfolio diversification, expected return of investment, and return-to-risk of a portfolio. The researchers gathered data by using a questionnaire and the trading simulation program, Rotman Interactive Trader, for collecting trading volume in each transaction and the time before making buying or selling decisions. The sample consists of 84 bachelor's degree students of Chulalongkorn University in the academic year 2020. The statistics used for analyzing data are frequency, percentage, mean and standard deviation. The inferential statistics used were 3-way ANOVA to prove the difference among variables and the Tukey-Kramer test for comparison between groups. The results found that overconfidence and financial literacy affects trading volume in each transaction. The samples with high overconfidence and high financial literacy tend to have high trading volumes. Overconfidence, financial literacy, and visualization also affect the time before making buying or selling decisions. Moreover, visualization was found to affect the expected return of investment and return-to-risk of a portfolio with a significant level of 0.10.

Key words: Overconfidence, Financial Literacy, Visualization, Risk Aversion, Trading Activities, Portfolio Diversification

INTRODUCTION

Nowadays, there are many types of investment and financial products due to the higher demands of investors. Also, the suppliers of financial products continue to create products that be able to satisfy investors' needs. One of the securities which are suitable for the new-coming investors, such as exchange-traded fund or ETF, includes all of the needs of these beginning investors that have low investment fund and moderate risk appetize. The reason behind this is that ETF has the characteristic of Mutual Fund and Stock in itself. Investors can buy or sell these securities at any period. Risks of ETF are transferred to other securities in other industries which leads to maintaining the moderate risk level for the investors. In this research, the bachelor's degree students are the population that has investment potential. However, their investing behaviors are considered to have a high failure rate of investment decision making because of overconfidence that leads to information ignorance before making a decision that affects the risk and inefficient investment. From the literature review, there is a positive relation between visualization and the information gain in people which leads to an efficient learning process and a low overconfidence level. Although, there is less research that experimented or studied the effects of overconfidence, financial literacy, and visualization on investing or trading behaviors. Thus, this research aimed to study the effects of risk visualization on trading behaviors, portfolio diversification, expected return, and return-to-risk ratio in the population that have different overconfidence and financial literacy level. For the visualization, the table and histogram visualizations were used to the different group of samples which have different overconfidence and financial literacy level. Trading volume and time data were collected during the experiment also as the portfolio detail.

LITERATURE REVIEW AND HYPOTHESES

Glaser and Weber (2003) found that the overconfident investors tend to have a large amount of buying and selling which are correlated to Barber and Odean (1999) that found inefficient trading behavior (large buying or selling amount but less profit) in these investors. Odean (1998) also found that overconfident investors have higher portfolio risk than low confident investors. In addition, Chuang and Lee (2009) define high-risk-asset preference in overconfident investors as a result of the evaluation of assets lower than the actual value. According to Merkle (2017), the overconfident investor's portfolio has lower risk diversification which leads to overconfidence affects the portfolio diversification.

Lusardi (2003) argued that financial literacy affects financial and trading behavior positively. To define, the education and seminar affect the saving and financial stability which lead to higher financial literacy and better financial problem-solving. As the same as the research pf Lusardi (2008) that found the different level of financial literacy affects the mean and method to solve the financial problem differently. Howcroft et al. (2003) discovered that higher financial literacy people are less willing to find additional information to support their trading decision than low financial literacy people.

Oudoff and Timmermans (2015) found that visualization affects the time that people used before answering each question as well as the overconfidence level of that person to be lower due to the realization of self financial understanding as said by Cokely and Hoffrage (2015).

Therefore, this research focused on the effects of trading volume (buying and selling amount) in each transaction, time before making buying or selling decisions, portfolio diversification, expected return, and risk-to-return ratio on overconfidence, financial literacy, and visualization (table and histogram).

RESEARCH METHOD

Five survey questions from Asaad (2015) are used to measure basic financial knowledge about interest, inflation, bond, mortgage, and risk. Based on their result, the participants are grouped into two groups: high and low financial literacy. The participants whose score lower than the median or 4 points are assigned to the low-financial literacy group.

To state how confident they were, the twelve six-point Likert scale questions of Sara Sukavara (1990) was used. Then, we calculated individual scores and grouped participants into two groups: high and low overconfidence. The participants whose score lower than the median or 42 points indicate a low overconfidence level.

The degree of risk aversion was measured using the procedure of Holt and Laury (2002). The participants were required to choose ten paired lottery choices whereby option A is safer than option B. The total number of choices A was used to infer the individual degree of risk aversion, a risk-averse person would choose A choices more than four, a risk-loving person would choose A choices less than four and a risk-neutral person would choose four A choices and then switch to ption B.

The experiment was conducted using 84 bachelor's degree students of Chulalongkorn University in the academic year 2020. The participants were divided into 12 groups according to their financial literacy, overconfidence, and visualization that were assigned randomly. Table 1 provides descriptive statistics for participants. We used a trading stimulation program, Rotman Interactive Trader, for collecting individual trading volume in each transaction and time before making buying or selling decisions. For clarity, the measurement of dependent variables examined in this study is provided in Table 2.

In this experiment, the participants were required to the allocated investment portfolio of Exchange Traded Funds (ETFs) to achieve a given level of return within 20 years and an intermittent rebalancing portfolio is allowed every 5 years. Before the experiment, a case brief was given to the participant. The experiment repeated 3 times: demonstration, before giving the visualization round, and after giving the visualization round. At the end of an experiment, the participant satisfaction survey and visualization literacy assessment was given to the participants.

Table 1: Characteristics of the participants

Group	Overconfidence	Financial Literacy	Visualization	n	%
A	High	High	None	8	9.76
B	High	Low	None	6	7.32
C	Low	High	None	5	6.10
D	Low	Low	None	10	12.20
E	High	High	Table	6	7.32
F	High	Low	Table	6	7.32
G	Low	High	Table	6	7.32
H	Low	Low	Table	9	10.98
I	High	High	Histogram	6	7.32
J	High	Low	Histogram	6	7.32
K	Low	High	Histogram	5	6.10
L	Low	Low	Histogram	9	10.98
Total sample				84	100.00

Table 2: Measurement of dependent variables

Dependent variables	Measurements
Trading volume	Average trading volume (Investment units)
Trading time	Weighted average time before making buying or selling decisions (Second)
Portfolio diversification	This variable is measured using a Herfindahl index of portfolio at the end of year 0.
Portfolio return	This variable is measured using an expected return of portfolio at the end of year 0. (%)
Portfolio return-to-risk	This variable is measured using a return-to-risk of portfolio at the end of year 0.

After cleaning and transforming data into the desired format, the data were analyzed using descriptive statistics and three-way ANOVA. If the null hypothesis were rejected at the 0.1 level of significance, a multiple comparison method, Tukey-Kramer, would be used to identify differences between means.

RESULTS

H1: The overconfidence, financial literacy, and visualization affect the trading volume.

From table 3, the result of testing H1 indicates that the levels of overconfidence and financial literacy affect trading volume. The high-overconfident tend to trade in larger volume. This result is consistent with the previous finding that a high level of overconfident of investors will lead to high transaction volume (Glaser and Weber, 2003). Besides, the sample with high financial literacy tends to have a higher trading volume.

H2: The overconfidence, financial literacy, and visualization affect the trading time.

As shown in table 3, the result of testing H2 indicates that the levels of financial literacy affect trading time, the high financial literacy samples tend to take time longer to make buying or selling decisions than low financial literacy samples, imply that the high financial literacy samples carefully consider before investing. The result of this hypothesis shows that the type of visualization affects trading time. The histogram takes a longer time to interpret the information ($\bar{x}$histogram = 25.732) than the no visualization group ($\bar{x}$none = 17.034) and the table ($\bar{x}$table = 16.414). Furthermore, there is significant interaction between overconfidence, financial literacy, and types of visualization. The trading time of high level of overconfidence and financial literacy samples who receive histogram visualization or group I ($\bar{x}$I = 36.572) is longer than the same level of overconfidence and financial literacy samples who do not receive any visualization ($\bar{x}$A = 16.683). Moreover, the trading time of group I is also higher than both trading time of high ($\bar{x}$B = 17.017) and low ($\bar{x}$D = 16.203) level of overconfidence samples who have low level of financial literacy and do not receive any visualization, trading time of low level of overconfidence and high level of financial literacy samples who receive table visualization ($\bar{x}$G = 12.983) and the trading time of both high ($\bar{x}$F = 8.944) and low ($\bar{x}$H = 19.324) level of overconfidence samples who have low financial literacy and receive table visualization.

H3: The overconfidence, financial literacy, and visualization affect the portfolio diversification.

The result of testing H3 can be seen in table 3, the level of overconfidence, the level of financial literacy and the type of visualization have no significant difference mean with portfolio diversification. These results are contrary to the previous findings that portfolio diversification depends upon their financial literacy (Hilgert et al, 2003) and the portfolio of high-overconfident investors tends to be less diversified (Park et al, 2010). When the decision support data was displayed in the form of interactive visualization, it allows users to explore, manipulate and interact with the data. Getting the result of investing immediately helps samples understanding investment concepts such as diversification, risk-return tradeoff, etc. faster and improves their financial performance. Therefore, the level of financial literacy and overconfidence do not affect portfolio diversification not as same as mentioned findings.

H4: The overconfidence, financial literacy, and visualization affect the return of portfolio.

The result of testing H4 is shown in table 3, we can observe that the type of visualization affects the return of a portfolio. There is a difference between the portfolio's expected return of samples who receive a visualization and samples who do not receive any visualization. The group of the histogram has the highest portfolio expected return ($\bar{x}$histogram = 0.082), the second-highest portfolio expected return is no visualization group ($\bar{x}$none = 0.079). Whereas the group of the table has the lowest portfolio expected return ($\bar{x}$table = 0.068). In addition, these results align with previous findings that the histogram able to improve the accuracy of forecasts under uncertainty because it shows trends and relationships between data values that are essential in forecasting. (Sirkka L., 1989) and the portfolio expected return of samples who receive table visualization tends to be lower than those who receive interactive visualization (Anya Savikhin, Ross Maciejewski, and David S. Ebert, 2008).

H5: The overconfidence, financial literacy, and visualization affect the portfolio return-to-risk.

As shown in table 3, the result of testing H5 indicates that the level of overconfidence and the level of financial literacy have no significant difference mean with the portfolio return-to-risk. These results are not consistent with the previous findings that the high-overconfident investors tend to hold riskier portfolios than the low-overconfident investors (Odean ,1998). Furthermore, this result shows that the visualization type affects the portfolio return-to-risk. The portfolio return-to-risk of table, histogram, and no visualization group are 0.828, 0.730, and 0.721, respectively.

Table 3: Main Results

Source	df	F-value	p-value
Trading Volume			
Visualization	2	0.581	0.562
Financial literacy	1	5.060	0.028*
Overconfidence	1	4.963	0.029*
Visualization x Financial literacy	2	1.783	0.176
Visualization x Overconfidence	2	0.374	0.690
Financial literacy x Overconfidence	1	0.341	0.561
Visualization x Financial literacy x Overconfidence	2	0.094	0.911
Trading Time			
Visualization	2	6.313	0.003*
Financial literacy	1	3.644	0.060*
Overconfidence	1	0.222	0.639
Visualization x Financial literacy	2	0.790	0.458
Visualization x Overconfidence	2	0.201	0.818
Financial literacy x Overconfidence	1	7.993	0.006*
Visualization x Financial literacy x Overconfidence	2	2.831	0.066*
Portfolio Diversification			
Visualization	2	1.064	0.351

Financial literacy	1	0.082	0.776
Overconfidence	1	0.715	0.401
Visualization x Financial literacy	2	0.688	0.506
Visualization x Overconfidence	2	0.027	0.871
Financial literacy x Overconfidence	1	0.674	0.513
Visualization x Financial literacy x Overconfidence	2	2.044	0.137
Portfolio Return			
Visualization	2	4.268	0.018*
Financial literacy	1	0.103	0.749
Overconfidence	1	0.350	0.556
Visualization x Financial literacy	2	0.073	0.930
Visualization x Overconfidence	2	1.259	0.290
Financial literacy x Overconfidence	1	0.757	0.387
Visualization x Financial literacy x Overconfidence	2	0.848	0.432
Portfolio Return-to-risk			
Visualization	2	8.324	0.001*
Financial literacy	1	0.827	0.366
Overconfidence	1	0.310	0.580
Visualization x Financial literacy	2	2.160	0.123
Visualization x Overconfidence	2	1.267	0.264
Financial literacy x Overconfidence	1	1.119	0.332
Visualization x Financial literacy x Overconfidence	2	2.264	0.112

DISCUSSION

Our study provides the result supporting the several studies on overconfidence and trading behavior which demonstrate that high-overconfident tend to trade in large volumes. Moreover, the levels of financial literacy also affect trading volume, the investors with high financial literacy tend to have large trading volumes and they are very circumspect about their investing. Our empirical result led us to conclude that the total time spent for making buying or selling decisions depends upon the level of overconfidence, level of financial literacy, and type of visualization. Our study also indicates that using the histogram for visualizing decision support data can reveal patterns and trends that lead to better investment performance and more willingness to take on additional risk for investment than using the table visualization, even though it takes a longer time to interpret the graph. In addition, interactive visualization can help to promote the investment concept understanding among students and enhance their investment performance. Nevertheless, the limitation of our study is a carry-over effect from repeating an experiment, the result of the second and third experiment might be influenced by the prior experiment condition. As regards future research, we suggest that designing the next experiment should concern this effect and the experiment should be validated by larger sample size.

REFERENCES

Barber, B. M., & Odean, T. (1999). The courage of misguided convictions. Financial Analysts Journal, 55(6), 41-55.

Chuang, W. I., & Lee, B. S. (2006). An empirical evaluation of the overconfidence hypothesis. Journal of Banking & Finance, 30(9), 2489-2515.

DeSanctis, G., & Jarvenpaa, S. L. (1989). Graphical presentation of accounting data for financial forecasting: An experimental investigation. Accounting, Organizations and Society, 14(5-6), 509-525.

Freedman, E. G., & Shah, P. (2002, April). Toward a model of knowledge-based graph comprehension. In International conference on theory and application of diagrams (pp. 18-30). Springer, Berlin, Heidelberg.

Garcia-Retamero, R., Cokely, E. T., & Hoffrage, U. (2015). Visual aids improve diagnostic inferences and metacognitive judgment calibration. Frontiers in Psychology, 6, 932.

Gervais, S., & Odean, T. (2001). Learning to be overconfident. the Review of financial studies, 14(1), 1-27.

Glaser, M., & Weber, M. (2007). Overconfidence and trading volume. The Geneva Risk and Insurance Review, 32(1), 1-36.

Hilgert, M. A., Hogarth, J. M., & Beverly, S. G. (2003). Household financial management: The connection between knowledge and behavior. Fed. Res. Bull., 89, 309.

Holt, C. A., & Laury, S. K. (2002). Risk aversion and incentive effects. American economic review, 92(5), 1644-1655.

Howcroft, B., Hewer, P., & Hamilton, R. (2003). Consumer decision-making styles and the purchase of financial services. Service Industries Journal, 23(3), 63-81.

INFE, O. (2011). Measuring financial literacy: Questionnaire and guidance notes for conducting an internationally comparable survey of financial literacy. Periodical Measuring Financial Literacy: Questionnaire and Guidance Notes for conducting an Internationally Comparable Survey of Financial Literacy.

Keim, D. A. (2002). Information visualization and visual data mining. IEEE transactions on Visualization and Computer Graphics, 8(1), 1-8.

Lichtenstein, S., & Fischhoff, B. (1977). Do those who know more also know more about how much they know?. Organizational behavior and human performance, 20(2), 159-183.

Lusardi, A. (2003). Saving and the effectiveness of financial education.

Lusardi, A. (2008). Household saving behavior: The role of financial literacy, information, and financial education programs (No. w13824). National Bureau of Economic Research.

Mandell, L., & Klein, L. S. (2009). The impact of financial literacy education on subsequent financial behavior. Journal of Financial Counseling and Planning, 20(1).

Merkle, C. (2017). Financial overconfidence over time: Foresight, hindsight, and insight of investors. Journal of Banking & Finance, 84, 68-87.

Michailova, J. (2010). Development of the overconfidence measurement instrument for the economic experiment.

Michailova, J., Mačiulis, A., & Tvaronavičienė, M. (2017). Overconfidence, risk aversion and individual financial decisions in experimental asset markets. Economic research-Ekonomska istraživanja, 30(1), 1119-1131.

Odean, T. (1998). Volume, volatility, price, and profit when all traders are above average. The journal of finance, 53(6), 1887-1934.

Odean, T. (1999). Do investors trade too much?. American economic review, 89(5), 1279-1298.

Oudhoff, J. P., & Timmermans, D. R. (2015). The effect of different graphical and numerical likelihood formats on perception of likelihood and choice. Medical Decision Making, 35(4), 487-500.

Park, J., Konana, P., Gu, B., Kumar, A., & Raghunathan, R. (2010). Confirmation bias, overconfidence, and investment performance: Evidence from stock message boards. McCombs Research Paper Series No. IROM-07-10.

Russo, J. E., & Schoemaker, P. J. (1992). Managing overconfidence. Sloan management review, 33(2), 7-17.

Sara Sukavara. (1990). Effects of group counseling on increasing self-confidence. Bangkok: Chulalongkorn University.

Savikhin, A., Maciejewski, R., & Ebert, D. S. (2008, October). Applied visual analytics for economic decision-making. In 2008 IEEE symposium on visual analytics science and technology (pp. 107-114). IEEE.

Srinuan, K., & Promsuwan, S. (2016). A Study of Personal Characteristics Investment Behaviors and Investment Motivation of Thai Investors Affecting Decision Making in the Stock Exchange of Thailand. In RPBS Academic Conference on Business Management and Digital Technology (2016). Bangkok.

Tokar Asaad, C. (2015). Financial literacy and financial behavior: Assessing knowledge and confidence. Financial Services Review, 24(2).

Trinugroho, I., & Sembel, R. (2011). Overconfidence and excessive trading behavior: An experimental study. International Journal of Business and Management, 6(7), 147.

Korkusol Pravakho
Chulalongkorn Business School
Chulalongkorn University, Bangkok, Thailand

Kittiyanee Ruang-on
Chulalongkorn Business School
Chulalongkorn University, Bangkok, Thailand

Isariya Suttakulpiboon
Chulalongkorn Business School
Chulalongkorn University, Bangkok, Thailand