Measurement of Loss Aversion Behavior Under Prospect Theory: Comparison of Various Kinds of Individuals

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Abstract

This paper designs a binary prospect questionnaire according to previous literature for extracting the certainty equivalents of gains and losses prospects. Individual utility function is defined by the power utility function, in which the gain power parameter and loss power parameter are estimated by the least squares method. The respondents for the present study comprised of 20 common people, 20 MBA students, and 20 financial workers, and the main findings are as follows. First, individuals revealed risk averse attributes for gains and losses, but the risk averse magnitude for gains was larger than it was for losses. Second, the individual utility function is likely concave. Third, relative to others, the financial workers were less loss averse. Finally, women were generally more loss averse than men.

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Kahneman and Tverskey (1979) used a panel of university professionals and students as research subjects to design a series of questionnaires, and the results from the questionnaire survey revealed that the answers of most respondents violated the traditional expected utility theory, and thus, introduced the prospect theory. Prospect theory can be summarized into three effects: certainty effect, reflection effect, and isolation effect. Certainty effect refers to individuals who over weigh their emphasis on the results of certainty. Reflection effect refers to individuals who, while faced with losses of uncertain results, show personal preference of risk loving; whereas when faced with gains tend to select options with certain results and showed risk aversion. Isolation effect refers to people who, when faced with problems of uncertainty, produce cognitive simplification, which would acknowledge the problems as more simplified forms, and ignore the impacts of previous conditions.

Tversky and Kahneman (1992) after the prospect theory, developed another new argument for the prospect theory. This argument takes into account the concept of cumulative probability, rather than the isolatable decision weighting method, and extended this theory to many aspects. This theory is called the cumulative prospect theory. Cumulative prospect theory applies on factors of uncertainties, and has more than one of the risk prospects, and permits different weighting functions between losses and gains. There are two important principles of the cumulative prospective theory: Diminishing sensitivity and loss aversion use to explain the curative features of value function and decision weighting function. Furthermore, Tversky and Kahneman (1992) proposed several phenomena of the general public's impact on selections, including framing effects, nonlinear preferences, source dependence, risk seeking and loss aversion.

Loss aversion can explain some behaviors different from the expected utility theory. Thaler (1980) proposed the endowment effect, that once a person owns an item, now this item will be appraised much higher than when it is not owned. According to Weber and Camerer (1998), in connection to the investors' customs to dispose of profitable assets

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and continue to hold of unprofitable assets, this tendency is called the disposition effect. Shefrin and Statman (1985) discovered that investors showed risk aversion in areas of profits, and showed risk loving in areas of losses. Therefore, when investors are disposing off their risky assets, they tend to get rid of assets with actual gains, and continue to retain assets of losses. This phenomenon is selling of gains and retention of losses. Odean (1998) also discovered that there is an obvious mismatch of effort on the part of the investors, which is the tendency to sell off the winners' portfolios, and retention of losers' portfolios.

Objectives of the Study

Abdellaoui, Bleichrodt, & L'Haridon (2008) proposed, under the prospect theory, an effective method of measuring utility of 48 graduate students (25 were female), from simple binary prospect questionnaire to achieve the certainty equivalents of gains and loss prospects. They then re-defined the utility function as a power utility function. Finally, they further obtained mixed prospects to estimate the loss aversion coefficient. The study concluded that within the gains and losses, utilities derived under different probabilities did not have significant variance, which revealed that utility is not dependable on the probabilities applied on when deriving the values. On the behaviors of risk attributes, with respect to gains, there were mainly risk aversions (35 individuals), whereas there were more risk loving for losses (20 individuals); however, there was also considerable proportion of behaviors showing risk aversions (16 individuals). When there was a combination of gains and losses, overall, the behavior of risk attributes demonstrated that 80.5% of the surveyed population preferred to avoid risks. While on the behaviors of utility function, both gains and losses were all concave utilities, indicating that individuals were risk averters; of the loss aversion coefficients, 76.7% of the surveyed population was classified as loss aversion.

The present study refers to Abdellaoui et al.'s (2008) binary prospect test, through the questionnaires stimulated the methods of gambling, and segregated the surveyed population in accordance to their identities into three categories : MBA Students, General Public, and Financial Officers. The main objectives of this study were collated as follows:

1) To examine the different identity categories and ascertain if there was any significant variance in the certainty equivalents derived.

2) To examine the different identity categories and ascertain if there was any significant variance between the power (α) of gains and power (β) of losses.

3) To examine the different identity categories and factors of gender and ascertain if there was there any significant variance in the loss aversion coefficients (λ) derived.

Literature Review

Brooks and Zank (2005) affirmed that people showed risk aversion in circumstances of profitability, and when faced with losses, behaviors exhibited by investors are risk loving. Levy (2010) derived a theoretical relationship between the degree of loss aversion, the concavity/convexity of the value function, and the equilibrium market price of risk. The result showed that as the degree of loss aversion is the key in determining the risk price, the convexity/concavity of the value function is much less important. An estimate of the loss aversion index was yielded using international data, including 16 different countries over 100 years. Dimmock and Kouwenberg (2010) empirically examined the effect of loss-aversion on household participation in equity markets, household equity allocations, and household allocations between mutual funds and individual stocks. Using household survey data, direct measures of each household's loss-aversion coefficient were obtained. The results showed that higher loss-aversion is associated with a lower probability of participation and reduced the probability of direct stockholding significantly more than the probability of owning mutual funds. Additionally, a relationship between loss-aversion and portfolio allocations to equity was not found.

Singh and Bhowal (2009) focused on investor behavior to explain the various "market anomalies" that challenge standard theory, which is emerging from the academic world, and is beginning to be used in money management. Next, Mehta and Aggarwal (2011) found that there is an association between demographic profiles and personality type of the investor with investment choice. The differences among the different genders were found to be significant for provident funds, fixed deposits, and real estate. The females were found to be conservative while investing, whereas males were found to be aggressive. The investors in the lower age group did not prefer post office as an investment option, but the investors in the higher age group preferred the post office as an investment avenue.

Methods of Measuring Loss Aversion

This study made reference to the test model of Abdellaoui et al. (2008) with respect to utility and loss aversion, designed to measure the degree of individuals' risk aversion (α and β) and loss aversion (λ). To facilitate the measurement, this paper assumes that the probability weighting function is exactly equal to its objective probability.

➬ **Binary Prospect :** A binary prospect refers to a situation where two outcomes result from a gambling or an investment. However, if it is in excess of two outcomes, then it is called multiple prospects. Binary prospect $L(x, p ; y)$ represents that there is a p probability in the future that derives outcome x, and a 1-p probability that derives outcome y. When $x = y$, $p = 0$ or $p = 1$, then it is known as a risk-free prospect. When the outcome is greater than a particular reference point, it is known as a gain; when the outcome is smaller than some reference point, it is known as a loss. Where everything remains constant, this study assumes the reference point as zero. Accordingly, when two possible outcomes are greater than or equal to zero, then it is called the gain prospect; when two possible outcomes are smaller than or equal to zero, then it is called the loss prospect. Additionally, when two possible outcomes derive one as positive and the other as negative, then it is called the mixed prospect. Therefore, gain prospect indicates $x \geq y \geq 0$ or $y \geq x \geq 0$; loss prospect indicates $x \leq y \leq 0$ or $y \leq x \leq 0$; mixed prospect indicates $x > 0 > y$ or $y > 0 > x$.

➬ **Utility and Probability Weighting :** In accordance to prospect theory, an individual makes decisions according to subjective probability rather than objective probability. However, this subjective probability is an accelerating function of objective probability. Additionally, function type of subjective probability is that it derives gain outcome deviated from that of loss outcome. Accordingly, $w^+(p)$ and $w^-(p)$ represent the objective probability p that derives the subjective probability of gain outcome and the subjective probability of loss outcome respectively. In this paper, this subjective probability is named as the probability weighting function. Besides, probability weighting function must fulfill $w^+(0) = w^-(0) = 0$ and $w^+(1) = w^-(1) = 1$.

Secondly, making U represents utility function, this is an accelerating function and $U(0) = 0$. In accordance to prospect theory, utilities of gain prospect, loss prospect, and mixed prospect are as follows:

$$\text{Gain prospect utility} = w^+(p) \times (U(x) - U(y)) + U(y) \text{ for } x \geq 0, y \geq 0 \qquad (1)$$

$$\text{Loss prospect utility} = w^-(p) \times (U(x) - U(y)) + U(y) \text{ for } x \leq 0, y \leq 0 \qquad (2)$$

$$\text{Mixed prospect utility} = w^+(p) \times U(x) + w^-(1-p) \text{ x } U(y) \text{ for } x > 0\, y > 0 \qquad (3)$$

➬ **Loss Aversion :** In accordance of prospect theory, people when facing similar quantity of gains and losses, consider losses as even more unbearable. Tversky and Kahneman (1992) suggested using $-\frac{U(\$1)}{U(\$1)}$ to measure the loss aversion coefficient, and derived the empirical value of loss aversion coefficient as 2.25. Accordingly, it meant that equal quantity of loss brought about a negative utility which is 2.25 times more than the positive utility of equal quantity of gain. This makes u to represent the basic utility function, and the loss aversion utility function can be expressed as follows:

$$U(x) = \begin{cases} u(x) & \text{if } x \geq 0 \\ \lambda u(x) & \text{if } x < 0 \end{cases} \qquad (4)$$

where λ is the loss aversion coefficient.

➬ **Measuring Utility Function and Loss Aversion :** This paper assumes the utility function as power utility function, and makes $\alpha > 0$ and $\beta > 0$ to represent the power of gain prospect and loss prospect respectively, combining the functions at (4) to derive the utility function assumption as follows:

$$U(x) = \begin{cases} x^{\alpha} & \text{if } x \geq 0 \\ -\lambda(-x)^{\beta} & \text{if } x < 0 \end{cases} \qquad (5)$$

In which, when power α is greater than 1 or power β is smaller than 1, it represents a convex utility function, which indicates an individual as a risk lover. On the contrary, when power α is smaller than 1 or power β is greater than 1, it represents a concave utility function, which indicates an individual to be a risk averter. Additionally, when either power α or power β is smaller than 1, it represents a linear utility function, which indicates that an individual is risk neutral. When α is greater than 1 or β is smaller than 1, it indicates an individual is more risk loving ; contrarily, when α is smaller than 1 or β is greater than 1, it indicates an individual is more risk averse.

This study intended to measure the magnitude of an individual's risk aversion and loss aversion, that is to measure α, β, and λ values. This paper assumes that the probability weighting function is exactly equal to its objective probability, which are the special circumstances assumed and considered in this paper on prospect theory, simply the expected utility theory. In other words, this paper assumes :

$$w^{+}(p)=w^{-}(p)=p \qquad (6)$$

Introduce function (5) and (6) into function (1) and (2), the prospect utilities achieved for gain prospect, loss prospect, and mixed prospect are as follows:

$$\text{Gain prospect utility} = p\times(x^{\alpha}-y^{\alpha})+y^{\alpha} \text{ for } x\geq 0, y\geq 0 \qquad (7)$$

$$\text{Loss prospect utility} = \lambda[p\times(-(-x)^{\beta}+(-y)^{\beta}-(-y)^{\beta}\ ] \text{ for } x\leq 0, y\leq 0 \qquad (8)$$

$$\text{Mixed prospect utility} = p\times x^{\alpha}-\lambda(1-p)\times(-y)^{\beta} \text{ for } x>0>y \qquad (9)$$

Given the probability of p, making $G > 0$ and $L < 0$ to represent the certainty equivalents of gain prospect and loss prospect, then, from function (7) and (8) to derive :

$$G^{\alpha}=p\times(x^{\alpha}-y^{\alpha})+y^{\alpha} \qquad (10)$$

$$-(-L)^{\beta}=p\times(-(-x)^{\beta}+(-y)^{\beta})-(-y)^{\beta} \qquad (11)$$

We selected a series of gain prospects (x_i , p ; y_i), i =1, ..., k, and by mean of a questionnaire, derived certainty equivalents G_i respectively. Thereafter, according to the function (10), we used the non-linear smallest square method to derive α_i respectively. Finally, this study used the medians of this series of α_i as the estimates for α. Similarly, when we selected a series of loss prospects (x_i, p ; y_i), i = 1, ..., k, and by mean of a questionnaire, derived certainty equivalents $L_i < 0$. Thereafter, according to function (11), we used the non-linear smallest square method to derive β_i respectively. Finally, this study uses the medians of the series of β_i as the estimates for β. Therefore, the estimated quantity $\hat{\alpha}$ and $\hat{\beta}$ of α and $\hat{\beta}$ are as follows respectively :

$$\hat{\alpha} = \text{median}(\alpha_1, \alpha_2, ..., \alpha_k) \text{ and } \hat{\beta} = \text{median}(\beta_1, \beta_2, ..., \beta_k) \qquad (12)$$

In this study, samples of mixed prospects were used to estimate the loss aversion coefficients λ. Firstly, we selected $G^* > 0$ from the range (that is the value gap determined for U) of the gain prospect (0, G_k) , then, we determined the value $L^*_i < 0$ by mean of a questionnaire from the surveyed population that will make the certainty equivalents of mixed prospect (G_i, p ; L^*_i) as zero. Mathematically, it is expressed as follows:

$$p\times(G^{*})^{\alpha}-\lambda(1-p)\times(-L^{*})^{\beta}=0 \qquad (13)$$

Tversky and Kahneman (1992) suggested using $-\frac{U\text{(-US \$1)}}{U\text{(US \$1)}}$ to measure the loss aversion coefficient. Hence, by taking into account the domestic currency and US dollar currency, and from the variance derived from these two currencies, this study computes λ in accordance to the mathematical function listed below.

$$\lambda = \frac{(L^{*}/1000)^{\beta}}{(G^{*}/1000)^{\alpha}} \qquad (14)$$

Given a series of mixed prospects (G^*_i , p ; L^*_i), i = 1, ..., k, we can derive loss aversion coefficients λ_i in accordance to function (14). Finally, this study uses the medians of this series of λ_i as the estimates for λ. Therefore, the estimated quantity $\hat{\lambda}$ of λ is as follows:

$$\hat{\lambda} = \text{median}(\lambda_1, \lambda_2, ..., \lambda_k) \qquad (15)$$

since we do not impose any restriction on λ in our estimation process, so both loss aversion (loss aversion, $\lambda > 1$) and gain seeking (gain seeking, $\lambda < 1$) are possible occurrences.

Questionnaire Design

➯ **Subject of the Questionnaire :** This study segregated the surveyed population in accordance to their identities into three categories, respectively as: Financial Officers, General Public, and MBA Students; each category recruited 20 individuals totalling up as 60 individuals (half of each gender). Just like what Abdellaoui, Bleichrodt, and Paraschiv (2007) mentioned, it is best to provide real incentives; however, if the amount is not significant, then the utility will be closer to linear. Therefore, we made use of much larger amounts to determine the coefficients of gains and losses (Minimum NT$20,000; Maximum NT$100,000), giving the survey population a much more realistic feeling of gains and losses when making choices. MBA students were students of Ping Tung University of Science and Technology. Financial Officers were the employees of Taiwan Cooperative Bank. The general public was randomly selected from the wealth management customers of Taiwan Cooperative Bank.

➯ **Questionnaire Type :** The questionnaire was divided into two sections, the first section of the questionnaire was used for deriving the certainty equal values of gains prospects and losses prospects; and the second section of the questionnaire comprised of mixed prospects for deriving the certainty equal values of loss aversions respectively. The first section of the questionnaire comprised of four main parts based on the differences of gains prospect probabilities (p_g = 1/2) and (p_g = 2/3) and losses prospect probabilities (p_l = 1/2) and (p_l = 2/3), then, the same was arranged in six panels of different starting values (as Table 1) to produce 24 sets of questionnaires. In each questionnaire, the surveyed population was required to complete five phases of selections in accordance with the sequence, which would produce 1 certainty equal value for the use of deriving gain power (α) and loss power (β) in this study. In this study, the standard gamble method was applied for implementation, and the surveyed population was only required to select one option out of the two scenarios in every phrase:

➯ **Scenario A:** The probability of occurrence is 100%, which is a risk-free gambling.

➯ **Scenario B:** A risky gambling, by using a binary prospect $L(x_i, p\,; y_i)$ to represent. Indicates a probability of p in the future to derive outcome x_i, probability of $1-p$ to derive outcome y_i.

Table 1: Starting Values of Six Sets of Questionnaires Unit: NTD

Questionnaire	1	2	3	4	5	6
$\|x_i\|$	20,000	40,000	60,000	100,000	100,000	100,000
$\|y_i\|$	0	0	0	0	60,000	80,000

Source: Authors' Research

The starting values of the first phrase of the questionnaire of Scenario A were all programmed to equal the expected values of Scenario B. Next, the values from the second phase to the fifth phase of the questionnaire were determined based on the bisection method. The bisection is an approximation method used to seek numerical solutions, making use of gradual convergence to estimate the ranges, and derive numerical solutions. Based on Table 1, using A.10,000 vs. B. (20,000,1/2;0) in the first phase of questionnaire 1 as an example, this indicates that when a surveyed testee participated in a gambling, $10,000 will be received under Scenario A, whereas there is 50% probability that $20,000 will be received under Scenario B ; another 50% of the probability was that the respondent will receive nil profit , and the starting value of $10,000 will be the expected value of (20,000,1/2). If the surveyed testee in the first phase selected Scenario A, this indicates that in a risky gambling, he or she would rather have $10,000 and the respondent was reluctant to participate in the gambling. Next, the surveyed testee will proceed with the scenario selection in the second phase; if the surveyed testee in the first phase selected Scenario B, this indicates that the surveyed testee is willing to participate in the risky gambling. The computation rule of certainty equal values will be the computation of values to a multiple of 100 ; if it is not a multiple of 100, then the values are rounded off to their nearest hundreds to obtain integers. This method creates a range of values, and the certainty equal values should fall within the range of values, and they should be the median of these values. As per the Table 2, let G_l be the certainty equal values derived from the gains' prospect questionnaire, and this study took five phases to derive the certainty equal values (the figures marked in bold in the Table 2 are the selections made by the surveyed testees in each phase), and the certainty equal values of G_l should

Table 2: Illustration on Bisection Method		
Phrase	Selections available for obtaining G_1	Selections available for Obtaining
1	10,000 vs. **(20,000, 1/2 0)**	**0** vs. (90,900, 1/2; -90,900)
2	**15,000** vs. (20,000, 1/2; 0)	**0** vs. (90,900, 1/2; -45,400)
3	12,500 vs. **(20,000, 1/2; 0)**	0 vs. **(90,900, 1/2; -22,700)**
4	**13,700** vs. (20,000, 1/2; 0)	0 vs. **(90,900, 1/2; -34,000)**
5	13,100 vs. **(20,000, 1/2; 0)**	**0** vs. (90,900, 1/2; -39,700)
6		0 vs. **(90,900, 1/2; -36,800)**
Certainty Equalvalue	13,400	-38,200
Source: Authors' Research		

fall within the range of 13,100 to 13, 700. Then, the median of these two values, which is 13,400 was regarded as the certainty equal value. The derivation process for losses prospects is similar to the one for the gains prospects.

In the second phase, when deriving the certainty equal values of loss aversion, we designed six questions. Each question underwent six phases of selections, and could create one certainty equal value for a loss aversion for use to derive the loss aversion coefficient (λ) in this study. The surveyed population was only required to select one option out of the two scenarios at every phase: Value of Scenario A is zero. Scenario B is the mixed prospect ($G^*_i, p\,; L^*_i$), which indicates a probability of p in the future to derive outcome G^*_i, probability of $1-p$ of loss L^*_i. From certainty equal values derived from questions 1 to 6 of the first phase of gains prospect (p_g = 1/2) to pick out the gains G^*_1 .... G^*_6 (G^*_1.... G^*_6 are third quartiles selected from the questions 1 to 6 of gains prospect of this study; 90,900 in the Table 2 is the third quartile from question 6 of gains prospect (p_g = 1/2)), of which the values of G^*_1 .... G^*_6 are fixed constants, and the probability p is given as 1/2, which subsequently applies bisection to determine L^*_i of each phrase. All six questions underwent six phases, then, the questionnaires were administered to determine the certainty equal values L^* of losses selected by the surveyed testees. The Table 3 reveals that the certainty equal values L^*_6 derived from the question 6 should lie within -39,700 to -36,800. Hence, we took -38,200 as the median of -39,700 and -36,800, and regarded it as the certainty equal value. When deriving the certainty equal values of losses aversion, we executed an additional phase, that was because the number gap of $G^*_i - L^*_i$ is greater than number gap of $|x_i - y_i|$.

➯ **Measuring Procedure of the Questionnaire :** The measuring procedures of the questionnaire was first introduced by the host on the content of this test. The respondents completed the simulation test questions, which was followed by a three minute Q&A session for surveyed testees to clear their doubts. Each surveyed testee was seated at a certain distance from his/her counterparts, so as to avoid them discussing the answers among themselves, and then, the formal survey questionnaire was administered to the respondents. The questionnaire was divided into two phases, first there were a total of 24 copies of the questionnaires pertaining to certainty equal values of gains prospects and loss prospects. The questionnaires were arranged in sequential order. The first six copies of the questionnaires (p_g = 1/2) were for certainty equal values of gains prospects. The second six copies of the questionnaires (p_l = 1/3) were for certainty equal values of losses prospects. The next six copies of questionnaires (p_g = 2/3) were for certainty equal values of gains prospect. The final six copies of questionnaires (p_l = 1/2) were for certainty equal values of losses prospects.

Empirical Results

➯ **Comparison of the Magnitude of Risk Aversion :** In this study, the risk attributes are defined as: Original certainty equal values after the statistical process - if the certainty equal values selected by the surveyed testee were smaller than the expected values, then the surveyed testee would be classified as risk averse; if the certainty equal values selected by the surveyed testee were equal to the expected values, then the surveyed testee would be classified as risk neutral; if the certainty equal values selected by the surveyed testee were greater than the expected values, then the surveyed testee would be classified as risk loving. The questionnaires respectively recorded the original certainty equal values in accordance to MBA Students, Financial Officers, and the General Public. The Tables 3 and 4 collated the risk attributes of gains and losses, and list the medians and quartiles of certainty equal values of gains and losses prospects in the Table 5.

From the medians of gains prospects given in the Table 5, it can be seen that the main behaviors shown in the gains of each panels were risk averse. The percentage of risk aversion (exhibited by the responses of 12 questions of gains completed by the MBA students and Financial Officers) was as high as 95% (11 questions); whereas the responses of 12 questions of gains completed by the General Public was all risk averse. The results obtained for the gains portion were consistent with the research results obtained by Abdellaoui et al. (2008), where risk averse behaviour was exhibited by the respondents. On the other hand, the main behavior shown in case of losses was also risk averse. The percentage of risk aversion exhibited from 12 questions of losses completed by MBA students was 58% (seven questions), whereas percentage of risk aversion exhibited by Financial Officers and General Public was both 66% (eight questions). In terms of losses as compared to gains, the surveyed testees were more inclined to be risk neutral. The results of risks aversions obtained from the losses portions deviated from the risk loving behaviors obtained from the research by Abdellaoui et al. (2008), which indicated that the local people were more conservative when faced with losses than this literature proclaimed.

Table 3: Risk Attributes of Certainty Equalvalues Under Gains Prospects

	Questionnaire	1	2	3	4	5	6
MBA	p_g = 1/2	Risk-Averse	Risk-Averse	Risk-Averse	Risk-Averse	Risk-Loving	Risk-Averse
Students	p_g = 2/3	Risk-Averse	Risk-Averse	Risk-Averse	Risk-Averse	Risk-Averse	Risk-Averse
General	p_g = 1/2	Risk-Averse	Risk-Averse	Risk-Averse	Risk-Averse	Risk-Averse	Risk-Averse
Public	p_g = 2/3	Risk-Averse	Risk-Averse	Risk-Averse	Risk-Averse	Risk-Averse	Risk-Averse
Financial	p_g = 1/2	Risk-Averse	Risk-Averse	Risk-Averse	Risk-Averse	Risk-Averse	Risk-Averse
Officers	p_g = 2/3	Risk-Averse	Risk-Averse	Risk-Loving	Risk-Averse	Risk-Averse	Risk-Averse

Source: Authors' Research

Table 4: Risk Attributes of Certainty Equalvalues Under Losses Prospects

	Questionnaire	1	2	3	4	5	6
MBA	p_g = 1/2	Risk-Averse	Risk-Averse	Risk-Averse	Risk-Averse	Risk-Averse	Risk-Averse
Students	p_g = 2/3	Risk-Loving	Risk-Averse	Risk-Loving	Risk-Loving	Risk-Loving	Risk-Loving
General	p_g = 1/2	Risk-Averse	Risk-Averse	Risk-Averse	Risk-Averse	Risk-Loving	Risk-Loving
Public	p_g = 2/3	Risk-Loving	Risk-Loving	Risk-Averse	Risk-Averse	Risk-Averse	Risk-Averse
Financial	p_g = 1/2	Risk Averse	Risk Averse	Risk-Averse	Risk-Averse	Risk-Averse	Risk-Loving
Officers	p_g = 2/3	Risk-Loving	Risk-Averse	Risk-Loving	Risk-Loving	Risk Averse	Risk-Averse

Source: Authors' Research

Furthermore, to classify the individuals' risk attributes towards gains and losses of the surveyed testees, if the certainty equal values selected by the surveyed testee were smaller than the expected values, then the surveyed testee was risk averse. Of the 12 questions of certainty equal values pertaining to gains, if at least eight questions generated risk averse, we classified the survey testee as risk averse. Of the 12 questions of certainty equal values pertaining to losses, if eight questions generated replies of risk loving, we classified the survey testee as risk loving. As for mixed risk attributes, of the 12 questions of certainty equivalents pertaining to gains (losses), where there were 5~7 selections of risk loving (averse), then the survey testee was classified as risk neutral. In terms of gains, the attributes exhibited were mainly risk averse, especially in case of the General Public, up to 19 (95%) out of the 20 surveyed testees exhibited risk averse attributes, and in case of Financial Officers also, up to 17 (85%) out of the 20 surveyed testees exhibited risk averse attributes ; and in case of MBA students, risk attributes exhibited as risk averse and mixed risk attributes were equally weighted. With reference to the General Public and Financial Officers, we observed that the ratio of risk averse attributes was higher than the ratio observed by the study of literature (Abdellaoui et al., 2008). In terms of losses, we observed that in case of the General Public, 16 (80%) out of the 20 surveyed testees exhibited

Table 5: Medians of Certainty Equalvalues of Gains Prospects and Losses Prospects (Absolute Values)				
Panel A. MBA Students				
Question	Gain		Loss	
	p_g = 1/2	p_g = 2/3	p_l = 1/3	p_l = 1/2
1	**9,000** (9,000~9,000)	**12,000** (12,000~14,000)	7,800 (5,500~8,700)	**9,000** (8,400~9,000)
2	**18,100** (18,100~22,100)	**25,900** (21,000~27,800)	**12,000** (12,000~16,100)	**18,100** (16,800~21,800)
3	**27,100** (27,100~32,700)	**36,200** (25,500~36,200)	23,700 (23,700~23,700)	**27,100** (27,100~32,700)
4	**45,200** (45,200~45,200)	**43,600** (43,600~47,700)	39,500 (30,100~43,600)	**45,200** (42,100~55,300)
5	81,800 (80,200~81,800)	**84,000** (82,300~87,800)	77,400 (71,100~77,400)	**79,900** (78,100~82,100)
6	**89,000** (88,400~90,900)	**92,000** (91,100~93,900)	86,800 (85,800~87,800)	**89,900** (89,000~90,900)
Panel B: General Public				
Question	Gain		Loss	
	p_g = 1/2	p_g = 2/3	p_l = 1/3	p_l = 1/2
1	**9,000** (8,400~9,000)	**11,500** (8,600~12,400)	7,800 (5,800~7,800)	**9,000** (8,400~9,400)
2	**18,100** (16,800~18,100)	**22,300** (17,400~24,000)	15,700 (11,700~15,700)	**19,900** (17,700~21,800)
3	**27,100** (25,200~28,500)	**33,700** (26,200~36,200)	**18,100** (17,700~23,700)	**27,100** (26,600~32,700)
4	**45,200** (42,100~45,200)	**60,300** (56,100~60,300)	**30,100** (30,100~39,500)	**45,200** (44,400~54,600)
5	**78,100** (78,100~81,800)	**83,100** (82,300~84,900)	**72,000** (71,100~75,700)	81,800 (78,100~81,800)
6	**89,000** (89,000~90,900)	**92,900** (92,000~93,900)	**85,900** (85,900~87,800)	90,900 (89,000~90,900)
Panel C: Financial Officers				
Question	Gain		Loss	
	p_g = 1/2	p_g = 2/3	p_l = 1/3	p_l = 1/2
1	**9,000** (8,400~9,000)	**12,000** (8,600~12,400)	7,800 (5,900~7,800)	**9,000** (8,800~10,900)
2	**18,100** (17,700~18,100)	**24,000** (22,300~24,900)	**12,000** (11,100~15,700)	**18,100** (18,100~21,800)
3	**27,100** (25,200~28,500)	33,700 (26,200~34,300)	20,900 (17,700~23,700)	**29,900** (27,100~34,600)
4	**45,200** (42,100~45,200)	**60,300** (56,100~60,300)	34,800 (30,100~39,500)	**45,200** (45,200~54,600)
5	**79,900** (77,700~82,100)	**84,000** (82,300~84,000)	**72,000** (71,700~75,700)	**78,100** (78,100~81,800)
6	**89,900** (89,000~90,900)	**92,000** (92,000~93,900)	**85,900** (85,800~87,800)	90,900 (88,800~90,900)

Source: Compiled by the Authors. The values before the bracket are medians, indicate risk averse when marked in BOLD. The values shown in sequence as the first quartile and third quartile.

mixed risk attributes, whereas in case of Financial Officers, 17 (85%) out of the 20 surveyed testees also exhibited mixed risk attributes. Eight out of the 20 surveyed testees - in case of MBA students - exhibited risk averse attributes, while seven surveyed testees exhibited mixed risk attributes, of which there was no significant difference in these ratios (8 : 7). After we combined the risk attributes of gains and losses, we came to the conclusion that the surveyed testees, when faced with gains prospects mainly exhibited risk aversion, and while faced with losses prospects, the ratio of mixed risk attributes was higher. The findings achieved on the risk attributes, when faced with losses prospects were different from the empirical results obtained by Abdellaoui et al. (2008) as risk loving.

Finally, we conducted the Wilcoxon test (Table 6) based on different identity categories of original certainty equal values of each panel in accordance to positive prospect probability of 1/2 and negative prospect probability of 1/2, and compared them to ascertain whether there was any discrepancy between each panel when answering questions on certainty equal values. Other than question two of positive prospect, panels of Financial Officers and MBA Students (z = -2.288 ; p = 0.022), and panels of MBA Students and General Public (z = -2.824 ; p = 0.005) exhibited a more pronounced variance ($p < 0.05$), and other statistics were unable to determine significant variances in certainty equal values derived by different identity categories.

With reference to the functions of gains power (α) and losses power (β) after estimation, we can differentiate an individual by category in accordance to the utility pattern of gains and losses. When power (α) is greater than 1 or

Table 6: Wilcoxon Test on Gains Prospects and Losses Prospects

	Wilcoxon Test Gains Prospect Probability 1/2			Wilcoxon Test Losses Prospect Probability 1/2		
	F vs. S	**G vs. F**	**G vs. S**	**F vs. S**	**G vs. F**	**G vs. S**
Questionnaire 1	-1.592 [0.111]	-1.994 [0.046]	-0.274 [0.784]	-0.130 [0.897]	-1.194 [0.233]	-0.467 [0.640]
Questionnaire 2	-2.288 [0.022]	-0.829 [0.407]	-2.824 [0.005]	-0.499 [0.618]	-0.512 [0.609]	-0.262 [0.793]
Questionnaire 3	-1.158 [0.247]	-0.520 [0.603]	-1.261 [0.207]	-0.548 [0.583]	-1.449 [0.147]	-0.350 [0.726]
Questionnaire 4	-0.458 [0.647]	-0.405 [0.686]	-0.350 [0.726]	-0.314 [0.753]	-0.425 [0.671]	-0.288 [0.773]
Questionnaire 5	-1.087 [0.277]	-0.720 [0.471]	-1.192 [0.253]	-1.431 [0.152]	-1.845 [0.065]	-0.071 [0.944]
Questionnaire 6	-1.534 [0.125]	-0.351 [0.726]	-0.900 [0.368]	0.000 [1.000]	-0.142 [0.887]	-0.088 [0.930]

Source: Compiled by the Authors. *F* represents Financial Officers panel, *S* represents MBA Students panel, and *G* represents General Public panel. Values of each column of Wilcoxon Test represent *z* value of two-tailed test, and their corresponding *p* values are within the brackets.

Table 7: Estimated Results of Gains and Losses Prospect Powers

	Gains Prospect Power α	Losses Prospect Power β
Panel A. MBA Students		
Median	0.9839	1.0320
IQR	0.6988~1.2971	0.7296~1.1728
Panel B. General Public	**Gains Prospect Power α**	**Losses Prospect Power β**
Median	0.9131	1.0751
IQR	0.5736~1.1576	0.5788~1.3322
Panel C. Financial Officers	Gains Prospect Power α	Losses Prospect Power β
Median	0.9636	1.0218
IQR	0.7490~1.1443	0.7057~1.2002

Source: Compiled by the Authors. The corresponding probability p=1/2. IQR represents quartiles, shown in sequence as first quartile and third quartile. Power Utility Function $V(x)= x^{\alpha}$ for $x > 0$ and $V(x) = -(-x)^{\beta}$ for $x < 0$.

power (β) is smaller than 1, it represents *s* a convex utility function, which indicates an individual as a risk lover. Contrarily, when power (α) is smaller than 1 or power (β) is greater than 1, it represents *s* a concave utility function, which indicates an individual as a risk averter. Additionally, when power (α) or power (β) is smaller than 1, it represents a linear utility function, which indicates an individual as risk neutral. The more power α is greater than 1 or power β is smaller than 1, it indicates an individual is more risk loving; contrarily, the more power α is smaller than 1 or power β is greater than 1, it indicates an individual is more risk averse. Table 7 lists out medians and quartiles of estimated values of gains power (α) and losses power (β) by each surveyed category. We can observe the medians of gains power by each surveyed category respectively, where the panel of MBA Students (0.9839), the panel of General Public (0.9131), and the panel of Financial Officers (0.9636) were all smaller than 1, demonstrating concave utilities. For medians of losses powers by each surveyed category respectively, where the panel of MBA Students (1.0320), the panel of General Public (1.0751), and the panel of Financial Officers (1.0218) were all greater than 1, thereby also demonstrating concave utilities. In terms of power utility function, we achieved consistent results as obtained by Abdellaoui et al. , 2008.

We conducted the Wilcoxon test on gains power (α) of each surveyed category, and we obtained z = -0.112 ; p = 0.911 for panels of MBA Students and the General Public ; z = -0.762 ; p = 0.446 for panels of General Public and Financial Officers, and z = -0.336 ; p = 0.737 for panels of Financial Officers and MBA Students. These data indicate that the behaviors of gains power (α) by surveyed testees of three different identity categories were not significantly different. Furthermore, after conducting the Wilcoxon test on losses power (β) of each surveyed category, we obtained z = -0.523 ; p = 0.601 for panels of MBA Students and the General Public; z = - 0.483 ; p = 0.629 for panels of General Public and Financial Officers; z = - 0.261; p = 0.794 for panels of Financial Officers and MBA Students. These data indicated that the behaviors of losses power (β) by surveyed testees of three different identity categories were not significantly different.

➪ **Comparison of Magnitude of Losses Aversion :** If the median of losses aversion exceeded 1 ($\lambda > 1$), such surveyed testee was classified as loss aversion; if the median of losses aversion was less than 1 ($\lambda < 1$), then such surveyed testee was classified as gain seeking. The Table 8 lists out the medians (λ) of loss aversion derived from six mixed prospects (Third quartiles obtained from questions 1~6 of mixed prospects, where the probability given was 1/2) by three different identity categories. We found clear evidence (medians of loss aversion coefficients were all greater than 1) of loss aversion within the three different identity categories. From the medians of loss aversion coefficients by each category, it was found that the magnitude of losses aversion by Financial Officers (1.0187) was smaller than what it was for MBA Students (1.0302) and the General Public (1.2284). For the Wilcoxon Test on medians of loss aversion coefficients of each panel, the p-value of each panel generally did not reach the significant level, which indicated no significant difference in the loss aversion coefficients derived by each panel (Panels of MBA Students and Financial Officers : z = - 0.149 ; p = 0.881 ; panels of Financial Officers and General Public : z = -0.411; p = 0.681 ; panels of General Public and MBA Students : z = -0.597; p =0.550).

Table 8: Loss Aversion Coefficients of Mixed Prospects

	MBA Students	General Public	Financial Officers
Loss Aversion λ (Median)	1.0302	1.2284	1.0187
IQR	0.4646~1.6802	0.8907~1.6232	0.5319~1.4695

Source: Compiled by the Authors. IQR represents the difference between the third and the first quartiles.

Table 9: Loss Aversion Coefficients Differentiated by Gender

	Female	Male
MBA Students	1.2230 (0.8388~2.2517)	0.6508 (0.3275~1.1778)
General Public	1.3857 (1.0521~1.5954)	1.1160 (0.7193~1.6073)
Financial Officers	1.0187 (0.7028~1.3801)	1.1605 (0.4340~1.5275)

Source: Compiled by the Authors. The values are medians, and the following bracket displays the first and the third quartiles.

Medians of loss aversion coefficients of each panel in accordance to gender were collated in the Table 9, and analyzed in panels based on gender. We found that the magnitude of risk aversion by females was at a greater extent than it was by males within the panels of MBA Students and the General Public, as the loss aversion coefficients were (1.2230>0.6508) and (1.3857>1.1160) respectively; as for Financial Officers, the magnitude of risk aversion by males was slightly greater than it was for females. Therefore, there was differential impact of gender on the magnitude of loss aversion. Females were more inclined to have loss aversion tendency. Similarly, Table 9 applied Wilcoxon Test to determine whether there was any significant difference in loss aversion coefficients under the difference in gender of each panel. In terms of males, panels of MBA Students and General Public (z = -1.070 ; p = 0.285), panels of General Public and Financial Officers (z = -0.255 ; p = 0.799), panels of Financial Officers and MBA Students (z = -0.968 ; p = 0.333); these data indicated that there was no significant difference in loss aversion coefficients of males by different identity categories. In terms of females, panels of MBA Students and General Public (z = -0.153 ; p =0.878), panels of General Public and Financial Officers (z = -0.561 ; p =0.575), panels of Financial Officers and MBA Students (z = -1.376 ; p = 0.169); these data indicated that there was no significant difference in loss aversion coefficients of females by different identity categories.

Conclusion

This paper mainly examines the behaviors of loss aversion under prospect theory. After examining the responses of the MBA Students, the General Public and the Financial Officers, the main results are as follows. First, there was no significant difference in certainty equal values derived from gains prospects and losses prospects of different identity categories. Second, consistent with Abdellaoui et al.(2008), there was no significant difference in the gains power and losses power derived from different identity categories. Third, there was no significant difference in the loss aversion coefficients derived from different identity categories. Indeed, females as opposed to males, were more inclined to loss aversion, a finding which is consistent with the ones obtained by Brooks and Zank (2005). Finally, the magnitude of loss aversion exhibited by Financial Officers was of a lesser extent as compared to the panels of the General Public and MBA Students.

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