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# Loss Aversion of the Condominium Market in Seoul

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## Abstract

**Purpose:** This study conducted an empirical study to estimate the loss aversion rate of individual investors in the Seoul condominium market. **Research design, data and methodology:** A survey was conducted with Seoul residents ranging from 30's to 60's with various backgrounds. Descriptive statistical analysis and a paired sample t-test were conducted using SPSS 27.0 statistical package. **Results:** The results of the t-test showed that Seoul residents are indeed more sensitive to loss than gains, as pointed out in various researches related to behavioral economics. Also, the loss aversion rate associated with KRW 50 million risk was found to be 2.14. Finally, the same question was asked with KRW 100 million risk, doubled associated risk of previous question, using the same scenario, and it's been verified that the loss aversion rate increases as the associated risk or stake increases. The loss aversion rate with double risk is 2.26 which is about 5% higher than the one with KRW 50 million risk. **Conclusions:** This study can help many groups of people in society who need to establish rewards and punishment policies within any organization. In particular, incorporating human cognitive biases, such as loss aversion can help the South Korean government shape more effective reward and punishment policies when building rewards and punishments using taxes.

**Keywords:** Loss aversion, Behavioral economics, Experimental economics, Behavioral real estate, Behavioral decision making, Investors behaviors

**JEL Classification Code:** R10, R31, R38, R58

## 1. Introduction

One big thing that both investors and leaders share in common is that they are decision makers. Herbert A. Simon once said that management and decision-making are equivalent, and it is no exaggeration to say that investing is a continuation of the decision-making process. The psychological study of decision-making, which is the parent discipline of behavioral economics, examines how people make decisions, what biases they exhibit in the process, and how to reduce these biases. The core of this research is that human information processing is not as perfect as conventional economics assumes. Humans are

very efficient at processing information. While this efficiency often leads to accurate results, it can also lead to biased conclusions.

Among the various biases that humans exhibit, the "loss aversion" bias is one of the most common among investors. It first gained attention as a theory that effectively explains investor behavior in the stock market, art market, etc. and, following the pioneering work of Genesove and Mayer (2001), loss aversion has now been recognized in the housing market.

The study of loss aversion bias is essential not only for any organization that needs to make rules regarding rewards and punishments for employees, but also for marketing practitioners who need to create the right

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relationship with customers, and even policy makers. The South Korean government has strongly demonstrated its political will to punish those who own multiple houses and reward newlyweds through various real estate policies over the past decade. However, once the government has decided whom to reward and punish, it needs to seriously consider what and how to reward and punish most effectively. For example, when building rewards and punishments using taxes, incorporating human cognitive biases, such as loss aversion, can help governments shape reward and punishment policies most effectively and eventually achieve its goals.

If we look at the domestic studies that have been published using behavioral or experimental economics approaches, they can be divided into two main categories. The first is where human decision-making processes are experimented and studied through various controlled situations and survey questions. These papers can be found in various social science papers such as business administration and psychology, which are the fields that study human behavior as leaders or various consumers. However, the second category studies tend to use market data and conduct statistical analysis just like the research that was performed based on traditional economics, instead of using any controlled experiments. The studies that apply the behavioral economics theory but follow traditional economics research method in real estate industry include an empirical analysis of the synchronization between housing and transaction volume, or an empirical analysis of the loss aversion phenomenon in the Korean residential real estate market, focusing on the theory of the reference dependence in prospect theory. The research methods of these papers show that they were conducted using financial panel data from the Korea Institute of Public Finance or household panel data from Korean labor & Income Panel Study. It indicates that although the research theory is based on behavioral economics, which originated due to the limitations of traditional economics, the research method they employed is denying the value of the behavioral economics theory as well as the experimental economics. Typical empirical analysis in traditional economics uses statistical methods to infer human behavior from market data and avoids dealing with humans directly.

Experimental economics, on the other hand, is a field that should not be ignored when discussing behavioral economics. It is because the field of behavioral economics has become more active, experimental economics-related research using its methodology has also become more active. Experimental economics uses controlled experiments to study economic behavior, with the goal of testing economic theories and gaining insights into human decision-making processes by identifying patterns of

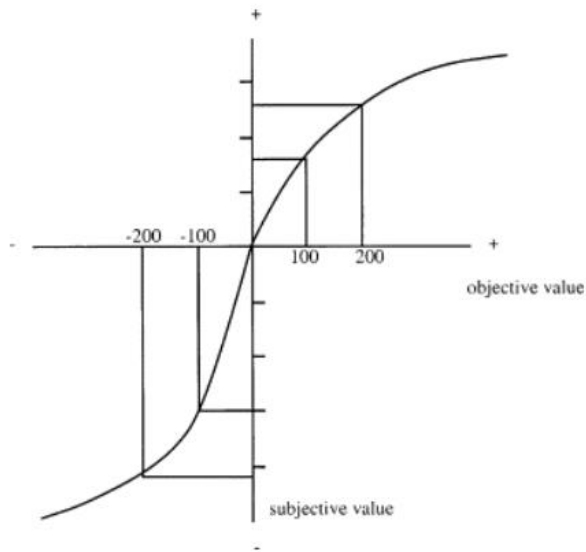
human behaviors. When Daniel Kahneman was awarded the 2002 Nobel Prize in Economics for his work in behavioral economics, the father of experimental economics, Vernon L. Smith, was also awarded the Nobel Prize in Economics for his contributions to the development of experimental economics. They share the same merits that they pioneered "experimental economics" and destroyed the traditional tools of economics.

In observing the loss aversion behavior of investors in Seoul, this paper does not follow the traditional economics research methodology of empirical analysis that uses existing statistical data like previous papers, but rather, based on the experimental economics approach, which is the research methodology befitting behavioral economics. The researcher designs and conducts a controlled experiment to check whether loss aversion behavior actually occurs in the Seoul condominiums market and estimates the loss aversion rate based on the results.

## 2. Literature Review

### 2.1. The Concept and Background

Prospect theory was first introduced by Daniel Kahneman and Tversky in their article "Decision Making Under Uncertainty" (1979). According to this theory, people's choice process can be divided into two stages: editing and evaluation. One of the psychological characteristics of the evaluation stage is that humans feel a sharper change in subjective value in the loss domain than in the gain domain, i.e., the emotional pain or subjective value that the loss of 5,000 won can bring to the human is relatively greater than the positive emotional utility of gaining 5,000 won. This suggests that people are more sensitive to losses than gains, which is called 'loss aversion'. A graphical representation of this change in psychological value is shown in <Figure 1> below. The figure below shows that the positive utility at +100 is only about the half of the negative utility at -100.



**Figure 1:** The value function of prospect theory

The coefficient of loss aversion is a concept introduced in Kahneman and Tversky's Prospect Theory to calculate the propensity to be loss averse and the resulting loss aversion rate. A simple experiment sample to determine the loss aversion coefficient is flipping a coin. When offered a game where you flip a coin and win KRW 10,000 if it lands on heads and lose KRW 10,000 if it lands on tails, most people refuse to play it because the potential pain of a loss exceeds the joy of a winning. According to research by John Payne at Duke University, the average person has a risk aversion score of 2 or higher, which means they are about twice as sensitive to the chance of losing money. That's where the number 2 comes in as the coefficient or rate of loss aversion.

However, it's important to keep in mind that 2 is only an average, and some people are much weaker or much stronger than others. Many different factors can affect the loss aversion coefficient, and one person's loss aversion coefficient can change as their occupation, age, wealth, and other environmental factors change. According to Kahneman, one of the many factors that affect the loss aversion coefficient is the size of the stake, i.e., if the loss aversion coefficient is 2 in the coin flip game in the previous example where you win 10,000 won on a head and lose 10,000 won on a tails, the loss aversion coefficient will be higher than 2 if you play the same game but with stake of 100,000 won or 1 million won instead of 10,000 won.

## 2.2. Literature Review

Genesove and Mayer (2001) were the first to demonstrate the loss aversion in the housing market.

Analyzing data on condominium transactions in central Boston from 1990 to 1997, they report that homeowners facing losses set selling prices 25-35% higher than the other owners. The study found that loss aversion was still statistically significant even at actual transaction prices rather than asking prices, and that the likelihood of a loss reduces the likelihood of a home being sold because probability of the house facing loss reduces by 3-6% to be sold if the current market price is 10% lower than the historical purchase price.

Since then, various papers have analyzed the loss aversion phenomenon in the housing market. As one of the latest papers, Andersen et al. (2023) published a new article titled Reference Dependence in the Housing Market. Using administrative data from Denmark, they analyzed the reference point and loss aversion in the housing market, and found that households are affected by losses about 2.5 times more than gains, resulting in a loss aversion rate in the Danish housing market is 2.5.

Speaking of domestic research, an article titled Loss aversion behavior and Reference point Setting in the Housing market was introduced in Volume 79 of the National Land Research in 2011. Kim et al. (2011) used KLIPS household panel data to identify whether households have moved their residences and measured the degree of loss aversion based on this information. While 'reference point' is one of the key concepts in loss aversion theory and has been addressed in many papers, this paper reports that loss aversion does not exist for losses calculated based on the purchase price, but rather for losses calculated based on the most recent price.

Cho and Kim (2015) also examined the factors that influence homeowners' decisions to sell their houses when facing house price losses or gain. They found that in the loss group, the average monthly expenditure of the household, the current market value of the primary residence, and ownership of any second home other than the primary residence were more likely to influence the decision to sell their houses even though they are in losses. In contrast, the number of household members, average monthly household expenditure, size of the home, current market value of the primary residence, income of the household head, and ownership of real estate other than the primary residence were significant variables when making decision to sell their houses. In other words, the more number of household members they have or the bigger size home they have, homeowners are less likely to sell their houses when facing loss. However, when they face gain, they are more likely to sell their houses.

In 'Loss aversion of individual investors, risk attitudes and household financial asset holdings' introduced in the Financial Planning Review in 2013, Cha and Jung identified the loss aversion propensity of individual

investors by comparing their risk preferences for potential gains and potential losses, compared their loss aversion according to their risk attitudes, and analyzed households' financial asset holdings based on the results of each study to understand individual investment and asset allocation behavior from a behavioral finance perspective.

### 3. Research Design

#### 3.1. Setting Research Questions

This study aims to estimate the loss aversion rate of condominiums in Seoul. First, we are going to examine whether Seoul residents are actually more sensitive to losses than gains, then estimate the loss aversion rate from an investor's perspective, and finally, we examine whether the loss aversion rate is positively related to the size of the risk. Therefore, we set the following research questions.

**Research Question 1.** Are Seoul residents actually more sensitive to losses than gains?

1-1. Is the percentage change in condominiums prices required for someone who does not own a house in Seoul to feel overnight beggar due to the increase in the price of someone else's condominiums less than the percentage change in condominiums prices required for an condominiums owner in Seoul to feel overnight rich due to the increase in the price of their own condominiums?

**Research Question 2.** If Seoul residents are indeed more sensitive to losses than gains in their condominiums, what is the loss aversion rate?

2-1. What shall be the expected gain when investors in Seoul decide to invest in a condominium with a risk of a 50 million won drop in price?

**Research Question 3.** If loss aversion is variable, will a greater risk cause a greater loss aversion?

3-1. What shall be the expected gain when investors in Seoul decide to invest in a condominium with a risk of a 100 million won drop in price?

3-2. Are the mean and median loss aversion rates for the 100 million won risk in Research Question 1 higher than the mean and median loss aversion rates for the 50 million won risk in Research Question 2?

#### 3.2. Survey Design and Analysis Methods

In order to examine whether citizens are actually more

sensitive to losses than gains, which is the research question 1, the following surveys are conducted to obtain data. To estimate the loss aversion rate in the Seoul condominium market, a survey was conducted to 439 Seoul residents. The survey period is from January 30, 2024 to February 17, 2024, and was conducted by a survey agency.

##### Survey Question 1

1-1. Suppose you are a resident in Seoul but do not own any house. A close acquaintance of yours owns a condominium worth about a KRW 1 billion in Seoul. The price of his or her condominium has dramatically increased lately so you are now feeling like an overnight beggar. At what price of your friend's condominium do you think you will feel like an overnight beggar when your friend's condominium price has dramatically increased in a year?

Select a response from 1) 1.1 billion to 20) 3 billion in increments of 1 billion at each step.

1-2. Suppose you are a resident in Seoul and currently own a KRW 1 billion worth condominium in Seoul. One day, the price of your condominium, which hasn't increased for a while, suddenly increases significantly and you now feel like an overnight rich. At what price do you think you will feel like an overnight rich when the price of your condominiums has increased in a year?

Select a response from 1) KRW 1.1 billion to 20) KRW 3 billion in increments of 1 billion at each step.

##### Survey Question 2

2-1. You are considering a 30-year-old Seoul condominium for an investment purpose. It is a favorable area for reconstruction and you are waiting for an important government decision. If the related policy is passed, the price of the condominiums is expected to increase significantly as the reconstruction is confirmed. However, if it doesn't pass, the price is expected to drop by about KRW 50 million. The odds are currently 50/50. You are now contacted by a broker and he said that a condominium had just become available for sale.

What is your expected value hike to make an investment decision despite the risk of KRW 50 million decline of the value?

\* Real estate transaction taxes, fees, etc. are assumed to be insignificant.

Select 1 response from 1) KRW 40 million to 11) KRW 140 million in increments of KRW 10 million for each level

##### Survey Question 3

2-2. You are considering a 30-year-old Seoul condominium for

investment purposes. It is a favorable area for reconstruction and you are waiting for an important government decision. If the policy is passed, the price of the condominiums is expected to increase considerably as the reconstruction is confirmed. However, if it does not pass, the price is expected to drop by about KRW 100 million.

What is your expected value hike to make an investment decision despite the risk of a KRW 100 million decline of the value?

\* Real estate transaction taxes, fees, etc. are assumed to be insignificant.

Select 1 response from 1) KRW 70 to KRW 90 million to 11) KRW 290 million in increments of KRW 20 million for each level

After frequency analysis of the survey results responding to the above research questions with SPSS statistics, a T-test is performed to check the difference of sensitivity. T-test is a test method used to determine whether the difference in the mean between two groups is statistically significant, and it is a technique often used in social science papers when comparing the means of two groups. After establishing the null and alternative hypotheses, we chose the paired sample t-test among the three types of t-tests to compare the difference in means between the two measures.

#### 4. Empirical Analysis

##### 4.1. Characteristics of the Sample

The demographic characteristics of the sample are shown in Table 1. The numbers of men and women are 230 and 209 respectively, with men outnumbering women by about 10%, and the age range is similarly distributed across 30s, 40s, 50s, and 60s. In terms of education, about 70% of the people have a college degree, followed by 16.4% with a graduate degree. In terms of marital status, about 60% are married, while 36% are single, and 36% are white-collar workers, followed by 17% of other professionals, about 13% of service and sales workers, and about 11% of unemployed, managers, and housewives.

**Table 1:** Sample characteristics

Classification		Frequency	Percentage (%)	classification		Frequency	Percentage (%)
Gender	Male	230	52.4	Marriage	Married	258	58.8
	female	209	47.6		Separation due to death	6	1.4
Age range	30s	114	26		Divorce	16	3.6
	40s	111	25.3		Single	159	36.2

Education	50	106	24.1	Occupation	Admin	49	11.2
	60s	108	24.6		Professionals	76	17.3
	Middle School and below	2	0.4		Office workers	158	36
	High School	54	12.3		Service and sales workers	56	12.8
	University	311	70.8		Housewife	48	10.9
Graduate School	72	16.4	Unemployed and others	52	11.8		

Looking at the financial characteristics of the sample, 57% are self-employed and about 41% own a car. The largest number of respondents (25%) has no real estate assets at all, with the second largest number (21%) having between 500 million and 1 billion. However, when it comes to the amount of real estate assets that they purchased for investment purposes rather than inheritance or gift, about 33% said they had no real estate assets at all, and about 27% said they had between 500 million and 1 billion. This means that 8% of Seoul residents own real estate by chance, regardless of their intention to invest. A whopping 21.1% of respondents said their real estate assets were between KRW 1 billion and KRW 3 billion, but only 7.6% of respondents said their real estate assets were between KRW 1 billion and KRW 3 billion.

When asked about the size of their financial assets, about 45% of respondents said they own more than KRW 100 million, while about 15% said they own less than KRW 20 million. Also, only about 22% of respondents said they had more than KRW 100 million, and 45.6% said they had less than KRW 20 million, which is about three times as many as those who said they had less than KRW 20 million.

The most frequent income range is between KRW 2 million and KRW 4 million with 33% of respondents' vote, followed by KRW 4 million to KRW 6 million with 26.8% of respondents. On the other hand, the average monthly expenditure range is between KRW 2 million and KRW 4 million with 41% of respondents, followed by less than KRW 2 million with 29% respondents.

**Table 2:** Financial Characteristics of the Sample

<Unit: KRW>

Classification		Frequency	Percentage (%)	classification		Frequency	Percentage (%)
Occupancy Form	Self	256	58.3	Financial Assets Scale owned	~20 million	67	15.2
	Rented	174	39.6		~40 million	53	12.1
	Nonresident	9	2.1		~60 million	63	14.3
Real estate Assets	None at all	112	25.5		~80 million	30	6.9

Scale owned	~200 million	65	14.8	Financial assets purchased for investment purposes Scale	~100 million	25	5.7
	~500 million	70	15.9		100 million and more	201	45.8
	~1 billion	93	21.2		~20 million	193	44
	~2 billion	76	17.3		~40 million	50	11.4
	~3 billion	23	5.2		~60 million	66	15.1
Real estate purchased for investment purposes Scale	None at all	141	32.1	Monthly Earnings	~80 million	21	4.8
	~200 million	64	14.6		~100 million	12	2.7
	~500 million	74	16.9		100 million or more	97	22.1
	~1 billion	85	19.4		~200 million	34	7.2
	~2 billion	60	13.7		~400 million	145	33.0
Average monthly expenditure	~3 billion	15	3.4	~600 million	106	26.8	
	~200 million won	135	30.7	~800 million	77	10.0	
	~400 million won	176	40.1	~10 million	44	8.3	
	~600 million won	82	18.7	10 million or more	33	10.7	
	~800 million won	25	5.7	Total	439	100	
	~10 million	12	2.8				
10 million or more	9	2.1					

**Table 3:** Comparison of frequency analysis of overnight beggar and overnight rich

Given Choices	How much price appreciation for a year is needed to feel like an overnight beggar?		
	Frequency	Percentage	Cumulative Percentage
1) KRW 11 billion	61	13.9	13.9
2) KRW 12 billion	19	4.3	18.2
3) KRW 1.3 billion	28	6.4	24.6
4) KRW 1.4 billion	5	1.1	25.7
5) KRW 1.5 billion	143	32.6	58.3
6) KRW 1.6 billion	12	2.7	61.0
7) KRW 1.7 billion	10	2.3	63.3
8) KRW 1.8 billion	5	1.1	64.5
9) KRW 1.9 billion	2	0.5	64.9
10) KRW 2 billion	119	27.1	92.0
11) KRW 2.1 billion	0	0	92.0
12) KRW 2.2 billion	0	0	92.0
13) KRW 2.3 billion	0	0	92.0
14) KRW 2.4 billion	1	0.2	92.2
15) KRW 2.5 billion	9	2.1	94.3
16) KRW 2.6 billion	1	0.2	94.5
20) KRW 30 billion	24	5.5	100.0
All	439	100	100.0
1) KRW 11 billion	22	5.0	5.0
2) KRW 12 billion	11	2.5	7.5
3) KRW 1.3 billion	20	4.6	12.1
4) KRW 1.4 billion	6	1.4	13.4
5) KRW 1.5 billion	121	27.6	41.0
6) KRW 1.6 billion	6	1.4	42.4
7) KRW 1.7 billion	8	1.8	44.2
8) KRW 1.8 billion	14	3.2	47.4
9) KRW 1.9 billion	5	1.1	48.5
10) KRW 2 billion	156	35.5	84.1
11) KRW 2.1 billion	3	0.7	84.7
12) KRW 2.2 billion	2	0.5	85.2
13) KRW 2.3 billion	1	0.2	85.4

### 4.2. Estimate of the Loss Aversion Rate

(1) Analyze the difference in sensitivity to gains and losses

<Table 3> shows the answers to the Research Question 1. According to the survey results, about 33% of the 439 respondents (143 people) answered KRW 1.5 billion, which was the most frequent choice, followed by 119 people or 27% of the respondents who chose KRW 2 billion, which was the second most frequent answer. It is also worth noting that 70 respondents, or 14%, said they would feel like an overnight beggar if their friend's condominium increased by KRW 100 million, which is only 10% increase. On the other hand, only 24 people, or 5.5%, said that they would feel like the overnight beggar if their acquaintance's condominium appreciated 200% in a year and reached KRW 3 billion, and that they would not feel like the overnight beggar if the price was less than that.

14) KRW 2.4 billion	0	0.0	85.4
15) KRW 2.5 billion	24	5.5	90.9
16) KRW 2.6 billion	1	0.2	91.1
20) KRW 30 billion	39	8.9	100.0
All	439	100	100.0

Looking at the analysis above, 156 people, or about 36%, answered 2 billion, while only 28% answered 1.5 billion, which is the opposite of the first question. Also, only 22 respondents, or 5%, said they would feel like the overnight rich if their home appreciated 10%, or a gain of 100 million. That's fewer than the 39 people who said they would feel like the overnight rich when their house went for 3 billion, the largest choice given to the question.

By comparing the two responses, it is clear that more than half of the responses are clustered around 1.5 billion won or less to the question about how much an apartment would need to rise to make them feel like the overnight beggar due to an increase in the price of an acquaintance's apartment, meaning that a 50% increase in the price of a 1 billion won apartment would be enough for more than 50% of Seoul residents to feel like the overnight beggar. In contrast, when asked about the price increase needed to feel like the overnight rich when you are a homeowner, the cumulative percentage of frequent responses reaches 50% at 1.9 billion won, which is significantly different from the 1.5 billion won response to the previous question, indicating that a much larger price change is needed to feel like the overnight rich than the amount needed to feel like the overnight beggar. In addition, about 36% of respondents said that they would feel like the overnight rich if the price of the owned apartment becomes double, two billion won, while about 33% of respondents said that they would feel like the overnight beggar already at 1.5 billion won. Furthermore, 14% of respondents said that a 10% increase in the price of their friend's apartment would make them feel like the overnight beggar, while only 5% responded that 10% price increase needed to feel like the overnight rich, which suggests that investors are much more sensitive to losses than gains.

**Table 4:** Comparison of descriptive statistics of Overnight Beggar and Overnight Rich according to changes in Seoul condominium prices

Classification	Overnight beggar	Overnight rich
minimum	1	1
maximum	20	20
average	6.73	8.58

Standard Deviation	4.672	4.922
Skew	1.144	0.826
Kurtosis	1.317	0.306
Median	5	10

The following is the analysis result of the paired sample t-test. The result is  $t = -9.214$ ,  $p < 0.001$ , which is statistically significant at the significance level of 0.001. Therefore, the null hypothesis is rejected and the alternative hypothesis is accepted, and we can say that there is a significant difference between the price change required to feel the emotion as an overnight beggar and the price change required to feel the emotion as the overnight rich.

**Table 5:** Overnight Poor and Overnight Rich T-test

classification		Mean	Standard deviation	t	p
Reactions to changes in condominium prices in Seoul	Overnight Beggar	6.73	4.672	-9.129	.000
	Overnight Rich	8.58	4.922		

The above analysis verifies that Seoul residents are indeed more sensitive to losses than gains. However, this analysis is only meant to reveal the difference in sensitivity, not to measure loss aversion, because in the survey question, there was no risk in the respondents' choices in the first place. There is no assumption that the respondent is engaging in any risk-taking behavior in pursuit of profit, and the purpose of the question is to measure how they react to losses and gains in a contingent situation. Since the theory of loss aversion in behavioral economics deals with human choices in uncertain situations where the prospects of gains and losses are mixed, I would like to estimate the rate of loss aversion by asking a question that makes profits and risk more explicit.

## (2) Estimate the loss aversion rate

Research question 2, which is to estimate the rate of loss aversion in the Seoul real estate market, is designed to be similar to the coin flip game, one of the most representative games in behavioral economics. They are similar in a sense that they both require a choice under uncertainty but are different because the designed question is about the real estate market not the gambling.

Prospect theory, proposed by Tversky and Kahneman in 1979, is a descriptive theory that uses mathematical models to explain decision making process under uncertainty. As mentioned earlier, several experiments that have measured the loss aversion rate have shown that the

loss aversion rate is usually between 1.5 times and 2.5 times. Although no study has yet attempted to measure the loss aversion rate based on Seoul condominiums, it can be inferred that the loss aversion rate in Seoul condominium market will be at least between 1.5 times and 2.5 times based on the estimation of loss aversion rates for residential real estate markets overseas.

After frequency analysis of the responses to research question 2, the table below shows the calculated loss aversion rate.

**Table 6:** Loss aversion rate for a KRW 50 million drop risk

Given Choices	Loss Aversion Rate (%)	Frequency	Expectations
1) 40 million	0.8	18	14.4
2) 50 million	1	24	24
3) 60 million	1.2	4	4.8
4) 70 million	1.4	5	7
5) 80 million	1.6	5	8
6) 90 million	1.8	2	3.6
7) 100 million	2	219	438
8) 110 million	2.2	6	13.2
9) 120 million	2.4	18	43.2
10) 130 million	2.6	6	15.6
11) 140 million	2.8	132	369.6
Total		439	941.4
Average Loss Avoidance (%)			2.144419

According to the above analysis, 50% of the respondents answered 100 million won, and more than 30% of the respondents answered 140 million won, which is the largest amount choice provided. On the other hand, forty two respondents answered KRW 50 million or less, indicating that 8% of the respondents are more risk-averse than risk-adverse. If we define the loss aversion rate of respondents who answered the same amount of profit as the risk of 50 million won to be loss aversion rate of 1, we can analyze that 50% of respondents chose the loss aversion rate of 2, 100 million won. If we multiply the loss aversion rate and frequency by each other, add them together, and divide by 439, we get the average value of 2.144419. Therefore, the average loss aversion rate of respondents is about 2.14.

(3) Change in loss aversion rate

The results of the analysis of research question 2 confirm that the loss aversion rate for a Seoul condominium with a risk of losing 50 million won is 2.14. However, this loss

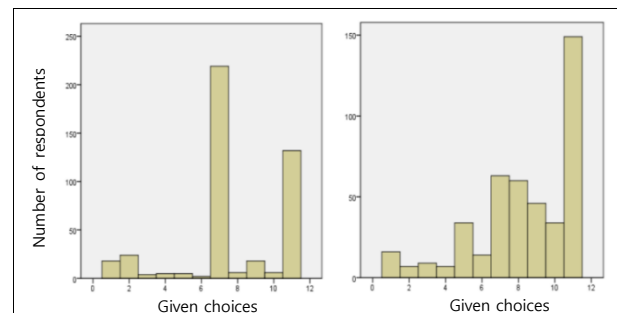
aversion rate is not fixed, but variable, and one of the factors affecting the loss aversion rate is that as the risk increases, the loss aversion rate also increases, according to behavioral economists.

So, in this study, we would like to see how the responses change when the risk is doubled to 100 million won in the same question and whether there is a real change in the loss aversion rate. The results are as follows

**Table 7:** Loss aversion rate for a 100 million won drop risk

Given Choices	Loss Avoidance Rate (%)	Frequency	Expectations
1) Between 70 million - 90 million won	0.8	16	12.8
2) Between 90 million - 110 million won	1	7	7
3) Between 110-130 million won	1.2	9	10.8
4) Between 130-150 million won	1.4	7	9.8
5) Between 150-170 million won	1.6	34	54.4
6) Between 170-190 million won	1.8	14	25.2
7) Between 190-210 million won	2	63	126
8) Between 210-230 million won	2.2	60	132
9) Between 230-250 million won	2.4	46	110.4
10) Between 250-270 million won	2.6	34	88.4
11) Between 270-290 million won	2.8	149	417.2
Total		439	994
Loss aversion rate			2.264237

In question 2, 50% of the respondents chose 100 million won as the expected gain for a potential loss of 50 million won, and about 30% chose 280 million won, the largest given value. Unlike the clustering of responses to these two answers in question 2, the responses to the potential loss of 100 million won are spread out evenly and show a different scatter plot. The scatterplots of the responses to the two research questions are shown in Figure 2 using bar graphs.



**Figure 2:** Comparison of histograms for 50 million won risk and 100 million won downside risk



The most notable difference between Research 3 and Research 2 is that the percentage of people who chose 7, which corresponds to a loss aversion of 2, was 50% for a potential loss of 50 million won, compared to only 15% for a potential loss of 100 million won. However, the similarity between the two graphs is that about 30% of people chose option 11, the highest value presented in the examples, in both research questions, indicating that there are about 30% of people who have a loss aversion of 2.8 or higher, the highest level of loss aversion, regardless of the stake size.

To verify whether loss aversion also increases as the risk increases, we asked the same question in the same scenario as in Research Question 2, only increasing the size of the risk from 50 million won to 100 million won, and analyzed the response results, and found that the loss aversion rate is 2.26. This is a higher coefficient than the 2.14 found in Research Question 2, which leads to the conclusion that loss aversion increases as the risk increases. Descriptive statistics for the two risk-taking questions are shown in the table below.

**Table 8:** Comparison of descriptive statistics for the two risk tolerance questions

Classification	50 million drop risk	100 million drop risk
minimum	1	1
maximum	11	11
average	7.72	8.32
Standard deviation	2.784	2.735
Skewness	-0.646	-0.953
Kurtosis	0.11	0.269
Median	7	9

According to the table above, the mean of research question 2 is 7.7 and the median is 7. The skewness is -0.646 and the kurtosis is 0.11. In contrast, the mean for Question 3 is 8.32 and the median is 9, which is higher than in Question 2. Furthermore, the skewness is lower at -0.953 and the kurtosis is higher than in Question 2 at 0.269.

The following is a t-test analysis of the two cases.

**Table 9:** Loss 50 million and Loss 100 million T-test

classification	Mean	Standard deviation	t	p
Reactions to changes in investment losses	Loss 50 million	7.722	-6.335	.000
	Loss 100 million	8.321		

The analysis results were statistically significant as

shown in Table 9. The above analysis proves that loss aversion rate of individual investor increases when the stakes of investment increase.

## 5. Conclusion

In this study, we analyze three research questions focusing on estimating the loss aversion rate of individual investors living in Seoul, Republic of Korea. First, we examined whether Seoul residents are actually more sensitive to losses than gains, second, we estimated the loss aversion rate to analyze the degree of loss aversion from the investor's perspective, and finally, we studied whether the loss aversion rate is positively related to the size of the risk.

First of all, in the analysis of the sensitivity difference between the gains and losses of Seoul residents, a survey was conducted with 439 people, and the average price increase required for those who do not own any house, to feel the emotion of being overnight beggar due to an increase in the price of an acquaintance's condominium was 6.73, while the average price increase required for homeowners to feel the emotion of being overnight rich was 8.58. The numbers 6.73 and 8.58 are only referring to the numbers of given choices, and if we convert them to condominium prices, they will be about KRW 1.673 billion and KRW 1.858 billion. The t-test analysis of this resulted in a value of -9.129, which is statistically significant at  $p < 0.001$  with a significance level of 0.0001. This proves that Seoul residents are indeed more sensitive to losses than gains.

Now, in order to estimate the loss aversion rate, we designed a scenario adapted to the domestic real estate market based on the coin flipping game, which is a representative economic experiment scenario related to loss aversion rate in behavioral economics, and surveyed 439 people. The results showed that if an investor were to make an investment decision under the risk of losing 50 million won, 50% of the respondents answered that they expect a 100 million won for gain, double the risk amount of 50 million won, and about 30% of the respondents answered 140 million won as their expected gains, the maximum value among the proposed examples. We calculated the loss aversion rate based on the survey results and found that the average loss aversion rate of respondents was 2.14. This is in line with previous studies that have shown that the loss aversion rate is generally between 1.5 and 2.5 through various economic experiments.

In order to study the last research question, whether the loss aversion rate increases as the risk increases, we

asked the same scenario as in question 2, but increased the risk from 50 million won to 100 million won, double amount. The results showed that in question 2, out of the 11 proposed choices, about 80% of the respondents chose either 100 million won or 280 million won, which corresponds to a loss aversion rate of 2, and 2.4 respectively.

In contrast to Question 2, Question 3 showed a completely different scatter, with only 48% of respondents choosing either KRW 200 million or KRW 280 million, with a loss aversion rate of 2 and 2.4 respectively. Based on the descriptive statistics of the responses to both questions, we calculated the median and mean values, and found that the median value increased as the risk increased, with a median of 9 for the 100 million won risk and 7 for the 50 million won risk, and the mean value also increased from 7.72 to 8.32. To summarize, the loss aversion rate in Research Question 3 was 2.26, which is about 5% higher than the loss aversion rate of 2.14 in Research Question 2, and both the mean and median values of the responses were higher than in Research Question 2, confirming the hypothesis that loss aversion increases as the risk increases.

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