INVESTIGATING FINANCIAL DECISION-MAKING WHEN FACING SKEWED DISTRIBUTIONS OF RETURN: A SURVEY STUDY IN VIETNAM

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Hlighlights

- This study investigates the relevance of behavioural finance to decision making
- We investigate the context of Vietnam
- We analyze the behavior finance in Vietnam

Abstract

This study investigates the relevance of behavioural finance to decision making. Studies suggest that human decision making is not always rational. This paper examines three behavioural financial theories: expected utility, optimal expectation, and cumulative prospect theory, to test financial decision-making when facing skewed distribution in Vietnam. A survey was conducted using lottery tickets, with six questions divided into three pairs. Each pair was aligned with one set of theories, and the questions selected allowed conclusions to be drawn to explain participants' behaviour. The experiment tested 321 people from a variety of age ranges, genders and occupations. Findings show that gender and ages do not significantly impact the decision-making process. However, they explain the preference of participants who appear to be behaving irrationally but do show some rationality when facing the skewed distribution of return. Decision-makers look for all the possible probability payoffs and choose the best outcome with the low-frequency distribution. They follow optimal expectation and cumulative prospect theory ranking the increasing order payoff valued by the parameter and support the cumulative prospect theory set out by Tversky and Kahneman (1992), showing "cognitive biases" and demonstrating that individuals routinely make decisions that contradict reasonable logic, The behavioural finance theory is again proven to be crucial. It strongly complements the standard financial theory. Individuals show heuristic behaviour when decision making in random situations especially when facing skewed distribution.

Keywords: financial decision-making, skewed distribution of return, rationality.

Jel: G11, G12, G30

INVESTIGATING FINANCIAL DECISION-MAKING WHEN FACING SKEWED DISTRIBUTIONS OF RETURN: A SURVEY STUDY IN VIETNAM

1. Introduction

Decision-making is a complex cognitive process of the human brain. Humans are not rational by nature, but they can think and carry on reasonably or not, depending on whether the protocol of hypothetical and common-sense levelheadedness is applied, unambiguously, to the considerations they understand and the actions they conduct. Human behaviour stems from the perception obtained by observing, feeling things, or phenomena. The natural approach to decisions indicates that people are rational without sophisticated calculations (Statman, 1995). Furthermore, the standard financial theory states that humans

know what they like or do not like, and their preference is perfect, which means they will compare possible options and make ~~a~~ preferred decision. Alternatively, they assume that their choices are the same, decide without emotion~~, and~~ random. Individuals seek to maximise their utility, given the predicted risk, and make a decision independently relied on relevant information (Markowitz, 1952). According to the efficiency hypothesis, if the market is overpricing, the arbitrage rule will provide equilibrium without distorted beliefs (Merton Miller and Franco Modigliani, 1958). Arbitragers make the market balance even though noise traders overreact in the stock market. The efficient market hypothesis claims that the price of a stock reflects all the knowledge.

On the other hand, behavioural finance asserts that investors often exhibit social and emotional prejudices that contribute to their irrationality. Both modern and proven concepts seek to resolve economic and financial issues. However, the reaction mode bias, in which subjects show distinctive risk states of mind when evaluating certainty counterparts versus impassion probabilities, could be a well-known bias within the appraisal of utility functions (Schwand, Vetschera, & Wakolbinger, 2010).

The interpretation of decision-making in standard financial theory is the expected utility function (EU), but optimal expectation (OE) is considered. Optimal expectations theory is introduced to observe optimistic bias, which is the present value of expected utility flow (Brunnermeier, Gollier, & Parker, 2007). This states that individuals are interested in available utility and expected ~~the~~ later utility, while standard theory states that individuals look for expected utility. If the available utility is valid, they will be optimistic about the second-order outcome. Th~~e~~is distorted belief~~s~~ may lead to gambling fallacy and over-optimism, and irrational overspending. Empirical evidence shows that investors may make errors, particularly in determining probabilities (Buehler, Griffin, & Ross, 1994). They overconfidently estimate their return and under-diversify their portfolio, particularly in asset management selection issues. Many behavioural studies show optimal belief is different from objective belief (Brunnermeier et al., 2007; Brunnermeier & Parker, 2005; Roger, 2011). Various proofs suggest that human behaviour in different situations will be explained by various theories (Statman, 1995; Xiao, 2008). The considerations that deal

with expected utility maximisation of standard financial theories which cannot explain such decisions are sometimes costly and irrational and can result in stock market crashes (Kapoor & Prosad, 2017).

Behavioural financial theory helps to explain what is not explained by classical financial theory. This theory argues that herd behaviour often influences investor behaviour and takes account of the more comprehensive experience. This is consistent with the notion that individual memory focuses on recent events. In a pioneering work, Kahneman and Tversky (1979) introduce the cumulative prospect theory (CPT), which shows that individuals adopt a risk-averse approach to gains when the value function is concave risk-seeking with losses when the value function is convex. The value function with probability weighting function is used instead of wealth utility, which indicates that individuals should use the value function to evaluate alternative. Traders overreact and underreact to information disclosure, and investors tend to focus on overvalued stocks so that portfolio reallocation will not be optimal (Alpert & Raiffa, 1982; N. Barberis & Huang, 2008; N. Barberis, Huang, & Santos, 2001). N. Barberis and Huang (2008) (cited by Roger (2011)) suggest that investors follow the cumulative prospect theory (CPT), and stocks with skewed return could be overpriced. The consequence is that they receive lower average returns.

This paper employs three theories (expected utility, optimal and cumulative prospect theory) to comprehend individual behaviour as represented by boundless cognitive ability investigate and which theories individuals adopt to follow different circumstances. The research was conducted by a survey asking Vietnamese people how they make decisions when facing a situation showing a skewed distribution? The process emphasised the role of heuristics by using a game to illustrate the decision-making process. The design followed a study by Roger (2011) with six questions divided into three pairs to compare three theories: EU, OE, CPT. This study differs from that of Roger in that it gives more weight to considerations of age range and gender, while Roger (2001) focuses on his students and does not evaluate the sexes differently. According to Venkatesh, Morris, and

Ackerman (2000), women and men decide dissimilarly; males' decisions are much more heavily affected by their mindset than females' decisions.

Papers are examining the impact of age on decision-making show significant differences (Mikels, Reed, & Simon, 2009; Parker, De Bruin, & Fischhoff, 2007). Retired individuals may be more overconfident about their ability to take correct decisions, which may hinder their ability to implement policies. Various literature studies support the concept that older adults prefer fewer choices than younger adults. In this paper, participants were divided into four groups according to age, following the age-based equity allocation in the Vanguard Fund report (Vanguard, 2018).

Many studies were performed with youth, adults, and retired men following age classifications (Baker, Kumar, Goyal, & Gaur, 2019; Kannadhasan, 2006; Ramiah, Zhao, Moosa, & Graham, 2016; Raut, Das, & Kumar, 2018). In Vietnam, the generation aged 72 – 90 years old experienced the government subsidy period of economic reforms "Renovation policy in 1986" and does not invest in the financial market. They accumulate and withdraw capital by holding valuable metals (i.e., Gold) or foreign currencies due to fear of government instability. Therefore, the silent generation is eliminated in our research. Individuals aged between 18 to 24 have been included in this survey. Understanding individuals' behaviour in the age group is crucial because they form the young labour force, which will be essential for the economy's future. It is expected that individuals in this age group would make an investment or spending decisions based more on their sentiment than their experience of previous financial crises and therefore take a riskier investment approach. Unlike the previous generation, their lifestyle is more liberal since they are more likely to spend more than they earn by using consumer credit. Other age ranges, such as Millennials after 1980 (25-37yrs), Generation X 1965-1980 (38-52yrs) and Baby Boomers 1946-1964 (53-65yrs), who experience one of the market crises (1973 oil crisis, 1979 energy crisis, 1980 saving loan crisis, 2001 internet bubble crisis, 2008 financial crisis) will be more cautious in their decision-making. With gender-related factors, changes in social norms, values, and behaviour expectations that shape individuals'

underlying mindset significantly impact their decision-making behaviour (Bussey & Bandura, 1999).

The nature of the population to be surveyed is the second significant difference from previous paper. European people have had the get used to the state lottery bonds for a long time, while Vietnamese people rarely buy lottery tickets. In this paper, the researchers designed a 'lucky ticket[1]" adapted to a Vietnamese perspective. The Vietnamese lottery bond market is still early, having been set up in the 1990s and expanded in the early 2000s. The lottery bond market is considered a tool for Vietnamese government macroeconomic policies rather than for corporations and-financial intermediaries[2] to raise funds (MOF, 2020).

This paper's research questions are: (1) Do individuals make rational decisions when facing a skewed distribution of return? (2) is there evidence to support whether any behavioural finance theories (expected utility, optimal expectation, or cumulative prospect) might follow? (3) How do they select their lottery numbers?

The methodology was to survey by asking participants in various age groups to select a lucky number from one to ten, using 2 lottery tickets designed to give a random payoff. They are required to select both tickets in order. The first lottery ticket represents the decision-making process and explains three theories (EU, OE, CPT). Sometimes, the winner's outcome is known beforehand; the rest will be divided equally among all participants (winners and losers). The second ticket follows the first-order stochastic dominance principle, which points out the required rationality level. The winner's payment amount is a fixed number related to the initial issue; however, the remaining amount, which is unchanged, is divided equally for all participants, including those who win.

This paper's motivation is to survey the best return or best payoff and examines whether the essential element of decision-making action is considered. The paper also considers whether Vietnamese investors can be rational when they face skewed distribution

[1] See the lottery tickets design in Appendix.
[2] Detail (mof.gov.vn)

and which tactics they select. They may act randomly, follow their heuristic instincts or the herd behaviour in the security market.

The study is essential since Vietnam is developing into an emerging market with Vietnam GDP's growth, based on the foreign investment, increasing by 97% over the same time (State, 2020). Higher FDI disbursements over the years mean an increase in investor trust in the economic prospects and their contribution to long-term investment in Vietnam. Vietnam is one of the few countries which encourages 100% foreign investment in most industries. More than 350 SOEs had equity funding, in whole or in part, during the period 2017-2020 (Deloitte, 2020). An understanding of the operation of the Vietnam Financial Markets is therefore of increasing significance.

This paper's main practical contribution is to equip asset managers with the knowledge to advise their potential investors better. This allows them to customise a suitable portfolio for their clients. The paper also provides a clear understanding of Vietnamese attitudes to the financial decision-making process. Furthermore, the paper provides a framework to assist policymakers in developing capital markets in Vietnam.

Hypothesis development:

The sentiment is a complicated process of human beings, especially the cognitive behaviour chosen to give them the optimal expectation. Thus, whether people decide based on rationality or random choice is necessary to study. Roger and Broihanne (2007) suggest that people act subjectively in choosing numbers. They have their preferred numbers, especially in a mutual betting game.

Moreover, the beauty contest game is the standard game for testing rationality. The participants who predict the closest number from 1 to 100 (given number multiply the average of all selected numbers) are the game-winner. Kahneman and Thaler (2006) recognise that people tend to choose the number far from 0, contrary to the theory of Nash (1950). Sentiment also refers to a herd phenomenon. Therefore, people hardly act ration when they have information about the distribution of payoffs. This paper tests rationality,

random choice, and positively skewed distribution. It is indicated that people are not risk-averse when they precede the outcome with skewed distributions.

Methodology

Data

The total observation population is a randomly selected group of 321 people[3] in various age ranges from 18 – 65-year-olds. The dataset includes both Vietnamese men and women. The below table presents the information of participants for this survey.

Table 1

The participants join the survey in different age-range

Age	Real observation
18 – 24 (Generation Z)	121
25 – 37 (Millennialss)	100
38 – 52 (Generation X)	50
53 – 65 (Baby boomers)	50
Total	**321**

A range of participants was surveyed: males and females, participants from 18-24-year-olds – Generation Z - mostly undergraduate students in various universities in Ho Chi Minh City, Vietnam. The second age range (25-37) is referred to as the Millennials generation, while the third age range (38-52), referred to as Generation X, are the people who work in the financial sector such as brokerage firms, banks, lecturers in finance. The last age range (53-65), referred to as the Baby Boomers, is pensioners. Among them, there are 144 males and 177 females. Table 2 illustrates the gender information between different age ranges of participants who participated in our study.

Table 2

The Gender between age-range of participants

Gender	18 - 24	25 – 37	38 - 52	53 - 65	Total
Men	31	56	29	28	**144**
Women	90	44	21	22	**177**

[3] The participants are bankers, brokers, lecturers, students, retired peoples in different banks, universities, brokerage, firm, parks in Viet Nam.

Total	**121**	**100**	**50**	**50**	**321**

Design of the lucky lottery ticket

Lottery 1

A Lottery company issue 10,000 (N) lottery tickets. Each ticket is sold at VND[4] 100,000 (P), with an interest rate of r = 5%. The participant who buys the ticket will choose one lucky number from 1 to 10. At maturity date, the company repays (1+5%) *(10,000*100,000) = VND 1,050,000,000 to the holder. The company randomly draws one number in the lucky series. The lucky participants who are lucky to have a drawn lucky number in the series will receive VND 1,000,000; Ni is the lucky series winner. The remaining amount ((1+r) *(N*P)-Ni*1,000,000/N or (1,050,000,000 – Ni*1,000,000)/10,000 is divided equally for all participants, including those who win.

Table 3

The payoff for lottery 1 - The series i column is the payoff received at the maturity date by a participant of series i when the number is drawn at random is the one appearing in the first column and the same line. ***N = 10,000, Winner*** **= $2 + r - {}^{N_i}/_{N}$, participant = $1 + r - {}^{N_i}/_{N}$**

	Series 1	**Series 2**	**Series 3**	**Series 4**	**Series 5**	**Series 6**	**Series 7**	**Series 8**	**Series 9**	**Series 10**
	1000	1500	800	1200	600	1400	700	500	1300	1000
1	1.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
2	0.9	1.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
3	0.97	0.97	1.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
4	0.93	0.93	0.93	1.93	0.93	0.93	0.93	0.93	0.93	0.93
5	0.99	0.99	0.99	0.99	1.99	0.99	0.99	0.99	0.99	0.99
6	0.91	0.91	0.91	0.91	0.91	1.91	0.91	0.91	0.91	0.91
7	0.98	0.98	0.98	0.98	0.98	0.98	1.98	0.98	0.98	0.98
8	1	1	1	1	1	1	1	2	1	1
9	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	1.92	0.92
10	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	1.95

Question 1: If you buy a lucky ticket, which number will you choose?

1	2	3	4	5	6	7	8	9	10

[4] VND: Viet Nam dong

Question 2: If you are the last person to buy lucky ticket 1, after seeing the number of tickets already sold for each choice of the lucky number, which number do you choose? (shows table 5)

1	2	3	4	5	6	7	8	9	10

Question 3: Assume that 20,000 tickets were issued by issuer 1. If you buy a lucky ticket, knowing that 10,000 tickets will be sold after your choice. The next buyer will receive complete information about the evolution of choices by updating information. Which number do you choose?

1	2	3	4	5	6	7	8	9	10

Lottery 2

A Lottery company issue 10,000 (N) lottery ticket, each ticket is sold VND 100,000 (P), interest rate r = 5%. The participant who buys the ticket will choose one lucky number from 1 to 10. At the maturity date, the company repay (1+5%) *(10,000*100,000) = VND 1,050,000. The company randomly draws one number in the lucky series (from 1 to 10). The company will take 10% of the initial total amount for winners (N*P) *10% (VND 100 mils). The remain amount [(1+5%) (N*P) - (N*P) *10%] (VND1,050,000,000-VND100,000,000) which is unchanged is divided equally for all participants, including those who win.

Table 4

The payoff for lottery 2 - The series i column is the payoff received at the maturity date by a participant of series i when a number is drawn at random is the one appearing in the first column and the same line. N = 10,000, Winner = $10\% \times N/N_i + 0.95$, Participant = 0.95

	Series 1	Series 2	Series 3	Series 4	Series 5	Series 6	Series 7	Series 8	Series 9	Series 10
	1000	1500	800	1200	600	1400	700	500	1300	1000
1	1.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
2	0.95	1.62	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95

3	0.95	0.95	2.2	0.95	0.95	0.95	0.95	0.95	0.95	0.95
4	0.95	0.95	0.95	1.78	0.95	0.95	0.95	0.95	0.95	0.95
5	0.95	0.95	0.95	0.95	2.62	0.95	0.95	0.95	0.95	0.95
6	0.95	0.95	0.95	0.95	0.95	1.66	0.95	0.95	0.95	0.95
7	0.95	0.95	0.95	0.95	0.95	0.95	2.38	0.95	0.95	0.95
8	0.95	0.95	0.95	0.95	0.95	0.95	0.95	2.95	0.95	0.95
9	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	1.72	0.95
10	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	1.95

Question 4: If you buy a lucky ticket, which number will you choose?

1	2	3	4	5	6	7	8	9	10

Question 5: If you are the last person to buy lucky ticket 2, after seeing the number of tickets already sold for each choice of the lucky number, which number do you choose? (shows table 5)

1	2	3	4	5	6	7	8	9	10

Question 6: Assume that 20,000 tickets were issued by issuer 1. If you buy a lucky ticket, knowing that 10,000 tickets will be sold after your choice. The next buyer will receive complete information about the evolution of choices by updating information. Which number do you choose?

1	2	3	4	5	6	7	8	9	10

Implementation of the survey

Two lottery tickets with different characteristics were created to minimise the risk that participants would respond without thinking. Lottery 1 is created to answer most of the questions we mentioned previously. Lottery 2 is also essential since it serves as a screening process to hypothesise that participants follow first-order stochastic dominance. Mainly, people tend to choose a more significant outcome in every number from 1 to 10.

Six questions based on three theories are designed and separated into three pairs (including two questions in each pair). Pair 1 (Q1 and Q4) is a random choice question. Participants are only provided with the characteristics of the lottery ticket. They receive neither information on the payoff table nor the participant's previous choice. The questions are randomly selected by choosing a lucky number from 1 to 10. Pair 1 (Q1, Q4) is the random selection of lucky series from 1 to 10. Q1 for Lottery 1 and Q4 for Lottery 2 are the same. Q1 & Q4: Assume that Participant buys the lottery, which number do they choose in the lucky series from 1 to 10? The purpose of Pair 1 is that participants will randomly pick up the number. Participants are indifferent in Pair 1, which is expected because it is their random choice. However, they have a preferred number. Notably, females and males tend to select the number belonging to Feng Shui, birth date, or anniversary date.

Pair 2 (Q2 and Q5) is designed for testing the Expectation of Utility, Optimal expectation, and Cumulative prospect theory. After answering the question in pair 1, participants will receive information about former participants' choices, briefly introduced in table 5. The surveyor will ask if a participant has known the choices of former players in each series and whether he/she is the last person who picks up the lucky series number, and which number will he/she choose? This table is created to increase participants' rationality to follow the first-order stochastic dominance. It is clear to recognise that series 8 has the lowest number of subscribers must be chosen in question 5.

Table 5

The number of lottery ticket was bought in each series (shown for participants)

The number of lotteries was bought in each series				
Series 1	**Series 2**	**Series 3**	**Series 4**	**Series 5**
1,000	1,500	800	1,200	600
Series 6	**Series 7**	**Series 8**	**Series 9**	**Series 10**
1,400	700	500	1,300	1,000

For Question 2 of lottery 1, the number of players distributed into each series represents their preferences. We assume the numbers for the possible outcome to select the

preferred choice if they follow the utility theory's expectation. The preferred choice is the highest frequency series, which is assumed as the random choice of the number that the lottery was bought in each series. The expected utility theory mentions that investors have a rational decision-making process if they face uncertainty, whether they are risk-averse or not. They have herd behaviour; therefore, they choose the highest frequency series. They should select series 2 (1,500) with the same probability distribution of 0.1 since the expected utility function of series 2 is maximised $E[U(series_2)] > E[U(series_n)]$. However, if their optimal beliefs, which is distinct from objective beliefs, somehow relate to irrational behaviour, participants are supposed to follow the optimal expectation theory.

A participant is interested in current utility and expected utility flows (Brunnermeier & Parker, 2005). According to Roger (2011), the players desire compensation for their first choice, which is different from the optimal objective beliefs. The optimal beliefs are the probability set of the expected time-average of the first choice's utility and the second choice's utility after the information is released that maximises welfare. The investors who have optimal expectations require skewed assets because they tend to be of over-optimism about states correlated with Arrow-Debreu securities: fair state price and low Probability (Brunnermeier et al., 2007; Roger, 2011). They desire to own these assets despite their low average return (N. Barberis & Huang, 2008; Brunnermeier et al., 2007; C.-L. Hwang & Lin, 2012). Series 8 is the highest positive skewed of payoff (3.115) and the highest variance series (0.101) in table 6. Hence, participants overinvest in the most skewed series (series 8) since they expect positively high returns.

Table 6

The skewed payoff in each series

	Series 1	**Series 2**	**Series 3**	**Series 4**	**Series 5**	**Series 6**	**Series 7**	**Series 8**	**Series 9**	**Series 10**
	1,000	1,500	800	1,200	600	1,400	700	500	1,300	1,000
Skewed of payoff	3.092	3.104	3.098	3.092	3.109	3.097	3.102	**3.115**	3.093	3.092
Variance	0.091	0.081	0.095	0.087	0.099	0.083	0.097	**0.101**	0.085	0.091

Figure 1 points out that the highest skewed series of the payoff is 3.115, with 500 participants (series 8) among ten series.

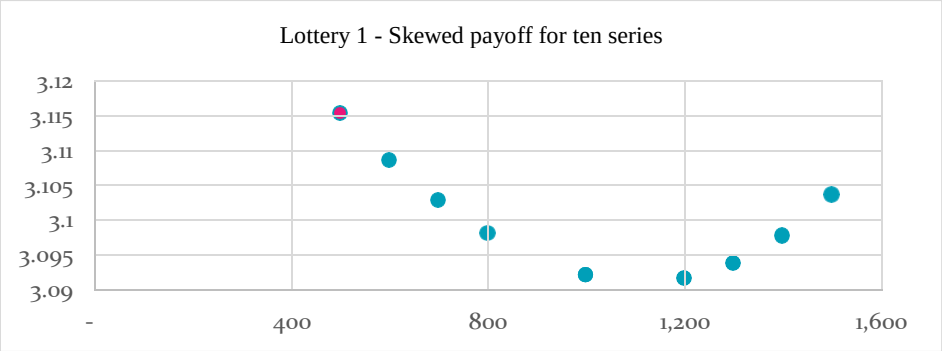


Figure 1 Skewed payoff for ten series, as a function of the numbers of participants

Suppose players prefer utility from gains and losses compared to some reference points. They will decide under uncertain conditions associated with observed behaviour (N. C. Barberis, 2013). The goal is to maximise value function rather than the utility function and decision weights instead of probability weights (N. C. Barberis, 2013; Tversky & Kahneman, 1992). Tversky and Kahneman (1992) introduce cumulative prospect theory employed in financial decision-making. According to Roger (2011), the player is interested in ranking outcomes instead of value. Whereby rank-dependence is the psychological norm that happens in life. Pessimism behaviour is the result of rational belief or unfavourable things. People tend to focus on the unfortunate consequence more than the excellent outcome. However, they lay stress even on the worse results or on the best result, and they do not become interested in the middle results (Diecidue & Wakker, 2001). The purpose of rank-dependence is to sort the results (or outcome) from the lowest to the highest. Ranking-dependence of outcomes (RDO) is $RDO = \sum_{k=1}^{10} \pi_k \times v(x_i)$, where:

- *Weighting function (Tversky and Kahneman, 1992):*

$\pi_k = W(p, \beta) = {p^\beta}/{(p^\beta + (1-p^\beta)^\beta}$ with β is the difference between gains ($\beta^+ =$ 0.61) and losses ($\beta^- = 0.69$), the range of gains and losses is nearly equal. We use the average value (0.65) for both and connect to the rank-dependence function $\pi_k =$ $w(p_1 + \cdots + p_k) - w(p_1 + \cdots + p_{k-1})$. The probability of each state is 0.1, then the weight of k[th] rank-dependence outcome is $\pi_k = w(0.1 \times k, \beta^-) - w(0.1 \times (k-1), \beta^-)$, the weight of gain is $1 - w(0.9, \beta^-)$.

-*Value function (Tversky and Kahneman, 1992):*

$$v(x_i) = \begin{cases} x^{\alpha} & if\ x > 0 \\ -\lambda(-x)^{\alpha}\ \lambda > 1; 0 < \alpha < 1\ if\ x < 0 \end{cases}$$ with α=0.88, λ= 2.25

- The maximised value function is decided by gains and losses in comparison with the reference point (the compounding interest rate, (1+ r)) (N. Barberis et al., 2001; Roger, 2011):

$\sum_{k=1}^{10} \pi_k \times v[X^i(k) - (1+r)]$ -> max.

Table 7

The payoff of ten series is ranked in increasing order, and the weight function is measured with the parameters estimated by Tversky and Kahneman (1992). α=0.88, λ= 2.25, β = 0.65.

Series 1	0.9	0.91	0.92	0.93	0.95	1.95	0.98	0.99	1	0.97
Series 2	1.9	0.91	0.92	0.93	0.95	0.95	0.98	0.99	1	0.97
Series 3	0.9	0.91	0.92	0.93	0.95	0.95	0.98	0.99	1	1.97
Series 4	0.9	0.91	0.92	0.95	0.95	0.97	0.98	0.99	1	1.93
Series 5	0.9	0.91	0.92	0.93	0.95	0.95	0.97	0.98	1	1.99
Series 6	0.9	0.92	0.93	0.95	0.95	0.97	0.98	0.99	1	1.91
Series 7	0.9	0.91	0.92	0.93	0.95	0.95	0.97	0.99	1	1.98
Series 8	0.9	0.91	0.92	0.93	0.95	0.95	0.97	0.98	0.99	2
Series 9	0.9	0.91	0.93	0.95	0.95	0.97	0.98	0.99	1	1.92
Series 10	0.9	0.91	0.92	0.93	0.95	0.97	0.98	0.99	1	1.95
Weight (πk)	0.17872	0.08121	0.06432	0.05798	0.05654	0.05872	0.06493	0.07759	0.10545	0.25453
Value function π_k*v[Xi(k)-(1+r)]	(0.0530)	(0.0344)	(0.0157)	(0.0202)	(0.0107)	(0.0234)	(0.0141)	(0.0125)	(0.0394)	(0.0755)

The weight and value function are calculated for ten series of the lottery ticket in this table. We rank all series' payoff from the lowest to the highest, the value function of series 5 and series 8 is higher than that of the others. People prefer series 5 and series 8 because the two series have mainly compensated for the lower weight. However, Lottery 2 is designed differently compared to lottery 1. Lottery 2 leads the player to attend rationality and obedience to the first-order stochastic dominance principle. Theparticipant (including the loser or winner) receive the same payoff. The lucky participant of lottery 2 will receive an extra amount, deducted from 10% of the initial issue. The more participants win, the fewer payoffs they receive because the total amount for winners is fixed. Hence, series 8 (500 frequency distribution) is the optimal choice for the last participant. A stochastic dominance series over the others is a series if the participant receives thehigher payoff in every ordered state of nature (Thomas E. Copeland et al., 2004). Series 8 with

cumulative probability distribution $F_x(W)$ will be stochastic dominance over series with cumulative distribution $G_i(W)$ for all no decreasing utility function (Fseries8(payoff) < $Gseries_i$ (payoff) (for W is defined on the payoff). Series 8 dominates $series_i$ since the cumulative distribution of $series_i$ always lies to the left of series 8 with the normal distribution.

Pair 3 (Q3 and Q6) rule is participant chooses the lucky series number with similar pair 2 again. However, they are told that more than 10,000 tickets will be sold after the previous successful issue. Participants also receive the updated news about participants' choice when selecting their lucky series. Roger (2011), question 3 and 6 are created to evaluate the rationality of their choice by conducting the beauty contest. The participants will receive all the information from the preceding choice and new update information. In the beauty contest, people know the given number. The participants who predict the closest number (given number multiply the average of all selected numbers) are the game-winner.

To sum up, this paper investigates whether decision-maker follows random choice or follow the financial theories as expected utility, optimal expectation or cumulative prospect theories. Six questions are employed for pair 1&4 testing the random choice, for pair 2&5 testing the positively skewed distribution. Participants choose series 2 if they look for the highest frequency series that maximises their expected utility and series 8 if they require the skewed asset since they are over-optimism of their expectation. They select series 5 or 8 if they prefer gains and losses compared with the reference point of payoff (cumulative prospect theory). Besides, pair 3&6 examine the rationality of choice when they recognise their limited rationality or decide rationally.

Results

The Outcome of Age-Range and Gender impact on decision-making in a random choice

The results present the difference between age range from 18 years old to 65 years old and difference among gender. In question 1 and 4, the age range 25-37 of men reaches the highest point of series 6 and 8 in question 1 for lottery 1 and series 6 in question 4 for lottery 2. As stated previously, Asian tradition affects the number selection behaviour, and

lucky numbers are usually number 6 or 8. When pronounced in Chinese, these numbers mean wealth and prosperity for their life. The question is why Millennials' decision-making (25-37) of men is affected by Feng Shui more than the older ages as 38-52 and 53-65 of the same gender. Generation X (38-52) and baby boomers (53-65) select series 7 especially popular. According to Roger (2011), series 7 is the number drawn more than others in the French Lotto game.

Moreover, the heuristic self-selection surveys show that the number 7 is the lucky number in Western culture. This number presents for seven days of the week, seven continents and the seas. Participants draw number 7 because this number has two syllables: various among one to ten. However, women in multiple age ranges have a different perspective comparing to men. For instance, from generation Z (18-24), women tend to select series 7, lottery 1 and lottery 2, while Millennial's women draw the number 8, from baby boomer and generation X choose series 6. Hence, Vietnamese people seem to adapt to diverse cultures globally, especially generation X and baby bombers.

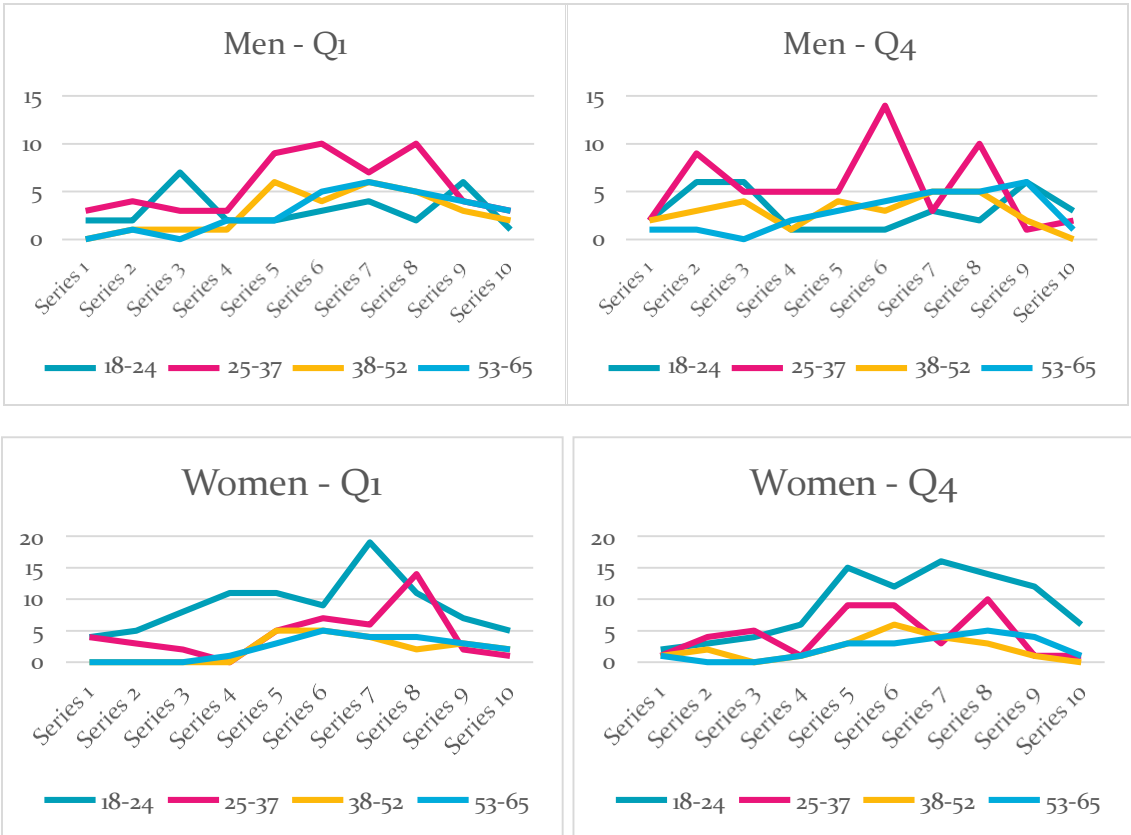


Figure 2 The outcome of Age-Range and Gender impact on decision-making in random choice - Question 1 and Question 4

Whichever the various age-range and gender that we survey, the results confirm that people have preferred number from their experience even though they make self-selection random. They do not draw the number at the beginning and end of the number sequence in question 1 and question 4 of two lotteries. Table 8 summarises the gender and range-age of agents participate in answering question 1 and 4. In total, 321 participants draw random choices in two games; 56 and 54 draw for series 7 question 1 and series 8 question 4. So, series 7 and series 8 are the favourite numbers. Both men and women of different ages choose series 7 of question 1 and series 8 of question 4.

Table 8

Summarise participants who answer question 1 and 4 (ranking from the highest to the lowest amount)

Question 1		Question 4	
Series 7	**56**	**Series 8**	**54**
Series 8	53	Series 6	52
Series 6	48	Series 5	43
Series 5	43	Series 7	43
Series 9	32	Series 9	33
Series 3	21	Series 2	28
Series 4	20	Series 3	24
Series 10	19	Series 4	18
Series 2	16	Series 10	14
Series 1	13	Series 1	12
Total	**321**	**Total**	**321**

The results of testing three theories EU, OE, CPT, in the decision-making process

It is assumed that participants must choose series 8 at Question 5 of lottery 2 if they comply with the first-order stochastic dominant. The assumption presented in the preceding section. Figure 3 shows the men and the women who participate in question 5 in various range-age.

Table 9 Participants (Men and women) answer to question 5

Men - Question 5		Women – Question 5	
Series 8	**33**	**Series 8**	**42**

Series 2	26	Series 5	34
Series 5	24	Series 7	22
Series 6	22	Series 6	18
Series 9	13	Series 2	16
Series 7	11	Series 4	15
Series 4	6	Series 9	15
Series 1	4	Series 10	8
Series 10	4	Series 3	4
Series 3	1	Series 1	3
Total	**144**	**Total**	**177**

Generation X, baby boomer, generation Z prefers series 8 to others in a millennium, generation X. A similar result presents in women shown in table 9 and shown in figure 3. People seem to concentrate on the formatted series to be a stochastic dominance over another if they get a better outcome from series in every ordered state of nature.

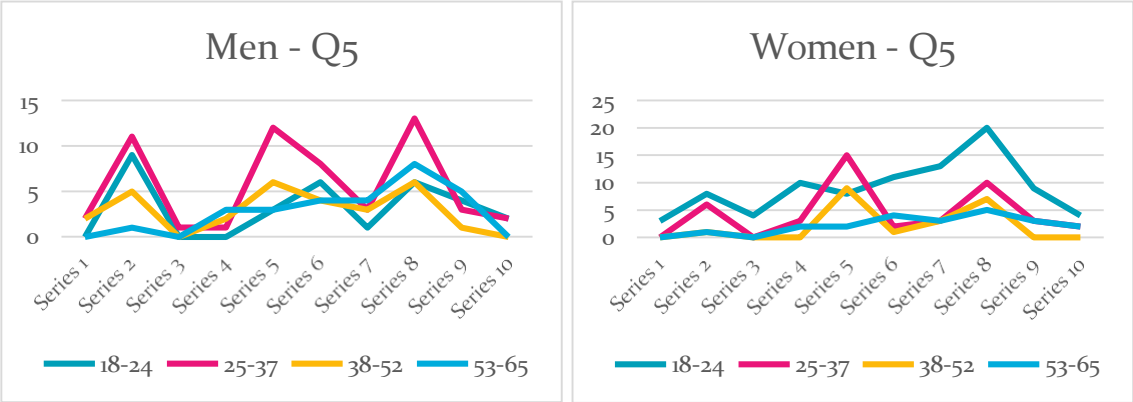


Figure 3 Gender in different ages answer for question 5

Question 2 of lottery 1 is designed to test whether participants follow one of three theories: EU, OE, and CPT. The highlighted results are given in Table 10. We rank the number of responses in each series from lowest to highest and provide in percentage. It can be seen that series 8 and series 5 is the preferred series since 34.03%, 18.75% of respondents is more top than other series. Other series have frequencies of less than 10%. As a result, the participant could be an optimal expectation investor or a cumulative prospect theory investor.

Table 10 The answers of rational men who participate in Question 2

Rational participants - Men (%)							
Series	**Bonds Bought**	**Question 1**	**Question 2**	**Question 3**	**Question 4**	**Question 5**	**Question 6**

Series 8	**500**	15.28%	**34.03%**	36.81%	15.28%	22.92%	27.08%
Series 5	**600**	13.19%	**18.75%**	13.19%	9.03%	16.67%	13.89%
Series 7	**700**	15.97%	8.33%	9.03%	11.11%	7.64%	8.33%
Series 3	**800**	7.64%	2.78%	5.56%	10.42%	0.69%	2.08%
Series 1	**1000**	3.47%	2.78%	1.39%	4.86%	2.78%	2.08%
Series 10	**1000**	6.25%	2.08%	2.08%	4.17%	2.78%	4.17%
Series 4	**1200**	5.56%	6.25%	4.17%	6.25%	4.17%	4.17%
Series 9	**1300**	11.81%	8.33%	9.03%	10.42%	9.03%	8.33%
Series 6	**1400**	15.28%	9.72%	10.42%	15.28%	15.28%	12.50%
Series 2	**1500**	5.56%	6.94%	8.33%	13.19%	18.06%	17.36%
	Sum	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

The results consolidate with females' responses in Table 11. Over 31.6% and 20.9% of answers in a total of 177 participants have selected series 8 and series 5. The outcome of the females' response is consistent with the result in table 10. It is further confirmed that gender participates in this survey have a consistent view of choice for the most skewed return. However, the result stays on the increasing order and corresponding weights, compare with the reference point valued by the parameter of (Tversky & Kahneman, 1992) in the cumulative distribution function.

Table 11 The answers of rational women who participate in Question 2

Rational participants - Women (%)							
Series	**Bonds Bought**	**Question 1**	**Question 2**	**Question 3**	**Question 4**	**Question 5**	**Question 6**
Series 8	**500**	17.51%	**31.64%**	32.77%	18.08%	23.73%	26.55%
Series 5	**600**	13.56%	**20.90%**	15.82%	16.95%	19.21%	15.25%
Series 7	**700**	18.64%	9.60%	8.47%	15.25%	12.43%	12.43%
Series 3	**800**	5.65%	2.82%	2.26%	5.08%	2.26%	2.26%
Series 1	**1000**	4.52%	2.26%	0.56%	2.82%	1.69%	3.39%
Series 10	**1000**	5.65%	5.08%	3.95%	4.52%	4.52%	4.52%
Series 4	**1200**	6.78%	2.26%	7.34%	5.08%	8.47%	7.34%
Series 9	**1300**	8.47%	6.21%	6.78%	10.17%	8.47%	5.65%
Series 6	**1400**	14.69%	11.86%	11.86%	16.95%	10.17%	11.86%
Series 2	**1500**	4.52%	7.34%	10.17%	5.08%	9.04%	10.73%
	Sum	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

The rationality of choice

Questions 3 and 6 are used to test the participant's choice~~'s~~ rationality. A previous assumption states that the player chooses the lucky number (series) after ten thousand

tickets sold out. They have already known the frequency of each series bought in previous, and they also get updated information at the same time they make a decision. If participants are rational investors, they will choose at random and not be influenced by the herd. According to Roger (2011), the rational person's players have unified in every situation. Hence the assumption is there is a uniform distribution of selection. The uniform distribution is an example of a state lottery in which series has the exact probabilities. Question 3 of lottery ticket 1 is set to examine the rationality of choice following theories. The players have expected utility investors if they firmly believe the maximised return be the case in the future. They get an optimal choice if they comply with OE.

Moreover, question 6 of lottery ticket 2 tested the rationality of the decision. Participants choose random since they believe in rationality that is created an equal distribution of payoff in chains of series. According to figure 4, panel A, mens' response in question 6 confirms that series 8 is their preferred choice. 39 men over 144 (27.08%) have the highest frequency. Men may finish question 5 before considering question 6 with the belief that series 8 is the lowest distribution series and expects others to have the same answer. They may gamble with the herd that series 8 will turn a high frequency after all.

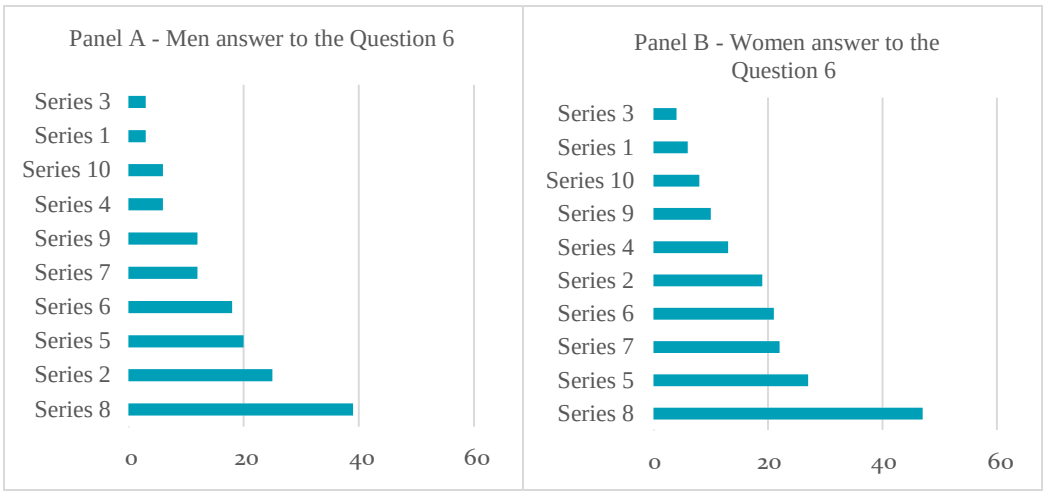


Figure 4 Men and Women answer to question 6

In panel B, figure 4, women have the same choice comparing to men. They are looking for series 8 with 47 over 177 (26.55%) frequency. However, the difference between men and women in question 6 is 17.36% of men select series 2, the second-highest

frequency, while women choose series 5 (15.25%). Series 2 with 1,500 tickets bought will lead them to the herd, while series 5 with 600 tickets bought let them gamble on the low-frequency series. Thus, the rationality assumption of both men and women have been clarified. Individuals are not entirely rational; they have herd psychology and risk skewed return.

We compare question 2, and question 3 after participants knew all payoff information. Firstly, as we can see in figure 5, there is a difference between mens' frequency distribution answers to questions 2 and 3 in each series. Total 144 men who participate in various ages still pick up series 8 and look for a chance on the lowest frequency series in question 2 and 3. Others scatter their frequency of choice at the rest of the series. Observation in figure 5 shows that the graph is a random distribution with no apparent pattern with several modes. It can be concluded that the answers of men for question 3 do not follow a uniform distribution.

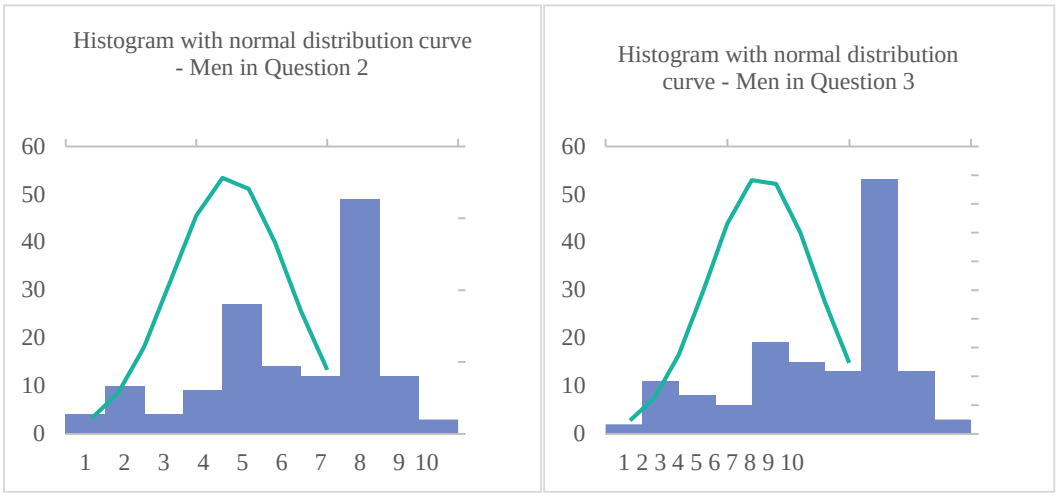


Figure 5 Men answer to question 2 and question 3 in the histogram with normal distribution

Most creatures have herd behavior, where they behave as part of a crowd rather than solving problems as individuals (S. Hwang, Rubesam, & Salmon, 2018; Welch, 2000). According to Krokida, Makrychoriti, and Spyrou (2020) herd activity applies to the mechanism in which market members emulate the acts of each other, model themselves on the activities of other participants, transact in one and the same way or exemplify the investment behaviour. In figure 6, women drop their decision from series 5 to series 2 since

they want to play with the crowd. They still believe in series 8, and this becomes the highest frequency. The histogram shows that this is not a uniform distribution with the skewed distribution curve for question 2 and question 3.

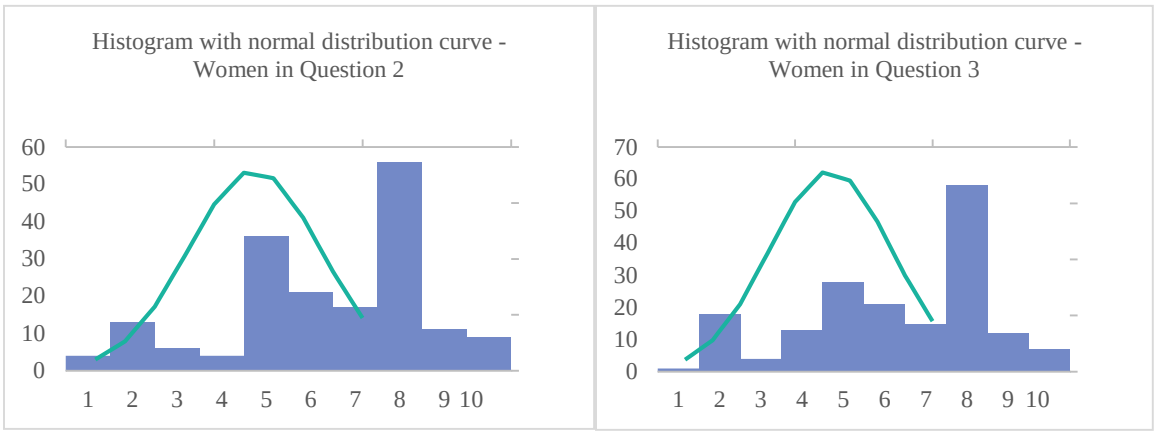
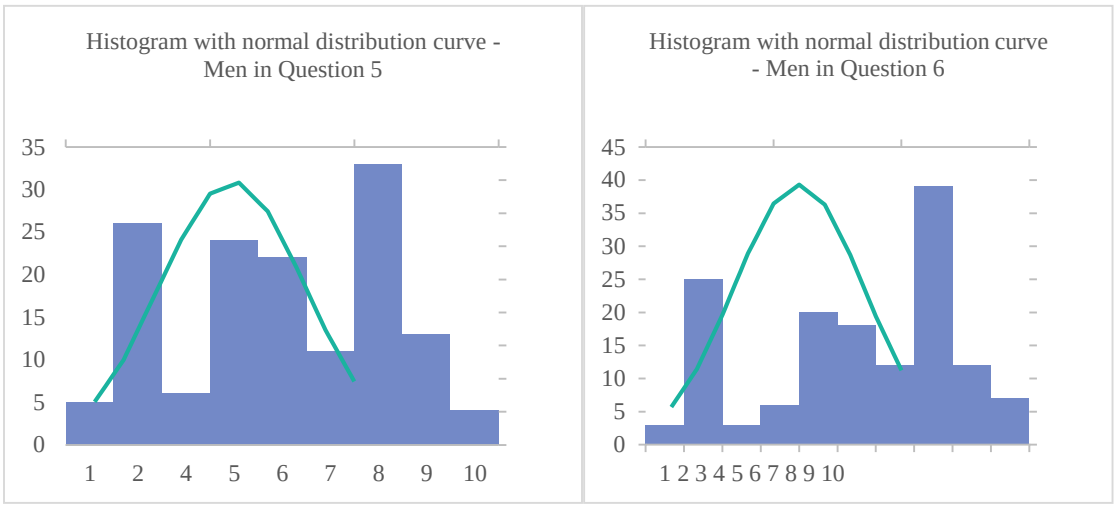


Figure 6 Women answer to question 2 and question 3 in the histogram with normal distribution

However, the result for men and women in question 6 compares to question 5 is slightly different. Men and women withdraw from series 2 of question 5 to series 5 of question 6 since they expect the high-frequency series.



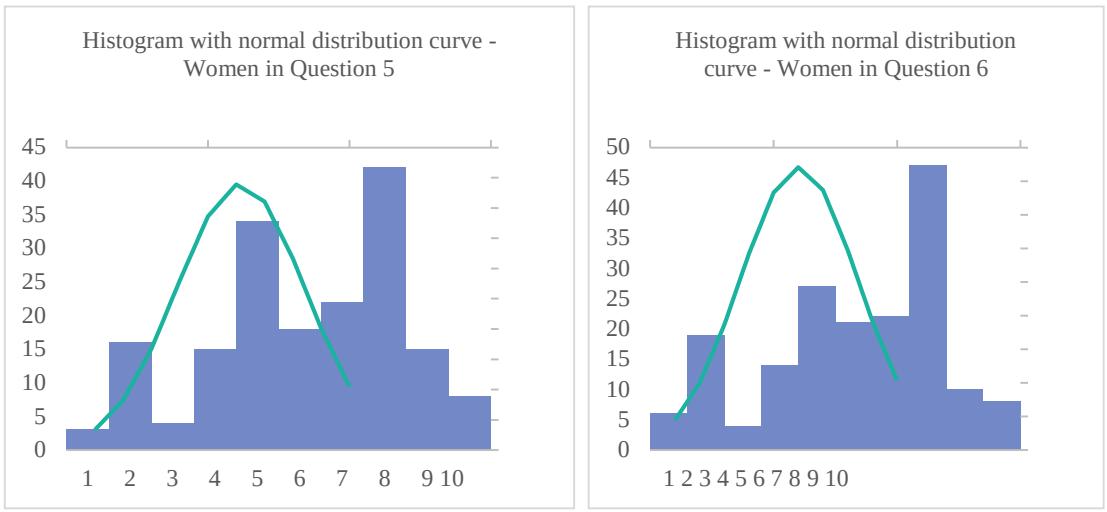


Figure 7 Histogram with normal distribution curve both men and women in Question 5 and question 6

In conclusion, our results confirm that the uniform distribution assumption is rejected for both men and women who participate in question 3, 6. People are not rational, totally and hardly act rationality when they have information about the distribution of payoffs.

Conclusion

This article investigates whether decision-makers depend on random selection or skewed distribution of return. We integrate three typical behavioural finance theories, expected utility, optimal expectation theory, and cumulative prospect theory, to test Vietnam's financial decision-making. The survey consists of two different kinds of lotteries designed to discerning the participant's behaviour. Our results show that people have their preferred number through the investigation when choosing randomly. The number 8 and 7 are the popular number in Vietnam since there is an integration between eastern and western culture. There is no difference in gender at a millennium, generation X, baby boomer, generation Z when they are required to choose at random. It was suggested (Tversky & Kahneman, 1992) that men and women have a consistent view of skewed return choice and reject the uniform distribution assumption looking for optimal expectation and cumulative distribution when the increasing order payoff is ranked. These results are replicated in this study in Vietnam, where investors' behaviour is the current concern. The difference between Asian context, especially Vietnamese people compare to

Western is over 50% of participants in Roger paper choose the number 5,7; presented for the optimal expectation theory (OE) while Vietnamese people skew on cumulative prospect theory (CPT). The results show that individuals utilise heuristics to choose numbers at random, resulting in non-random decisions at the aggregate stage.

Conflict of interest

There is no conflict of interest

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Appendix

Lucky lottery ticket and questions are designed, and we survey Viet Nam context (Vietnamese - English version)

Lottery 1

Một ngân hàng phát hành 10.000 trái phiếu với giá 100.000 đồng mỗi trái phiếu với lãi suất 5%/năm (trả lãi cuối kỳ), thời hạn 1 năm . Đến kỳ đáo hạn, ngân hàng trả 1.050.000.000 đồng. Khi lựa chọn mua một trái phiếu, người đăng ký chọn một số nguyên từ 1 đến 10. Vào ngày thanh toán, ngân hàng rút ngẫu nhiên một số may mắn từ 1 đến 10. Mỗi số may mắn.được chọn trúng sẽ nhận được 100.000 đồng. Số tiền còn lại được chia đều cho tất cả, kể cả những người chọn trúng số may mắn hoặc không chọn trúng.

A Lottery company issue 10,000 (N) lottery ticket, each ticket is sold VND 100,000 (P), interest rate r = 5%. The participant who buys the ticket will choose one lucky number from 1 to 10. At the maturity date, the company repay (1+5%) *(10,000*100,000) = VND 1,050,000,000. The company draws randomly one number in the lucky series. The participants who are lucky to have a drawn lucky number in the series will receive VND 1,000,000; with Ni is the number of a winner in lucky series. The remaining amount is divided equally for all participants, including those who win.)

Câu 1: Giả sử bạn mua một trái phiếu, bạn chọn số nào?

Question 1: If you buy a lucky ticket, which number will you choose?

1	2	3	4	5	6	7	8	9	10

Câu 2: Nếu là người cuối cùng mua trái phiếu 1, sau khi nhìn thấy bảng số người đã chọn ở từng con số. Bạn sẽ chọn số nào?

Question 2: If you are the last person to buy lucky ticket 1, after seeing the number of tickets already sold for each choice of the lucky number, which number do you choose?

1	2	3	4	5	6	7	8	9	10

Sau khi hoàn tất hết các mục trên thì ta sẽ có trường hợp tiếp theo:
Câu 3: Giả sử bây giờ 2.000.000 trái phiếu được phát hành bởi ngân hàng 1. Nếu bạn mua trái phiếu, biết rằng sẽ bán thêm 1.000.000 trái phiếu sau khi bạn chọn (những người đăng ký tiếp theo được thông báo đầy đủ về sự phát triển của các lựa chọn bằng cách cập nhật bảng trên màn hình), bạn chọn số nào?

Question 3: Assume that 20,000 ticket were issued by issuer 1. If you buy a lucky ticket, knowing that 10,000 tickets are to be sold after your choice. The next buyer will receive full information about the evolution of choices by updating information. Which number do you choose?

1	2	3	4	5	6	7	8	9	10

Lottery 2

Một ngân hàng phát hành 10.000 trái phiếu với mệnh giá 100.000 đồng mỗi trái phiếu với lãi suất 5%/năm (trả lãi cuối kỳ), thời hạn 1 năm . Đến kỳ đáo hạn, ngân hàng trả 1.050.000.000 đồng. Khi lựa chọn mua một trái phiếu, người đăng ký chọn một số nguyên từ 1 đến 10. Vào ngày thanh toán, ngân hàng rút ngẫu nhiên một số may mắn từ 1 đến 10. Mỗi số may mắn.được chọn trúng ngân hàng sẽ trích 10% từ mệnh giá dành cho người thắng. Số tiền còn lại được chia đều cho tất cả, kể cả những người chọn trúng số may mắn hoặc không chọn trúng

A Lottery company issue 10,000 (N) lottery ticket, each ticket is sold VND 100,000 (P), interest rate r = 5%. The participant who buys the ticket will choose one lucky number from 1 to 10. At the maturity date, the company repay (1+5%) *(10,000*100,000) = VND 1,050,000. The company draws randomly one number in lucky series (from 1 to 10). The company will take 10% of the initial total amount for winners (N*P) *10% (VND 100 mils). The remain amount which is unchanged is divided equally for all participants, including those who win

Câu 4: Giả sử bạn mua một trái phiếu, bạn chọn số nào?

Question 4: If you buy a lucky ticket, which number will you choose?

1	2	3	4	5	6	7	8	9	10

Câu 5: Nếu là người cuối cùng mua trái phiếu 2, sau khi nhìn thấy bảng số người đã chọn ở từng con số. Bạn sẽ chọn số nào?

Question 5: If you are the last person to buy lucky ticket 2, after seeing the number of tickets already sold for each choice of the lucky number, which number do you choose?

1	2	3	4	5	6	7	8	9	10

Sau khi hoàn tất hết các mục trên thì ta sẽ có trường hợp tiếp theo:
Câu 6: Giả sử bây giờ 2.000.000 trái phiếu được phát hành bởi ngân hàng 2. Nếu bạn mua một trái phiếu, biết rằng sẽ bán thêm 1.000.000 trái phiếu sau khi bạn chọn (những người đăng ký tiếp theo được thông báo đầy đủ về sự phát triển của các lựa chọn bằng cách cập nhật bảng trên màn hình), bạn chọn số nào?

Question 6: Assume that 20,000 ticket were issued by issuer 1. If you buy a lucky ticket, knowing that 10,000 tickets are to be sold after your choice. The next buyer will receive full information about the evolution of choices by updating information. Which number do you choose?

1	2	3	4	5	6	7	8	9	10