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Magdy Hussein[1] and Ngai Tsun Chan[2]

[1] International Technological University

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## Abstract

Technology around us continues to evolve and influence our lives whether we realize it or not. The evolution of technology has enabled people to do more than ever from the comfort of their location with a cell phone signal connected to a smartphone or laptop. Landline phones have become mobile phones for people to communicate anywhere in the world with a cellular signal. Smartphones act as mini computers connected to the internet with the growing number of applications from developers. The speed and computing power of these devices have enabled people to incorporate these devices into their lifestyles. Understanding if these technologies increase or decrease trader?s tendency towards the herding behavior and how it affects their level of confidence is important because it could ultimately affect their trading behaviors. Smallinvestors are at potential risk because as technology changes, so can the way small-investors trade stocks. Technologies have the ability to influence human behavior in positive or negative way. This study explores the influence of technology on small-investors? herding behaviors and level of confidence by using a 17 questions survey distributed online and in person.

***Index terms***— human behavior in positive or negative way.

# 1 Introduction

mprovements in technology in both hardware and software are reshaping people's lifestyles and have affected human behaviors at work, home, and outdoors. Technology have also influenced the ways people do things faster or more effective through the use of computers and smartphones that can seamlessly synchronize with their desktop computer counterpart allow people to access their data without much hassle. Activities like trading stocks can be an area of concern if traded under the wrong influences.

Documenting how technology changes can affect human behavior is important to understand because as the environment change so does the way people react and respond. Sometimes this can occur for the benefits, but can also do harm if not caught and discovered. As future generations utilize the use of new and better technology in terms of software and hardware, how will it affect their trading behaviors? The three main technologies focused in this research will include the landline telephone, internet on the computer, and smartphone applications because these comprise of the three main ways for investors to trade stocks.

For small-investors, understanding the tendency for herding behaviors and increased level of confidence to occur between the technologies is important because of how each type of technology can have a different impact on small-investors' decisions. Since herding behaviors and higher level of confidence may lead to regretful trading decisions, it is important to document the influences on small-investors by the three main technologies sources. The question becomes if these technologies affect the behaviors of smallinvestors. Should small-investors worry about the factors that may affect their behaviors for better or for worse? To explore its importance, the research question of "How likely does technology affects stock small-investors' herding behavior and their level of confidence?" will be the focal point of this research.

The aim of this research is to determine how likely technology affects small-investors' herding behaviors and their level of confidence. Determining if technologies, such as the landline telephone, internet on computer, and smartphone applications, will influence small-investors' herding behavior and level of confidence will be on the scope of the research. Secondary goal is to try to detect if there an increase level of herding behavior and

level confidence between the three technologies. The first hypothesis is that technology will cause more herding behavior to take place among small-investors. Secondly, technology will provide a higher level of confidence to small-investors among small-investors. The research findings will provide awareness to small-investors to allow for better decision making when trading stocks.

# 2 II.

# 3 Telephone Effects on Behavior

The invention of the telephone has allowed investors to trade stocks at their leisure of their homes by calling the stockbroker. This allowed investors to not physically be needed in the same room with the stockbroker to conduct the trade. Travel cost can be eliminated, while the transaction fee for each trade would be still valid. Communications between two parties either to the investor and broker or friend-tofriend seeking advice has also influence people on their behaviors. One such behavior is known is the herd behavior, which according to Koppel (2011) is the behavior where one follows the action or the opinions of another into order to feel safe and to be with the majority. This behavior may lead investors to either a right or wrong path as a result of this bandwagon effect to follow others. Communications over the telephone can lead to more conversations among their peers and thus may lead to the herd behavior in investors.

More communications from the invention of the telephone would promote more knowledge and information to be transferred from one person to another. However, sometime too much information may lead to being overconfident in one self. Overconfidence is defined by Nofsinger (2011) as the perception of oneself who under estimate risks, overestimate their level of knowledge, and believes that they can control the outcome of the event. Often time investors believe that they have better probability to gain a return from the stock market. This is also known as the better than average effect in which investor want to believe that they can gain the above average return.

# 4 III.

# 5 Internet Effects on Behavior

Wikipedia is a source of information and though its content may or not may be 100% accurate due its open source content. Much like a search engine of knowledge, Wikipedia can be easily accessed on the desktop or the phone without much effort due to its simple web design layout that contains mostly text without any fancy web features like sound or any flash content. Studies by researchers of Tsinghua University and Hong Kong University of Science and Technology, have found that the information within Wikipedia can influence stock small-investors behaviors in a positive way by offering more information to small-investors (Xin & Xiaoquan, 2013). Whenever companies disclose negative earnings reports or any negative news, stock small-investors can find out about them through Wikipedia to allow them to react properly and sell if necessary. As a result, information on the internet can lead to a certain degree of a herding behavior for those following the information on Wikipedia.

According to Nofsinger (2011), stock smallinvestors who switched over from the traditional phone based stock trading method to an online-based platform tended to exhibiting an increase of over confidence in behavior by a study done by Brad Barber and Terry Odean. In the study of 1,607 investors by Brad Barber and Terry Odean (Nofsinger, 2011), investors gained about 18% in return versus the 12% gain in return before and after switching to an online based. Switching to an online-based trading system found lowered trader's returns based on their study. Prior to the switch to the online trading system, the average portfolio turnover was around 70%. The percentage jumped to 120% after going and dropped a little to 90% two years later. Nevertheless, the number of trades done had increased after going to an online-based system. Their conclusion was that over confidence led to excessive trading, which lead to more transactions fees and commissions to stock brokers.

Today's faster computing and faster internet power also led to the development of High-Frequency Trading, where these small-investors account for the 40% to 70% of the transactions in the online market. It is expected to lower trading costs and improve the quality of service within the market (Abergel, et al., 2014). As online trading costs get cheaper over time, investors behaviors might be more exposed to over herd behavior, overconfidence, and excessive trading.

# 6 IV. Smartphone Applications Effects on Behaviors

According to a cash market transaction survey done in Hong Kong, the result suggests that only 69% of them were online small-investors in 2010 (Sam, et al., 2013). Sam, Chatwin, and Ma found that 62% of its citizens owned a smartphone according to Radio Television of Hong Kong. They also found that 76% of these smartphone users used them to access the internet in a study in 2012 according to Nielsen's Smartphone Insights Study. Coincidently, the study also concluded that Hong Kong was the third highest county with a 74% mobile apps usage in the same study by Nielson. Even though the study suggests that citizens of Hong Kong are commonly use mobile apps, Nielson's study of the global use of mobile applications around the world found that only 31% of all small-investors in the world use mobile apps to trade investments. In another study source of a mobile

banking perception found, Sam, et al. (2013) concluded that mobile trading was not popular yet in Hong Kong at only 4% of participants had used mobile trading apps.

While study by Sam, et al. ( **??**013) concluded that mobile trading was not trending yet among the citizens of Hong Kong, their survey study have suggested finding that there is a positive perception for mobile stock trading. Sam and Chatwin claim that the positive feedback of people toward mobile stock trading suggests a beneficial factor to its users.

In another study by Tai, Y. & Ku, Y. (2013) called "Will Stock investors use Mobile Stock Trading", trader's perception of risk caused trader's behavior to avoid trading on mobile devices due to risks involved. As a result, investors may choose may choose to avoid and skip the potential benefits from using mobile stock trading according to Tai, Y. & Ku, Y. (2013). The common risk perceptions founded toward mobile trading were difficulty when entering data prone to errors, piracy issues, crashing of the software and cellular signal loss. Tai, Y. & Ku, Y. (2013) believe that there is negative perception towards mobile stock trading because they are scared of making entry errors and others mention above according to studies done.

Tai, Y. & Ku, Y. (2013) also found positive findings that social influences among their peers, friends, and family can a determining factor whether users will adopt this mobile stock trading technology. They suggest banks promote mobile stock trading to the most likely users. Once the trend picks up, it could be similar to the herd behavior to adopt this fairly new technology to trade stocks on smartphones.

On January 18, 2006, the Nikkei 225 experienced a market decline of 7% after small-investors learned of the Live door scandal, which involved falsifying financials in order to increase its stock price. Later that year in November, mobile transactions among the three largest brokers in Japan hit $8.7 billion dollars' worth for the first time in history. This was 90% increase in dollar value from the prior year according to Hall, K., & Rowley, I. **??**2006). At the same time, they believed that small-investors rapidly sold their stocks at the convenience on their mobile phone software that attributed to the market drop that day which caused trading to be halted. Small-investors selling their stocks from this kind of news from a company scandal can promote a herding behavior that can send swarms of small-investors sell from the comfort from their mobile phones.

Currently, there are abundant of stock related applications for their smartphones that allow smallinvestors to trade, monitor, and analyze their stocks all within their smartphones anywhere in the world with a good cell phone signal. From a search for "trade stocks" in Apple's iTunes store, there were 100 software applications that would allow users to manage their stocks from their smartphones. According to Statista, the Apple App store had a total of 1.5M apps, while Google Play store had a 1.6M apps available as of July 2015.

One special smartphone application called Robinhood, which as of March 10 th , 4.5 rating out of 5 in the iTunes store with 242 reviews. Robinhood is unique because it gives small-investors zero commission fees per trade. In return, Robinhood holds your cash balance for a few days to earn interest before releasing the funds back to you after the sell. By having no cost trades, it will be interesting to see how current and new investors behave to these new technologies within the smartphone applications markets.

Brokerage firms, such as TD Ameritrade and Charles Schwab have also seen increased demands for smartphone applications according to KEN, H. (2016). TD Ameritrade have seen a steady 16% increase of smartphone app users yearly and with 18% of its trades done through a smartphone app. For Charles Schwab, the mobile application team claims to have 10,000 new users each month with a total of 800,000 or more using the software at any point in time. Based on the increasing usage of smartphone applications, it will be interesting to find out how it can affect trader's behaviors.

# 7 V.

# 8 Research Methodology

A blend of qualitative and quantitative research methodology will be used for the research for the subject matter presented in the research question. This research method will help identify the issues and the variables between each technology and the behavioral variables associated in the study. Each source of the technology is the interdependent variable while the herding behavior and the level of confidence become the variables. Overall, the research will determine if there is an influence on stock trader's behavioral herding tendencies and their level of knowledge in the market. Results of the study will help small-investors be aware of the actions they undergo while trading. From this, smallinvestors will be better able to make better decision from among the technology used to trade stocks.

Data collection method for primary data used with the quantitative method will consist of surveys with open and close-ended questionnaires done in person and online. The types of questionnaire used in this study will consist of self-completed questionnaires, and web questionnaires. The questions here will be distributed to a uniform sample size through the public via on site or online with web link. The participants will have the option to either fill out the surveys in person or fill out the surveys online at a more convenient time. Questions on the questionnaire will be designed to help answer the research question and its research objectives. Using qualitative methods, the data will be interpreted into findings by reviewing each respondent's feedback.

The un-uniform sample size for the study will be consisted of 100 human subjects who have traded stocks either by a telephone call to broker, online trading, or through a smartphone application. Presentation of data

will be shown in percentages on how many respondents selected for each answers. A review of the open-ended question will be conducted to gauge how respondents feel about herding, confidence, and technology.

# 9 VI.

# 10 Data Collection Results from Questionnaires

The data collection for the research study of 100 participants concluded after 10 days of collection from participants through various coffee shop locations within Silicon Valley and the distribution of the online surveys to small-investors. Dissecting the survey data in reference to Table **??**-1, the participants from the study came out to be 80% male and 20% female. Of the 100 participants, there is an even number of participants who are between 25-39 and 40-60 at 42% while 12% of them were over 60 years old and 3% were between 18-24. Most small-investors fell between the two age groups of 25-39 at 42% and ages 40-60 at 42%. The sample study yielded an equal number of participants that fell within those groups. The next highest group belonged to the 60+ group at 12%. In the study in reference to Table **??**-2, the majority of the small-investors at 46% do not believe that their friend's stock suggestions are valid sources of information for stock trading by combining the total of the disagree and strongly disagree. The rest of the small-investors were neutral on the matter with only 20% of the small-investors believing that listening to their friend was a good idea for trading. Results from the survey resulted that small-investors also do not prefer to trade based on their stockbroker's suggestions with 39% disagreeing, while 30% and 31% of the smallinvestors agreed and remained neutral to the thought. From the survey, 54% of the small-investors believe that technology has provided more and faster access to information through technology to enable them to process information quicker through the internet either on the computer or on using smartphone to access information.

Small-investors' levels of confidence, as the study shown, are related to the returns from their investments as 82% of the small-investors in the survey agreed to statement #7 in Table **??**-2. The results shows only 3% of the small-investors had disagreed and with 14% of whom felt neutral about the same statement. The internet has provided small-investors with access to more information as shown by the 97% of the smallinvestors in the study, which directly correlates to the 90% of the trader that believes technology gives them more knowledge. Small-investors can gain higher level of confidence in trading by having more knowledge of the stock market of which 83% of the small-investors agreed to the idea in the study. Among the three made ways of trading stocks, landline telephone, internet on the computer, and smartphones, the study indicates that the vast majority of small-investors ranks trading on the internet using a computer as the most preferred method to trade stocks with 63% of the votes in reference to Table 1-3. Trading on the smartphones applications ranked second at 21% followed by the 8% of small-investors who preferred trading on the landline telephones. Small-investors who use the computer to trade stocks were at 94%, while small-investors who used smartphone applications were at 58%. Not surprisingly, only 8% of the small-investors ranked the landline telephone to be the most preferred method. VII.

# 11 Findings on Data Sample

The even number of small-investors with aged between 25-29 and 40-60 was a surprise finding making up 42% in each group among the 100 small-investors in the research. The next highest age group belonged to the 60+ age group, which makes sense since these folks will have more savings and income than the 18-24 age group. The younger crowd might not have the income and might still be in school.

The number of males who took part of the research was significantly higher than females with 80% as compared to 20% females. This data may suggest that there are more male small-investors than female small-investors in the population. However, the gender bias may be due to the fact that more males were asked to participate in the research as compared to females that will be discussed in the limitations section.

In addition, 93% of the participants had graduated either from college or graduate school, which suggest that the majority of the participants from this study are well-educated people capable of processing information. Within the study almost half them at 45% of the 100 small-investors received a master's degree. This shows that they have the knowledge and capability to learn complex academic chores likes reading large amount of written content to do their stock research.

# 12 a) Findings on Herding

Data suggest that small-investors do not listen to their friends and stockbrokers to make their trading decisions, which suggests that small-investors rely on their own research before trading. For the 20% to 30% of the small-investors, who would buy or sell stocks based on suggestions from their friend or stock broker, may be more influenced by the herding effect. For the 31% to 34% of the small-investors who choose neutral to question one and two, there may not be enough information here alone for them to make a trading decision judgment as the data suggests.

Small-investors in the study indicated that technology does increase their tendency to the herding behavior. Fifty four percent of the small-investors believe that technology has allowed them to process more data and faster using computer and smartphones. This finding suggests that technological innovations that increase

communication or provide faster information to users can indeed increase the herding effect among small-investors. Some follow others to trade, thus more technological advances in communications via online and social media can increase herding behavior for those who do not do their own research in stocks and or use outside tools such as technical analysis or any other research databases in reference to APPENDIX C. Some small-investors believes people get information roughly at the same time in real time, in which technology makes information available to people faster and more easily than before. Small-investors who read the same article as others through social media may be reposted and encourage other small-investors to follow in a certain direction.

# 13 b) Findings on Level of Confidence

With technology as the vehicle to communicate information to small-investors, it seems likely that level of confidence among small-investors increase as more information are processed by small-investors. When asked if technology affect their level confidence, 63% said yes and 5% said no. The most commons reasons for the yes responses were because computers and smartphone allow information to be distributed faster and in real time to the general masses according to APPENDIX B. Technology have also provided smallinvestors to view more information on more than one computer screens using software tools to conduct technical analysis and other software tools. Technology has allowed small-investors to make more informed decisions to feel more secure, and therefore can increase small-investors' level of confidences.

# 14 c) Findings on Technology Influence

The once popular method of trading stocks by the landline telephone is replaced by new technology that are faster and more efficient for small-investors to trade either on the computer or smartphone applications. The shift towards the preferences to trading on the computer can be attributed by 63% vast majority of small-investors who most preferred the computer to trade stocks. Reasoning behind this in reference to APPENDIX C is because of the easier access to the information, dual screen monitors, better tools and software, and better security that is offered more on the computer than on smartphones applications. Another reason is that small-investors are often already conducting other activities on the computers already in addition to trading stocks on the same device. Those who use smartphone applications for trading mainly do so because of the better access and convenience they have when trading on the smartphones for 18% of the small-investors in the study. Though catching on, smartphone applications are still not as good as the computer counter part due to the lack of screen size and software features as on the computer. Convenience and accessibly is growing trend associated with trading on the smartphone that is driving this increase.

The 8% who preferred to trade via landline telephone in Table **??**-3 mainly do so to get in touch with their stockbroker, which shows small-investors have not all abandoned to listen to their stockbrokers. Some small-investors prefer landline telephone to trade is to avoid all the misleading information on the internet that can influence small-investors' decisions. They avoid the technology to make trades to avoid the information from their peers and the internet from corrupting their trading decisions. Their rationale to avoid trading on the smartphone was also to try to minimize data entry errors or mistake that can occur from the smartphone.

As small-investors who used the landline telephone to trade stocks fade away to the popular method of using computers and smartphone applications, smartphones application shows as potential tool for new users as smartphone become more functional and more secure. Already, we see that more than half at 58% of the small-investors in the study have traded stocks on the smartphone. Telephone trading is expected to decrease as the smartphone application usage go up as the younger generation follow the new trend with newer technologies, while the older generation using older technology dwindle. We also see less reliance on stockbrokers since majority of the small-investors in the survey do not believe their stockbrokers have ability to give them a return as belief among 39% of the small-investors. With more information provided to small-investors over the internet, small-investors can conduct their own research online to build their level of confidence. This correlates to the survey data since 90% of the participants acknowledge that the internet has provided them more knowledge in Table **??**-2.

# 15 VIII. Recommendation for Stock Small-Investors

Based on the feedbacks of those who gave written responses to the open-ended questionnaires, the followings are recommendation for small-investors. Small-investors who are comfortable with what they are doing and that is working for them should keep doing on what is working. New technologies are good, but can also be harmful if someone does not fully understand the effects it has on them. If trading on the telephone with the stockbroker works, then keep doing what is comfortable. Small-investors who might want to try new methods of trading can explore either monitoring or trading stocks via smartphone applications. Although, some smartphone applications may not be equivalent to the analytical tools offered by the computer software, some smartphone applications offer commission free trading, such as Robinhood that small-investors can take advantage of. Trading on the computer may still be the most popular way to trade stock because of the large amount of tools available. Overtime smartphone applications could address the most common problems perceived by responses of smartphone trading, such as security, limited screen size, and unfriendly user interface. Until

then, small-investors should trader under the method they prefer and be aware of the new methods of trading stocks reshaping the market as time changes.

# 16 IX.

# 17 Study Limitations

Seeking a balanced number of male or female small-investors would show more depth in the study to factor in any indications that male or female may have different behavior tendencies. It would be interesting to see how the data will present itself with studies groups with only one gender. The uniform sample set collected at 80% and 20% shows mainly behavior from the perspective of males and is inconclusive for female small-investors. A larger sample size would be better to increase the confidence level of the study, if more time was available during the 3-month research period. A more even number among each age group would make a more even study to capture ages of each generation as well.

The locations where data sampled were collected manually throughout various coffee shops in the Silicon Valley may be inconclusive of the overall population because behaviors of small-investors here may be more acceptable to technology. Areas with less technological influence may prefer to trade with their stockbrokers and may not own a smartphone. In addition, the sample size may be limited to coffee shop goers, which may only capture a certain demographics of people in terms of age and certain lifestyle.

Answers left blank or contained no explanation to the question is a limitation of the study as well that was uncontrollable during the study. There was no obligation to the participant to answer all questions based on their willingness to do so. Some of the questions used in the survey might have prompted some invalid responses as well as it might have not been clear to them what the question was asking. This may have led to more blank responses as well. As a result, some of the questions may have contradicting answers. For example, 46% of the small-investors believe that they will not buy a stock based on a friend's suggestion. However, at the same time part of the reason why 34% small-investors believed that herding would increase with technology was because of how it would increase from the social media influence among small-investors in APPENDIX C. Better design of the questions would had help prevented this.

In addition, surveys done at the coffee shops may be less thorough as compared to those who had the chance to do the survey online from the comfort of their leisure time versus those who were asked to stop what they were doing to fill out the survey on the spot. Future studies on this topic can address these limitations and further benefit to the study of behavior finance.

X.

# 18 Conclusion

In conclusion, the findings based on the survey data shows that it is likely that technology can increase small-investors ' tendency to the herding behavior from the vast amount of information small-investors can receive either on their computers or on their smart phones. Their level of confidence is also likely to increase from the information available on the internet. As more information is provided to small-investors, their decision become more informed and thus become more confident when trading. The technological preference in trading has shifted from the landline telephone to the internet on the computer in the current generation and the phasing out older technologies as new technology sets the new standard in stock trading. For smallinvestors to fully adopt the new smartphone trading trend, smartphone application developers must address the basic needs of small-investors such as security and the ease of use as mentioned in the findings. Trading on the smartphone with better software and tools in the near future could set a new frontier as more improvements are progressed in the comings years. Until then, stock small-investors have to keep doing their due diligence in researching stocks to keep their level of confidence high in their preferred method of trading, while avoiding the herd, as they perceive information on the web and social media at their fingertips on their computers or smartphones. [1] [2] [3]

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[3] ( )2017CHow Likely Does Technology Affect Small-Investors' Herding Behavior and their Level of Confidence?

**11**

| Gender | Male | Female | | | |
|---|---|---|---|---|---|
| | 80% | 20% | | | |
| Age | 18-24 | 25-39 | 40-60 | 60+ | |
| | 3% | 42% | 42% | 12% | |
| Education | No HS | HS graduate | College graduate | Some Graduate School | Complete Graduate School |
| | 0.00% | 6.00% | 37.40% | 11.10% | 45.50% |

Figure 1: Table 1 - 1 :

**12**

| Statement (Percent) | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| I would buy/sell a stock based on friend's suggestion. | 3 | 17 | 34 | 22 | 24 |
| I would buy/sell a stock based on my broker's suggestion | 3 | 27 | 31 | 16 | 23 |
| Having more knowledge of the stock market dynamics affects my confidence | 27 | 56 | 11 | 6 | 0 |
| Technology has given me more knowledge | 41 | 49 | 10 | 0 | 0 |
| I rely on the telephone to get market | 0 | 4 | 20 | 33 | 43 |
| The internet has provided me with access to more information. | 68 | 29 | 3 | 0 | 0 |
| Having gains on my returns increases my level of confidence. | 32 | 50 | 14 | 2 | 1 |

Figure 2: Table 1 - 2 :

**13**

| Yes | No |
|---|---|

Figure 3: Table 1 - 3 :

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