Reducing Uncertainty Representative Bias and Decision-making of Micro Subjects

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Abstract. The increasing number of predictions made in financial market indicated the error caused by representativeness. Representativeness heuristic is a popular study on subjective probability of an event. Researches have been made regarding the impact of representativeness heuristic on decision making. Previous studies have investigated the cause of representativeness from a psychological perspective. It has also been applied to financial cases. The study of representativeness provides an empirical guideline to investors in terms of making a prediction. This study uses case study to give a comprehensive overview on the impact of representativeness on two components of the market. This paper conducts further discussions regarding this heuristic in three aspects which are stock market, gambling and investment decisions. Representativeness bias is a very important theory in behavioral economics. Studying its influence mechanism can not only bring marginal expansion to the existing research, but also provide important reference for the behavior of investors. This paper is divided into five main parts, section one introduces representativeness heuristic and mention the connection between representativeness and economic field. Section two looks at previous studies on this heuristic, following by detailed analyses on three applications in the field of economy in section three. The method of case study is used in section three. Section four and five gives a conclusion of the content this paper and display of references respectively. The main finding of this paper is the influence of representativeness on predictions and decisions made by individuals and the superiority of firm in avoiding the negativity of representativeness. The findings illustrate the main difference between individuals and firms, giving a reference to individual investors to make a less affected decision.

Keywords: Representativeness, Stock Market, Gambling, Investment.

1. Introduction

Representativeness plays a significant role in people's lives. It also presents in many events in economic studies. The decision people made when purchasing a product, a prediction of the trend of the stock market and the judgement of the probability of winning a lottery can all under the influence of representativeness. A literature has been devoted to a detailed investigation of representativeness heuristic in psychological aspect, giving numerous events which representativeness appears obvious [1]. However, many intersections can be found between psychological cases and economic cases. Previous economists have conducted researches on the impacts of applying biases connected to representativeness heuristic in the economy, especially on decision-making [2]. It is a general agreement that biases connected to representativeness recurrent in people's decisions. Generally, representativeness may cause negative impacts on predictions. In a wide variety of investments, a good precise prediction is crucial for the reward. And to get an ideal prediction, the reference information has to be abundant and involve probability in its calculation. If representativeness affects the quality of information or the elements of calculation, the prediction may be representative. The prediction would become less profitable or even loss-making. Also, attractive information may be provided in some fraud tricks. People could make a wrong prediction and become victims of fraud. Given the defects of this heuristic, how different biases connected to representativeness affects individuals and firms' decision in microeconomy is something to be further explored. This paper aims to explained the procedures of making decisions in economic cases.

Understanding representativeness is important for both the individuals and the firms. For consumers, it is necessary to know how to select useful information. When using data to make a

prediction, individuals could identify representative information and categorize them. Data with representativeness characteristics could be considered less, avoiding irrational analysis. Also, it is helpful to make a complete judgement. After understanding the mechanism of representativeness, base rates are likely to be taken into account when making a judgement or a prediction. With the use of base rates, the conclusion made is more complete.

Similarly, it is also important for companies to study the way representativeness works. Firms may need to set a system for the storage of data and information. During the construction of system, it is important to enable the system to avoid representativeness. This system may include base rate as a composition. The firm must grasp representativeness completely to reach a precise system. Moreover, when firms analyzing previous performances, they may need to avoid pose self-explanations on some pointless figures and move to more significant parts.

This paper studies three economic cases: stock market, gambling and investment. Individuals and firms' performances are each analyzed, giving explanations of the performances under representativeness. Comparing previous studies, this essay uses more cases, giving a broader overview of the impact of representativeness on individuals and firms.

2. Literature Review

2.1. Origin and Development of Representativeness Heuristic

Subjective probabilities have been investigated before representativeness. A literature has been devoted to the process people perceive, use and analyze probability through decision making, intuitive statistics and probability learning [3]. The systematic study of representativeness started after Tversky and Kahneman closely investigate and characterized this heuristic. Numerous experiments are done in their paper, data comes from questionnaires gives an information support for their study. Attributes of the event and samples that make them representative are discusses. Their effects on subjective probabilities are also mentioned in their paper. In conclusion, their study provides an outline of representativeness as a heuristic and how it affects people's performance in judgements under uncertainty. More recently, this heuristic has been used in economic studies focusing on decisions made in the market. The studies on American and China markets indicated that investors suffer from representativeness when making decisions. Different culture has different extent affected by representativeness. Asian cultures suffer more comparing to United States [4-8].

2.2. Theoretical Framework of Representativeness Heuristic

Representativeness has been defined by "the degree to which it: (i) is similar in essential characteristics to its parent population; and (ii) reflects the salient features of the process by which it is generated." [1] However, this heuristic can disadvantage the investors in the market by manipulating the information. This heuristic generates unpredictable intuitive and systematic errors when judging probability under uncertainty. Representativeness has a manipulating role on samples. It is if no systematic error made, the sample is representative by definition. Unless the entire population is tested and analyzed, representativeness is always taking place [9]. Also, the main impacts of representativeness lie on the decision-making process. Representativeness has impacts on analytical decisions in two main ways, first investors give more weight and overreact to recent information. Second, they expect a reversion to mean and find pattern about a set of information with similarities [10].

2.3. Applications of Representativeness Heuristic in The Field of Economics

Impacts of representativeness on a few economic cases has been investigated in several studies. A study of Tunisian Stock Market indicates that the irrationality and overreaction to unanticipated and dramatic information represents the example of representativeness. A general past performance of firms may not apply to the future. If people subject to representativeness, they may assume the performance will continue to generate a similar result in the future [11]. Similarly, Guryan and

Kearney conducted a study about lottery sales. They investigated data of people buy different categories of lotteries, investigating the relationship between a winning ticket and its consumer demand, giving a positive connection. Representativeness explanation is used to explain this phenomenon [12]. Moreover, Chóliz discusses representativeness in gambling. The process of decision making and cognitive bias are investigated in Chóliz's study. The two experiments have observed and analyzed the effect of representativeness heuristic [13].

3. Applications

3.1. Representativeness in Stock Market

The stock market is a mechanism for individuals as well as public company to trade their shares, allowing participants to sell and buy stocks based on the judgements of the performance of the market. Shareholders and investors do stock exchange in various stock markets. The stock market is closely connected with consumptions and investments made [14]. In a stock market, individuals and investors from dominant companies are gathered, making their prediction on the future performance of the market. However, various factors can affect the efficiency of the stock market and lead consumers to make an inappropriate decision. The amount of information available, extreme numbers illustrated as well as the base rate of the data are closely connected to representativeness. During the collection and summarization of useful information, representativeness plays a significant role. As a matter of fact, people sometimes overreact to less important data and overlook essential information. This may lead to a common negative consequence. This weakness of individuals when making predictions is likely leading to possible losses such as sale of a potential stock. The following paragraphs analysis the influence of representativeness on individuals and firms in terms of the three factors. Last paragraph mentioned the drawback of get influenced by representativeness in stock market and the superiority of firms preventing them from being affected by representativeness.

3.1.1. Influences of the Availability to the Useful Data

For individuals, it is hard to avoid any shocking information since most of the references received are from the media. However, reports illustrated on the media is not necessarily true nor giving a fine illustration of the stock market. Accordingly, most of the consumers are very likely to be influenced by any significant information regardless whether it has been proven to be accurate [11]. It can be explained by the representative heuristic [15]. For example, De Bondt and Thaler (1985) indicated that there is a tendency for people to overweight latest information and, to some extent, neglecting the base rate of a set of data (or primary data) [16]. It is also found that it could be hard for individuals to get a wide range of data to support their predictions. The law of small number occurs when the data size is relatively small [17]. The stock market may not have characteristics corresponding to the sample data. At the same time, the characteristics of the sample data might be applied to the prediction of the market. It can sometimes lead to failures in trading.

In comparison, well-trained investors usually have their own method or system to reject or at least mitigate the effects of extreme values. By this way, less mistakes are made during the process. Sentiment usually has a negligible impact on well-organized large companies which carries on professional investigation when buying or selling stocks [18]. Firms work distinctly when collecting data. Usually, firms have their own system of reserving information. And the mode of the system is updating on top of experts' studies, filtering distracting information [19]. Apart from above, information exchange and strategic alliance exist between companies, allowing investors in the firms to enjoy plentiful informative resources. Consequently, the law of small number is partially avoided and firms are able to provide more practical strategies.

3.1.2. The Ignorance of the Base-rate

The derivation of the predicted probability of a stock (or an event) is the use of both diagnostic data and base-rate information [20]. Individuals are likely to neglect the influences of the base-rate

of a set of data, in the other words, individuals are deeply and widely affected by the “base-rate fallacy” [21,22]. People’s predictions follow a simple matching rule: "The predicted value is selected so that the standing of the case in the distribution of outcomes matches its standing in the distribution of impressions" [23,16]. Untrained ordinary people make judgements that are only combined diagnostic information. The impact of prior data is rarely considered. It is because no statistical evaluation is involved in the process, leaving base-rate an opaque factor to be used. The absence of base rates of data would result in inefficient prediction when trading stocks.

In comparison, a firm, as a professional organization, often performs better in using the prior data. The predictions suggested by a firm gather the wisdom of various investors and even economists. It is often a professional complex decision which may need months to be constructed. Some of the statistical calculations made by internal system and specialized investors are of a rigorous standard. In such procedure, the base rate of the information is unlikely to be ignored, especially as an indispensable component of the calculation of the possibility. A precise prediction of the stock market could ensure constant rewards as long as no unexpected shocks occurs.

3.1.3. Summary

Individuals and firms act differently in a stock market, this difference determines the extent to which they are affected by representativeness. Individuals prefer making intuitive unsystematic analysis of information and therefore give an unconvincing conclusion. In this case, representativeness affects people’s prediction, the sample size and base rate becomes less important in their prediction and the predictions made become less precise. Oppositely, firms work in an organized way. By using the statistical calculation, every piece of information has the equal weight, avoiding the influence of representativeness.

3.2. Representativeness in The Case of Gambling

Gambling is a popular game among certain countries. On the other hand, it is a risky game. Gamblers participated in this game always loss out, exploit their savings. However, the owners of casinos are happy to see irrational gamblers get addicted to the games. Every year, considerable amounts of profits are generated by casinos and flow to some social groups [24]. Researches have been made in terms of why casinos are likely to be of a high revenue. For instance, Guryan and Kearney (2008) have observed 3 gambling games and analyzed the dataset in each game (including the information from January 2000 to June 2002, consisting the range of information from number of gamblers attracted and figures of people won), mentioning a positive relationship among the occurrence of people won jackpots and the change in the demand of lottery tickets [12]. Representativeness heuristic takes parts in gambles when gamblers make predictions in games. The predictions and decisions gamblers made comes from the information they have. However, such information may have a small scale. Law of small number would influence their decision. It could have a negative downside: the sample could not represent the whole game. Incorrect predictions would therefore made, leading to possible losses of the gamblers. This study looks at the impact of representativeness and hot hand fallacy in gambling, from both consumer and producer sides. Possible solutions are also provided in a summary.

3.2.1. Representative Information Attracting People to Bet

Chóliz’s study (2010) conducted an experiment about the effect of representativeness, the way of human thinking and their links with common characteristics of the gamblers. Observation shows that gamblers often have a poor performance on processing the information they received and worrying ability of using the correct probability [15]. Moreover, in Guryan and Kearney’s study (2008), it is mentioned that gamblers sometimes have an expectation of using a small sample to represent a large population [12]. This mode can lead to several unpleasant results since small numbers are always not sufficient in terms of giving a detailed overview of the market [17]. Another general problem is that consumers can be rather irrational in gambling, especially when the success in a particular

organization or casino is representative and powerful, which could result in failures in gamblers' predictions.

3.2.2. Hot Hand Fallacy on Gambling

Though people like observing sophisticated gamblers' successful experiences. When newcomers watching others play games, they have no idea whether others' successes are results of luck or practical techniques. This indicated the potential that some of them might follow the hot hand fallacy, especially when the subject been observed experiencing successive rounds of winning. For example, if there are two gamblers playing games in a casino, gambler A has win eight successive rounds of a particular game while B has no record on this game, people would assume gambler A is better at this game. As people believe A has a higher probability to win, they may bet on A. However, no evidence shows where the advantage lies on. A and B shall have the same probability to win in this case. People who bet on A are under the influences of hot hand fallacy, misbelieving A having higher chance to win. Some outcomes heavily depend on luck, it may be neither reasonable nor logical. The pattern of certain cases does not necessarily exist.

3.2.3. Possible Solutions to Avoid Representativeness and Hot Hand Fallacy in Gambling

Losses are generated for gamblers by representativeness. Games may have certain patterns, but gamblers are misleading to believe certain features of the game, leaving little chance to win. It is not beneficial for individuals to remain uninformed of the existence of representativeness. Solutions for these irrational behavior and way of thinking should be claimed to maintain the market order since so many profits with low costs have been made by some certain social groups. The research made by Reid, Woodford, Roberts, Golding and Towell (1999) gives information about the relationship between the participation in gambling and people's social status and financial condition [25]. As Griffiths has mentioned in previous studies that some people might under the influence of psychological constitution and the nature of the game itself [24,26]. It can be concluded from the above that before people entering the gambling field, consumers need to be fully informed by how the game operate and the probability of winning the jackpot, in other words, mathematical calculation and logical order should be involved to assess their risk-taking levels.

Hot hand fallacy should also be avoided. To stop immoderate expenditure on gambling, gamblers could set a quota on the amount they want to spend. By setting the boundary, the significance of gambling to gamblers is reduced. The living standard is less affected by the wins and losses in gambling. Even gamblers unable to process the mechanism of the hot hand fallacy, restrictions on the amount of money spending on gambling would reduce the negative impact of hot hand fallacy to a large extent.

3.3. Representativeness in Investments

Investing the fund to boost sells or increase profit earned is an inevitable task for most of the companies, the directors in the board will always need to balance the financial situation within a firm and invest on a wide range of projects, including the cost of innovation and the budget for publicity [27]. Firms will always invest in most profitable projects. The extent to be influenced by representativeness can be a factor altering the firm's investment structure. Also, many individuals are willing to invest their money into a high payback program in order to gain a better financial position. Investments are often made based on the descriptive information and intuitive cognition. It provides an opportunity for representativeness to alter people's decision. On the one hand, when investors get distracted by shocking data, they probably not take the base rate of the set of data. It is also possible that not the entire set of the information is fully analyzed to make the judgement or the time period given is not enough to reach a rational summary. [10] On the other hand, people tend to give a subjective explanation for the result they received. These explanations may look reasonable but not necessarily apply to the results. If the defective explanation is adapted and used in consecutive decisions as a reference, the new prediction may go wrong as well. To explore this idea further, this study compares the impact on two types of investors (individual and firm) in two different aspects:

the procedure of processing information and making decision and the behavior of coming up with an explanation.

3.3.1. The Procedure of Processing Information and Making Decision

During the collection of information, the radical differences between individuals and firms is the size of the dataset and the method identifying useful data.

Individual investors tend to overweigh shocking data like a large profit made in one particular year. Predominant information largely affects the ability in judgement and lead to unfavorable consequences. They also have little availability to vast information. This is because a database needs considerable time to be constructed and will require huge effort to maintain it. Accordingly, people usually cannot find systematic data to support their predictions. Law of small number occurs in an imperfect basket of information. The prediction may not be considered as an effective prediction because the information used is broken. Consequently, predictions using limited information could lead to failures in investment. It is often a random error could be adjusted by reselecting more information. Individual investors are the most vulnerable group under the influence of representativeness in information. Their access to information is the most limited and their method to collect information is relatively less professional.

However, firms are less affected. Many companies have built their own reliable dataset. Companies often invest in a large scale, the running fee for a system is negligible compare to the potential profit earned. Some of the systems can already exclude distracting data for investors. Less representativeness is involved in the process of collecting information since firms tend to have specialized systems. The law of small number and the influence of shocking data can be automatically avoided. Some companies even invite experts to help them making a decision, correcting any mistakes in analyses. Companies are rarely under the impact of representativeness in selecting data.

3.3.2. The Behavior of Regression to the Mean

Both individuals and the firms are giving an explanation for any gains and losses in their investment activities. Most analytical processes require human effort to complete, some mental mistakes would be made during this step. Because of representativeness, people are seeking for explaining the consequences intuitively, avoiding using mathematical analysis to give a logical interpret.

If an individual experiences a reward from investment, the investor would believe in the potential of that investment or his own ability to make a prediction. Next time, this investor may rely on his own analysis of the data and therefore making his new decision. However, the first succuss may just be a product of luck and the investor's ability of making a prediction could actually be poor. As the investor is influenced by representativeness, the next investment is possible to be a failure.

Similarly, when comparing different types of investments made by a company, information analyses are involved. Accordingly, mean to the regression might take place. When doing the post-mortem, some recorded information and analytical results about each investment may be discussed. Some are more likely to be noticed and connected. Misleading and coincidental information might be involved in the discussion and the prediction of the future performance, this in turn would cause adverse effects on the firm's financial decisions.

4. Conclusion

This paper sets out to provide a comprehensive analysis of effects of representativeness on the performance of individuals and firms under uncertainty. It talks about the decision-making process in three different applications respectively, giving information in two major market participants. The main findings are as following: 1. Individuals are constantly and seriously under the impacts of representativeness in all three cases. 2. Firms partly avoid the negative impacts of representativeness if fewer human decisions are involved. It can be concluded from above: Subjective probabilities and intuitive decisions often connected to representativeness. To reduce the level of influence of

representativeness, intuitive process should be at least decreased. Instead, programs can be used to select information for investors. Also, individuals should aware of the sample size, the distribution of information and the base rate of the set of data. The extent to which the three are considered are important contributors to representativeness. The predictions must be made based on these factors.

However, the finding in this paper is subjected to a few limitations. Firstly, some speculations in this paper lack data support. The predictions are based on empirical model instead of experiments. It could become more convincing if data is involved in the speculation part. Secondly, firms' systems are not studied, leaving the detailed working procedure remain unclear. Furthermore, the impacts on different categories of individuals and firms are not discussed in this paper. The conclusion is lack of diversity.

The findings contribute to our understanding of certain irrational behavior in current market, indicating the impacts of representativeness and its related biases. It provides a reference to the solutions avoiding the negative influences in the market. Researches on how to mitigate representativeness on individual's predictions shall be made in the future.

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