



## Sign Effect, Speedup – Delay Asymmetry and Gender Effect in the Tehran Stock Exchange

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### ABSTRACT

The present study first investigates the asymmetry of speedup - delay (gain and loss) and Sign Effect in Tehran Stock Exchange, then examine the effect of gender on the discount rate and explain it with the loss aversion. The sample is 403 investors in Tehran Stock Exchange, and the nonparametric Tests are used to test the research hypotheses. The research results show that there is an asymmetry of speedup - delay in the Tehran Stock Exchange, which means; for gains, investors delay premium (a discount rate) is larger than the speed-up cost (a discount rate) and for losses; the discount rates of speed-up are larger than discount rates of delay.

Also, the findings of this study indicate that there is a Sign effect in the Tehran Stock Exchange; in other words, the discount rate of gains is greater than the discount rate of losses. This study also finds that gender is correlated with discount rates, which that means; women have a higher discount rate for the delay in gains and lower discount rate for the delay in losses, which is due to their higher loss aversion than men.

These anomalies are incompatible with the traditional discount model predictions, which is widely used in financial matters and assumes a constant discount rate.

### Keywords:

Asymmetry of speedup-delay, Sign Effect, Loss Aversion, Gender.

## 1. Introduction

Many financial decisions have consequences results in the future and investors are constantly evaluating these results and these results will be realized in the present or the future. In these intertemporal decisions, investors should weigh the results to draw a comparison between future and present opportunities. To model such decisions, Discounted Utility models (DU) are typically used. These models combine a utility function that reflects attitudes towards outcomes and a discount function that captures the effect of the passage of time. The most widely used discounted utility model in economics is the constant discounting in which the discount function is determined by a constant rate of a discount. Since its introduction by Samuelson in 1937, the discounted utility model (DU) has dominated economic analyses of intertemporal choice (Dhami, 2016).

Although even Samuelson himself acknowledged that DU wasn't a particularly realistic model of how people make intertemporal choices, the first major empirically grounded critique of DU came only in 1981 with the publication by Richard Thaler (1981). Thaler in this research concluded that the discount rate of profit is higher than the discount rate of losses. In other words, people prefer to suffer losses and not delay and in financial literature, it is known as Sign effect. Thaler's research (1981) findings show that the basic principles of the DU model are violated. Within the decade, a catalog of anomalies in intertemporal choice had been assembled (Loewenstein and Prelec, 1992). Loewenstein (1988) found that the Delay premium is larger than the Speed up cost in financial literature it is known as Delay-Speedup asymmetry and that was not consistent with the predictions of the DU model. Further research has shown that the Delay-Speedup asymmetry in losses area is inverse (shelley, 1993; Tu, 2004).

Given that discount rates are widely used in stock valuation models and financial decision makings, assuming that in all cases the discount rate is constant can have misleading results. As explained in his paper, the traditional Discounted Utility (DU) model could not explain these Anomalies, but a descriptive model with reference points and loss aversion can solve the problem easily. In this regard, this study investigates the Speedup - Delay asymmetry (gains and losses) and the Sign effect in the Tehran Stock Exchange. Also,

this study examines the effect of Gender on discount rates and provides an explanation based on loss aversion.

The main purposes of this study are to investigate whether, in Tehran Stock Exchange, the discount rate of Delay gains are further than the discount rate of Speedup gains, also the discount rate of gains greater than the discount rate of losses. And given that higher loss aversion of women, they have a higher rate of delay of gains and the lower discount rate of losses than men.

## 2. Literature Review

DU and its most famous form, Exponential Discounted Utility (EDU) are the dominant economic models of time discounting in finance, and it is used for many purposes. However, its psychological foundations are fairly limited. These models assumed that the discount rate encapsulated all psychological considerations. Samuelson (1937, p. 156) recognized that it was completely unreasonable to consider that people behave according to the EDU model and he also declared limitations about its use for welfare comparisons:

*“In conclusion, any connection between utility as discussed here and any welfare Concept is disavowed.”*

Despite Samuelson's reservations, the EDU model is still the dominant model used in welfare comparisons in economics (Dhami, 2016, p 586). Important properties of the EDU model include:

*Stationarity of the felicity:* The instantaneous utility,  $u$ , is time-invariant. *Consumption independence:* the marginal rate of substitution between two consecutive periods  $t$  and  $t + 1$  is independent of any other periods.

*Utility independence;* the numerical values associated with distinct consumption profiles determine which is preferred. Provided that the numerical value is identical, there is no preference associated with particular shapes of the consumption profiles, for instance, increasing, or decreasing.

*Independence of discounting from consumption:* The same discount function applies to an individual's consumption of any two distinct goods (say, oranges and apples). Furthermore, EDU does not specify how

and why the discount function could depend on individual specific traits or behaviors.

*Constant discounting*; the discount rate between any two consecutive periods, irrespective of the time location of the periods. This is known as the assumption of constant discounting.

*Diminishing marginal utility and positivity of the discount factor*: For most practical purposes, it is assumed that the felicity,  $u$ , is concave (diminishing marginal utility), and the discount rate is strictly positive, i.e.,  $\theta > 0$  (this reflects impatience). The Diminishing marginal utility creates an incentive to postpone consumption; however, a positive discount rate pushes in the direction of current consumption. This is the basic trade-off in EDU that determines the choice between current and future consumption (Dhami, 2016, p. 589).

However, some evidence has arisen from studies that, pose a challenge to the DU and EDU models. Under EDU, the discount is equal between two consecutive periods and assuming discrete-time, and it doesn't matter when these times are. This derives from the stationarity axiom of EDU (Fishburn and Rubinstein, 1982). However, this assumption in many times violated. Consider the following well-known example (Dhami, 2016, p587);

*“Thaler’s (1981) apples example*: It is reasonable to assume that a person will prefer one apple today to two apples tomorrow. The same person will, however, in all likelihood, prefer two apples in 51 days to one apple in 50 days.”

Such a pattern of preference reversals is not consistent with the assumption of stationarity in EDU. Stationarity implies that the discount rate is constant. By contrast, the evidence shows that when the time delay before a future reward is received is short, the per-period discount rate is high and the decision-maker appears very impatient. However, when the time delay is long, the Per-period discount rate is low and the decision-maker appears more patient (Dhami, 2016, p587). Two of the most important EDU anomalies are:

**Sign effect:**

Under EDU, the discount rate is equal for gains and losses. Empirical evidence implies that when deciding about the outcome–time pairs, losses are more salient than gains. Therefore, losses are discounted less than gains and the discount rates for

the losses are lower than gains. Thaler (1981) concluded that the discount rates for gains are larger than the corresponding discount rates for losses. Most people prefer to incur a fixed loss immediately than to delay it. In the literature, the discount rate of gains is the delay of gains. And the discount rate of losses is the delay of losses. In other words, the sign effect means (Tu, 2004);

$$\delta_{DG} > \delta_{DL}$$

**The Delay–Speedup asymmetry:**

For the first time, Loewenstein (1988) showed that the Delay premium ( $v_{0 \rightarrow 1}$ ) and the discount rate for Speed-up cost ( $v_{0 \leftarrow 1}$ ) were not equal and this is contrary to the prediction of DU models. In this research, Sixty-six undergraduates at the University of Illinois were asked the maximum amount they would pay for a Sony VCR with remote control (list price \$300) delivered today ( $v_0$ ). Then they were asked the minimum amount they would be willing to accept to delay receiving the VCR for one year ( $v_{0 \rightarrow 1}$ )? In other questions, subjects were asked the maximum amount they would pay for a Sony VCR with remote control (list price \$300) delivered a year from now ( $v_1$ ). They were then asked what minimum amount they would be willing to pay today to speed up their receiving the VCR by one year ( $v_{0 \leftarrow 1}$ )?

The finding of this research showed that Delay Premium in this experiment is 126\$ and speed up cost is 54\$ and this difference is significant this gives rise to the Delay–Speedup asymmetry. Loewenstein (1988) showed that with the help of concepts of loss aversion and reference point, this puzzle can be solved. Loewenstein (1988) argued that conventional discounting model predicts that the Delay premium ( $v_{0 \rightarrow 1}$ ) and the Speed up cost ( $v_{0 \leftarrow 1}$ ) exactly be equal while the reference point model predicts that ( $v_{0 \rightarrow 1}$ ) should exceed ( $v_{0 \leftarrow 1}$ ).

After Loewenstein research (1988), Benzion et al (1989) and Shelley (1993) have shown that for losses; Delay–Speed up asymmetry is reversed and speed up cost (or discount rate for speed up) higher than delay premium (or discount rate for the delay).

Tu (2004) based on insight of Loewenstein’s (1988) reference point model, construct a structural model for intertemporal choice with reference points and loss aversion by considering four scenarios: delay of gains, delay of losses, speed-up of gains, and speed-

up of losses. He used panel data from a Dutch representative household survey 1997-2002 and a nonlinear random coefficients model with panel data to estimate reference points of delay and speedup, the coefficient of loss aversion and discount rates. He found that on average the reference point of delay is larger than speedup, consistent with the hypothesis of Loewenstein; the mean of coefficient of loss aversion is around two, females are more loss averse than males, and high education and aging make people less loss-averse; high educated or older people are also more patient.

Abdellaoui, Attema and Bleichrodt (2009) measured utility in intertemporal choice and presented new and more robust evidence on the discounting of money outcomes. They found that intertemporal utility was concave for gains and convex for losses and obtained evidence of an asymmetry in discounting between gains and losses, which, in contrast with earlier findings, cannot be explained by a framing effect.

Dimmock and Kouwenberg (2010) empirically tested if loss-aversion affects household participation in equity markets, household allocations to equity, and household allocations between mutual funds and individual stocks. Using household survey data, they obtained direct measures of each surveyed household’s loss-aversion coefficient from questions involving Hypothetical payoffs. They found that higher loss-aversion is associated with a lower Probability of participation and higher loss-aversion reduces the Probability of direct stockholding by significantly more than the probability of owning Mutual funds. They also did not find a relationship between loss-aversion and portfolio allocations to equity.

Appelt, Hardisty and Weber (2011) found that people discount delayed gains (where the default is to receive a smaller gain sooner) more than accelerated gains (where the default is to receive a larger gain later). For losses, the pattern reverses—people discount delayed losses less than accelerated losses.

Lee and Veld-Merkoulova (2016) investigated the link between myopic loss aversion and actual investment decisions of individual investors, using survey data. Their results are consistent with the predictions of Benartzi and Thaler. Higher myopic loss aversion is associated with a lower stock investment as a share of total assets. Investors tend to evaluate their stock portfolio performance too often, which

contributes to the prevalence of myopic loss aversion. Their research was based on Loewenstein’s approach and the questions of Dimmock and Kouwenberg (2010) and in their research found delay–speedup asymmetry in the area of profit and loss. Yuxin Tan et al (2018) finds that the discount rate of gain(0.15) is higher than losses (0.05).

Table 1 summarizes the discount rates for a number of these studies that shows delay–speedup asymmetry and sign effect;

**Table 1; Average discount rate to delay and speedup Gain and loss in several studies**

Research	GAIN		LOSS	
	delay	speedup	delay	speedup
Benzion, Rapaport and Yaghi (1989)	27%	18%	17%	24%
Shelly (1993)	20%	15%	11%	18%
Tu(2004)	21%	3%	4%	12%
Dimmock and Kouwenberg (2010)	25%	4%	3.5%	9.9%
Lee and Veld-Merkoulova (2016)	17.8%	4%	3%	9.6%

Some articles have continued to examine the use of Delay and Speedup discounting, for example, Qu and Zhang (2020) research; they found we found that the discounting rates with a large magnitude of delayed money could negatively predict ordinary violations, errors, and total risky driving behaviors

**An explanation for EDU Anomalies by Loss Aversion and reference point**

Reference points and loss aversion are two essential and commonly used concepts in behavioral economics that arise from prospect theory of Tversky and Kahneman (1979, 1992). The most important idea of prospect theory is a value function with three basic features;

- 1) Reference dependence: gains and losses are defined on deviations from a reference point, rather than on the final level of wealth.
- 2) Loss aversion: the value function is steeper for losses than for gains, losses loom larger than corresponding gains.
- 3) Diminishing sensitivity: the decreasing marginal value for both domains of gains and losses.

In this theory, loss aversion is a very important concept. Many studies consider the value of the loss aversion coefficient to be about 2 (Kahneman and Tversky; 1992, Tu (2004), Dimmock and Kouwenberg; 2010, Le and Merkoulouva, 2016)

This kind of value function is quite different from the traditional expected utility theory. Concepts of reference points and loss aversion come from psychology, as Kahneman and Tversky mentioned in their paper, the reference point is changeable, might depend on expectations, consumption level in previous periods, comparison with others, status quo, etc.; and with the changing of the reference point, people might change the frame of gains and losses differently (Tu, 2004, p2)

The reference point and loss aversion are already widely used in models of decision making under uncertainty for a long time. Based on insight of Loewenstein's (1988) reference point model, Tu (2004) and Dimmock and Kouwenberg (2010) constructed a structural model for intertemporal choice with reference points and loss aversion by considering four scenarios: delay of gains, delay of losses, speed-up of gains, and speed-up of losses. Using the reference point equations, they showed that, there was a relationship between loss aversion and discount rates. And using these equations, they explained the speedup-delay asymmetry and Sign effect. They derived equations that link the answers to the survey questions about intertemporal choice to the parameters of the value function of prospect theory. The approach for deriving the equations followed Loewenstein (1988). The Dimmock and Kouwenberg (2010) method are as follows;

The value of a payoff sequence offering  $X_0$  at time 0 and  $X_T$  at time  $T$  is expressed as:

$$(1) \quad V(X_0, X_T; R) = v(X_0 - R) + \delta(T) v(X_T - R)$$

Where  $R$  denotes the reference point,  $\delta(T)$  denotes the individual's discount factor for a Period of length  $T$  and  $v(\cdot)$  is the value function used to evaluate payoffs. For convenience assumed  $v(0) = 0$ .

Consider the case where an individual will receive a gain of amount  $X$ , in the present at time 0. The individual is willing to delay the receipt of  $X$  to time  $T$ , if the payment is increased by the amount  $PDG^1$ . This implies that the individual is indifferent between receiving  $(X, 0)$  and  $(0, X + PDG)$ , and hence;

$$(2) \quad V(X, 0; R) = V(0, X + PDG; R)$$

$$(3) \quad \begin{aligned} v(X - R) + \delta(T)v(-R) \\ = v(0 - R) + \delta(T)v(X \\ + PDG - R) \end{aligned}$$

Where  $R$  denotes the individual's reference point for payments at time 0 and at time  $T$ , subject to  $0 < R \leq X$ .

By using the value function of prospect theory for  $v(\cdot)$ , but to simplify the analysis, Follows Barberis and Huang (2001) and Barberis, Huang and Santos (2001) and set the Curvature parameter of the value function equal to one:

$$(4) \quad V(X) = \begin{cases} x^\lambda & \text{if } x \geq 0 \\ -\lambda x & \text{if } x < 0 \end{cases}$$

Where  $\lambda > 1$  implies loss-aversion. Using this specification of the value function, equation (3) can be written as:

$$(5) \quad X - R - \delta(T)\lambda R = -\lambda R + \delta(T)(X + PDG - R)$$

$$(6) \quad PDG = [(1 - \delta(T))(X - R) + (1 - \delta(T))\lambda R] / \delta(T)$$

To simplify the exposition, consider the special case of complete reference point adjustment ( $R = X$ ). Let  $pDG = PDG / X$  and  $r = R / X = 1$ , then the following equation expresses the relative premium  $pDG$  demanded in return for delaying the gain as a function of the loss-aversion parameter and the discount rate:

$$(7) \quad \begin{aligned} pDG &= (1 - \delta(T))[(1 - r) + \lambda r] / \delta(T) \\ &= \lambda (1 - \delta(T)) / \delta(T) \end{aligned}$$

Given  $\lambda > 1$  and  $0 < \delta(T) \leq 1$ , the premium is positive and bounded. Following similar steps, three other types of questions derived (SG, DL, and SL):

$$(8) \quad pSL = (1 - \delta(T))$$

$$(9) \quad pSG = (1 - \delta(T))$$

$$(10) \\ p_{DL} = ((1 - \delta(T))(1/\lambda)) / \delta(T)$$

Explanation of Sign Effect ( $p_{DG} > p_{DL}$ ) with reference point equations;

Considering the equations (7 and 10) and its simplification, as well as  $\lambda > 1$ , we conclude that the discount rate for gain is greater than the discount rate for the loss;

$$p_{DG} > p_{DL} \rightarrow \lambda (1 - \delta(T)) / \delta(T) > ((1 - \delta(T))(1/\lambda)) / \delta(T) \rightarrow \lambda > (1/\lambda)$$

Explanation The delay–speedup asymmetry ( $p_{DG} > p_{SG}$ ) with reference point equations;

Given the equations (7 and 9) and its simplification and with  $\lambda > 1$  and  $0 < \delta(T) \leq 1$ ; delay - speedup asymmetry is accepted.

$$p_{DG} > p_{SG} \rightarrow \lambda (1 - \delta(T)) / \delta(T) > (1 - \delta(T)) \rightarrow \lambda / \delta(T) > 1$$

Explanation of gender effect on discount rate:

The effect of gender on loss aversion has been widely accepted in many studies. Anbarci et al. (2017) in a study concluded that there is a loss aversion in professional tennis game betting and concluded that there is a loss aversion in men and women but women are more loss averse than men. The study found that women players are more likely to take risks in the final match with a larger prize pool. The results of this study show that there is a heterogeneity of risk acceptance and loss aversion concerning gender.

Rau (2014) also examined the effect of gender on loss aversion. The results show that women are less likely to identify investment losses because they are more loss averse than men. Other studies are addressing the relationship between gender and loss aversions like as Rieger et al (2014) and Johnson et al (2006). The results showed that women were loss averse than men.

In this article, the reference point equations were used to investigate the effect of gender on investor discount rates.

Considering equation (7), loss aversion has a direct relationship with the discount rate of delay of gains, and according to equation (10), there is an inverse relationship between the loss aversion of individuals and the discount rate of delay of losses. If women had

more loss aversion than men, it could be expected that women with greater loss aversion than men would have a higher discount rate of delay of gains than men and a lower discount rate of delay of losses than men.

### 3. Methodology

The target population of this study is all active investors in Tehran Stock Exchange, Since in the Tehran Stock Exchange investors often trade with different Trading ID and sometimes one person trades with several Trading IDs, the size of this Statistical population is not clear. Our sample includes capital fund managers, portfolio holders, brokerage managers, and market analysts, and other active individuals with at least five years of trading experience in the capital market and their annual turnover at least annually 100 million Tomans per year (about \$10,000).

In this article, the research questions were distributed to the individuals that willing to participate in the study. The sample size of the study is 403 investors; based on the Krejcie & Morgan (1970) table for an unlimited population, our sample size should be at least 384 investors. Of these, 294 were male and 109 female. The following sections describe the research methodology;

Deriving investor discount rates and their loss aversion coefficient:

In this study, following the researches by Loewenstein (1988), Tu (2004), Dimmock and Kouwenberg (2010) and Lee and Veld-Merkoulova (2016); four situations regarding investors' time preferences were considered. These four situations include; Delay of Gains, Speedup of Gains, Delay of Losses and Speedup of Losses. According to the conventional discounted utility, individuals should have the equal discount rates in these four situations.

This section describes four questions for these four situations, and the discount rates were calculated according to the above four preferences. The anomalies discussed in the previous section illustrate the inequality of discount rates under these situations. After comparing the mean and median discount rates in these four situations (delay and speedup (gains) and delay and speedup (losses)) and comparing them using nonparametric tests, the effect of gender on the discount rate investors were investigated.

Then, using the Loewenstein (1988) reference point model approach and the equations developed by Dimmock and Kouwenberg (2010), the coefficients of

loss aversion were calculated and then the effect of gender on the discount rate is explained.

The questions in this study design in line with Loewenstein proposal (1988, p. 202) and research by Tu (2004, p. 6), Dimmock and Kouwenberg (2010, p. 13) and Lee and Veld-Merkoulova (2016, p. 10) in order to measure the aforementioned four-fold discount rates. In this study, four questions were designed that differ by two components: delaying (*D*) vs. speeding-up (*S*) a payment and gains (*G*) vs. losses (*L*). The time dimension is 1 year, and a payment (*X*) of 10,000,000 in Iranian Toman considered. These questions are presented below:

#### Delay of Gains

Imagine you win a prize of 10,000,000 Iranian Toman in the Bank Lottery. The prize is to be paid out today. Imagine, however, that the Bank asks if you are prepared to wait A YEAR before you get the prize of 10,000,000 Toman. There is no risk involved in this wait. How much extra money would you ask to receive AT LEAST to compensate for the waiting term of a year?

#### Speedup of gains

Imagine again that you receive a notice from the Bank Lottery that you have won a prize worth 10,000,000 Iranian Toman. The money will be paid out after A YEAR. The money can be paid out at once, but in that case, you receive less than 10,000,000 Toman. How much LESS money would you be prepared to receive AT MOST if you would get the money at once instead after A YEAR?

#### Delay of losses

Imagine the government fined you 10,000,000 Iranian Toman (Driving accident penalty or tax penalty, etc.) and you have to pay it today. If the government allows you to pay the fine A YEAR later (you have to pay and there is no way out) and pay more; How much extra money would you be prepared to pay AT MOST to get the extension of payment for A YEAR?

#### Speedup of losses

Imagine the government fined you 10,000,000 Iranian Toman (Driving accident penalty or tax penalty, etc.) and you have to pay it A YEAR later (you have to pay and there is no way out). If the government allows you to pay the fine now and in that case, you will get a REDUCTION in fine; how many reductions in fines

AT LEAST want to pay the fine now instead of after a year?

Each of these four questions leads to a different discount rate, providing discount rates for the delay of gains ( $p_{DG}$ ), speedup of gains ( $p_{SG}$ ), delay of losses ( $p_{DL}$ ), and speedup of losses ( $p_{SL}$ ). We use  $P_{DG}$ ,  $P_{SG}$ ,  $P_{DL}$ ,  $P_{SL}$  to represent the answer to each question above, then we can compute these four discount rates as follows:

$$p_{DG} = \frac{P_{DG}}{10,000,000}$$

$$p_{SG} = \frac{P_{SG}}{10,000,000 - X_{SG}}$$

$$p_{DL} = \frac{P_{DL}}{10,000,000}$$

$$p_{SL} = \frac{P_{SL}}{10,000,000 - X_{SL}}$$

After calculating the above ratios, by using equations 7, 8, 9, 10; we calculate the Loss aversion coefficient of investors by Dimmock and Kouwenberg (2010) method that explains in the previous section.

#### Research Hypothesis

In this research to investigate the asymmetry of Delay-Speed up in gains and losses in Tehran Stock Exchange, hypotheses 1 and 2 are proposed;

**Hypothesis 1:** In the Tehran Stock Exchange, The discount rate of delay the gains is more than the discount rate of speed up the gains.

**Hypothesis 2:** In the Tehran Stock Exchange, The discount rate of delay of losses is more than the discount rate of speed up of losses.

Also, to investigate the Sign Effect in Tehran Stock Exchange, hypotheses 3 is proposed;

**Hypothesis 3:** In the Tehran Stock Exchange, The discount rate of delay of gains is more than the discount rate of delay of losses.

Furthermore, as we explained in the previous section, we expect the discount rate of Delay a gains for women to be higher than for men. Also, we expect the discount rate of Delay a loss for men to be higher

than for women. Therefore to investigate the Gender Effect in Tehran Stock Exchange, hypotheses 4 and 5 are proposed;

**Hypothesis 4:** In the Tehran Stock Exchange, the discount rate of delay gains for women is higher than the discount rate of delay gains for men.

**Hypothesis 5:** In the Tehran Stock Exchange, the discount rate of delay losses for women is less than the discount rate of delay losses for men.

Also, according to previous explanations, the difference in the loss aversion of men and women is

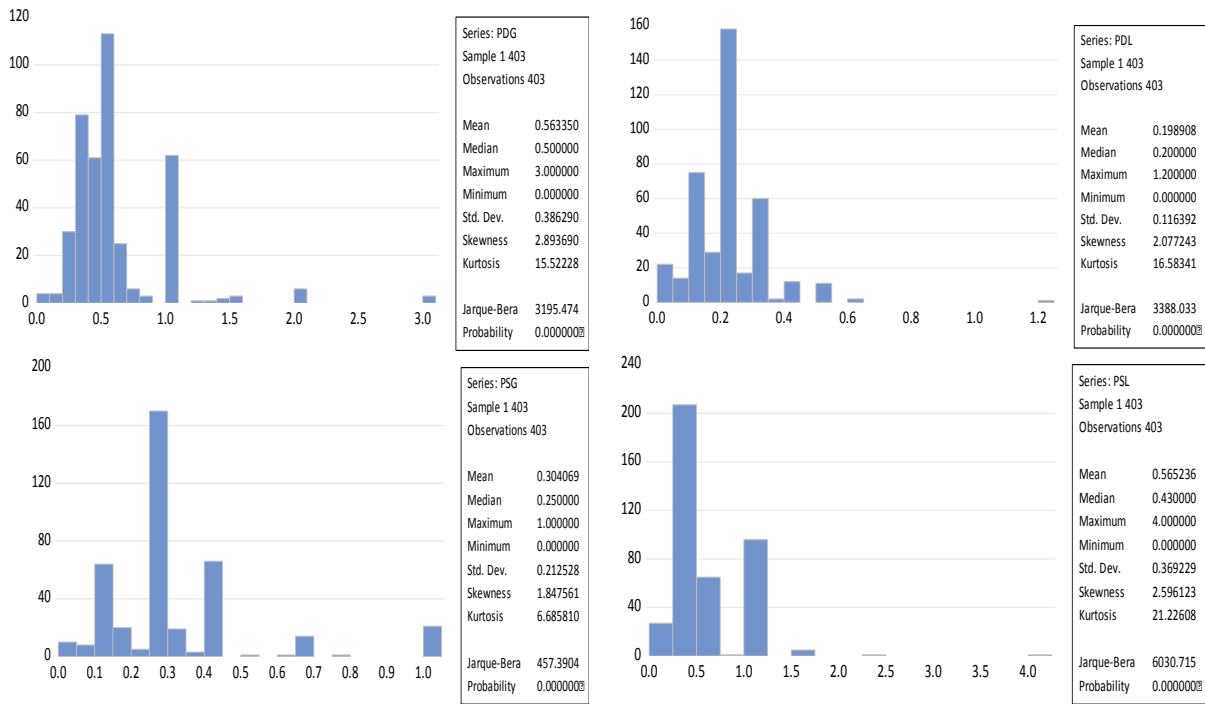
expected to explain the Gender Effect, so Hypothesis 7 is presented as follows;

**Hypothesis 7:** In the Tehran Stock Exchange, women have a higher loss aversion than men.

### 4. Results

To compare between discount rates and test the research hypotheses, we first examined the assumption of normal distribution of data, using Jarque-Bera and Kolmogorov-Smirnov tests. The Descriptive Statistics as follows (table 2);

**Table 2: Descriptive Statistics and Jarque-Bera test**



Given the Jarque-Bera probability value for all four rates that are less than 1% (0.0000), the assumption that the distribution of these data is normal is rejected, and with the 99% probability that the data distribution is not normal, so nonparametric tests are used to test hypotheses. The results of the Kolmogorov-Smirnov test (table 3) also show that the distribution of data is not normal (with the 99% probability);

**Table 3; Kolmogorov-Smirnov test**

Method	Value	Probability
Lilliefors (D) -PDG	*0.287217	0.0000
Lilliefors (D) - PDL	*0.230749	0.0000
Lilliefors (D) - PSG	*0.287756	0.0000
Lilliefors (D) - PSL	*0.221080	0.0000

\*Denotes significance at the  $p < 0.01$  level.



Given the probability statistic value is less than 1%, with a probability of 99% the distribution of all four discount rates is not normal. Therefore, the nonparametric method should be used.

### Test the first Hypothesis

**Hypothesis 1** *In the Tehran Stock Exchange, The discount rate of delay the gains is more than the discount rate of speed up the gains.*

The Wilcoxon test is used to test first hypothesis. The Wilcoxon signed-rank test is a non-parametric statistical hypothesis test used to compare two related samples, matched samples, or repeated measurements on a single sample to assess whether their population means ranks differ. The results of this test are as follows (table 4);

There is a significant difference between the two discount rates with respect to the Wilcoxon probability value of less than 1% (0.000) with 99% probability, and with the mean and median rank of PDG (delay of gains) are 524 and 287, respectively, and these values are larger than the average and median PSG (speedup of gains); There is delay-speedup asymmetry in the Tehran Stock Exchange with 99% probability. Then the null hypothesis ( $H_0$ ) is rejected and hypothesis of  $H_1$  with 99% probability accepted. In other words, the discount rate of the Delay a Gain is greater than the discount rate of the speedup of gain. The results of this part of the study are consistent with Tu (2004), Dimmock and Kownberg (2010), Lee and Veld-Merkoulova (2016) researches.

**Table 4; Wilcoxon signed-rank Test for hypothesis 1**

Method	Value	Probability
Wilcoxon/Mann-Whitney	*14.71884	0.0000
Wilcoxon/Mann-Whitney (tie-adj.)	*14.85077	0.0000

Category Statistics					
Variable	Count	Median	> Overall		
			Median	Mean Rank	Mean Score
PDG	403	0.500000	287	524.2047	0.483121
PSG	403	0.250000	107	282.7953	-0.482891
All	806	0.350000	394	403.5000	0.000115

\*Denotes significance at the  $p < 0.01$  level.

### Test the Hypothesis 2

**Hypothesis 2:** *In the Tehran Stock Exchange, The discount rate of delay of losses is more than the discount rate of speed up of losses.*

The Wilcoxon test is used to test this Hypothesis. The results of this test are as follows (table 5);

There is a significant difference between the two discount rates with respect to the Wilcoxon probability value of less than 1% (0.000) with 99% probability, and with the mean and median PDL (Delay a Loss) Are 247 and 88, respectively, and these values are smaller than the average and median PSL (Speedup a loss); There is Delay-Speedup asymmetry in losses in

the Tehran Stock Exchange with 99% probability. In other words, the discount rate of speed up of losses is greater than the discount rate of delaying losses, therefore the null hypothesis ( $H_0$ ) is rejected and hypothesis of  $H_1$  with 99% probability accepted. The findings of this section showed that there is a Delay-Speedup asymmetry in the loss zone (discount rate of Speed up is higher than discount rate of Delay a loss). This asymmetry is reverse to the profit zone (discount rate of Delay is higher than discount rate of Speedup). The results of this part of the study are consistent with Tu (2004), Dimmock and Kownberg (2010), Lee and Veld-Merkoulova (2016) researches.

**Table 5: Wilcoxon signed-rank Test for hypothesis 2**

Method	Value	Probability
Wilcoxon/Mann-Whitney	*19.01919	0.0000
Wilcoxon/Mann-Whitney (tie-adj.)	*19.15635	0.0000

Category Statistics					
Variable	Count	Median	> Overall		
			Median	Mean Rank	Mean Score
PDL	403	0.200000	88	247.5298	-0.621320
PSL	403	0.430000	296	559.4702	0.614870
All	806	0.250000	384	403.5000	-0.003225

\*Denotes significance at the  $p < 0.01$  level.

**Test the Hypothesis 3**

**Hypothesis 3:** *In the Tehran Stock Exchange, The discount rate of delay of gains is more than the discount rate of delay of losses.*

The Sign effect means that the discount rate of Gains is greater than the discount rate of Losses. And as it was said, the discount rate of gains is the delay of gains ( $p_{DG}$ ), and the discount rate of losses is the delay of losses ( $p_{DL}$ ). The sign effect means (Tu, 2004, p 14);

$$p_{DG} > p_{DL}$$

The results of the Wilcoxon test to test this hypothesis are as follows (table6);

There is a significant difference between the two discount rates with respect to the Wilcoxon probability value of less than 1% (0.000) with 99% probability, Given that the mean and median PDG ranks (571 and 297 respectively) are greater than the mean and median PDL ranks (235 and 28 respectively); there is Sign effect in Tehran stock exchange with 99% probability, Therefore discount rate of Gains is higher than discount rate losses, therefore the null hypothesis ( $H_0$ ) is rejected and hypothesis of  $H_1$  with 99% probability accepted. The results of this part of the study are consistent with Tu (2004), Dimmock and Kownberg (2010), Lee and Veld-Merkoulova (2016) researches.

**Table 6: Wilcoxon signed-rank Test for hypothesis 3**

Method	Value	Probability
Wilcoxon/Mann-Whitney	*20.51760	0.0000
Wilcoxon/Mann-Whitney (tie-adj.)	*20.71661	0.0000

Category Statistics					
Variable	Count	Median	> Overall		
			Median	Mean Rank	Mean Score
PDG	403	0.500000	297	571.7581	0.667190
PDL	403	0.200000	28	235.2419	-0.664135
All	806	0.300000	325	403.5000	0.001528

\*Denotes significance at the  $p < 0.01$  level.

**Test the fourth and fifth hypotheses.**

**Hypothesis 4:** In the Tehran Stock Exchange, the discount rate of delay gains for women is higher than the discount rate of delay gains for men.

**Hypothesis 5:** In the Tehran Stock Exchange, the discount rate of delay losses for women is less than the discount rate of delay losses for men.

To test these hypotheses, the Mann-Whitney test was used to compare mean ratings of discount rates for men and women. The results of the Mann-Whitney test to test fourth and fifth hypotheses are as follows (table 7);

**Table 7; Mann-Whitney test, test fifth and sixth hypotheses**

	Gender	count	median	Mean rank	Mean score	Test value	Probability
PDG	Women	109	46	241.08	0.270	*4.17	0.000
	Men	294	66	187.50	-0.104		
PDL	Women	109	16	174.47	-0.218	*2.99	0.0028
	Men	294	91	212.20	0.083		

\*Denotes significance at the  $p < 0.01$  level.

**discount rate of delay of gains ( $p_{DG}$ );** the probability value is smaller than 1 percent so we conclude that there is a significant difference between mean ranks of men and women, with 99% probability. And given the mean ranks for women is 241 and mean ranks for men is 187; we conclude that the discount rate of delay of gains for women is higher than men. Therefore in the hypothesis 4, the null hypothesis ( $H_0$ ) is rejected and hypothesis of  $H_1$  with 99% probability accepted.

**discount rate of delay of losses ( $p_{DL}$ );** the mean ranks for women is 174 and mean ranks for men is 212 and the probability is lower than 1 percent so we conclude with 99% probability; that there is a significant difference between mean ranks of men and women, so we conclude that discount rate of delay of losses for men is higher than women. Therefore in the fifth hypothesis, the null hypothesis ( $H_0$ ) is rejected and hypothesis of  $H_1$  with 99% probability accepted.

**The explanation of gender effect by loss aversion**

In this study, reference point equations were used to explain the effect of gender on the discount rate; according to equations (7-8-9 and 10), the two discount rates of delay and discount rates of losses are related to the loss aversion coefficient and the two discount rates of speedup of gains and speed of losses are not related to the loss aversion coefficient. In Equation (7), we will see an increase in the discount rate of delay of gains as the loss aversion coefficient increases and In Equation (10), we will see a decrease in the discount rate of delay of losses as the loss aversion coefficient increases; so if women have more

loss aversion than men, One can expect the discount rate of delay of gains (PDG) for women to be higher than men's; and discount rate of delay of losses (PDL) for men to be higher than women's. Now the question is whether women are more loss averse than men in this study? In this regard, we compare the median loss aversions of men and women and test the seventh hypothesis;

**Hypothesis 7:** In the Tehran Stock Exchange, women have a higher loss aversion coefficient than men.

In this study, after calculating discount ratios (in line with the previous description) using reference point equations (equation system including equations 7-8-9-10), we compute the loss coefficient of investors and use Mann-Whitney test (table 8);

The table results show that, the probability statistic value is less than 1%, so with a 99% probability there is a significant difference between men and women loss aversion coefficients and concerning the higher means ranks of loss aversion coefficients for women than men; we conclude that women are loss averse than men; Therefore in the sixth hypothesis, the null hypothesis ( $H_0$ ) is rejected and hypothesis of  $H_1$  with 99% probability accepted. The results of this part of the study are consistent with the result of Johnson et al (2006), Rau (2014) and Rieger et al (2014) researches.

Therefore, because women have a higher loss aversion, it can be expected that the discount rate of delay of gains (PDG) of women higher than men's and the discount rate of delay of losses (PDL) of men higher than women's.

**Table8; Test for Equality of Medians of LA**

Categorized by values of GENDER					
Method	Value		Probability		
Wilcoxon/Mann-Whitney	*2.851181		0.0044		
Wilcoxon/Mann-Whitney (tie-adj.)	*2.852038		0.0043		
Category Statistics					
GENDER	Count	Median	> Overall Median	Mean Rank	Mean Score
0	109	2.410000	63	229.1743	0.228015
1	294	2.025000	133	191.9252	-0.084424
All	403	2.210000	196	202.0000	8.18E-05

\*Denotes significance at the  $p < 0.01$  level.

## 5. Discussion and Conclusions

This research first investigates the asymmetry of Speed up - Delay for gains and losses and Sign Effect, then survey the effect of gender on the discount rate in Tehran Stock Exchange. The sample is 403 investors in Tehran Stock Exchange, and the Non-parametric tests are used to test the Hypothesizes. The result of this research shows that there is asymmetry of Speed up - Delay in the Tehran Stock Exchange for gains and losses, in other words; for gains, investors delay premium (discount rate) is larger than the speed up cost (discount rate) and for losses; the discount rate of speed up is larger than discount rate of delay. The result also shows that the discount rate of gains is greater than the discount rate of losses, therefore there is a Sign Effect in Tehran Stock Exchange. These anomalies are disagreeing with the traditional discount model predictions. In traditional discount models like DU, the discount rate is constant for speed up, delay also losses and gains.

This study also finds that gender is correlated with discount rates; women have a higher discount rate of Delay a Gain than men's and men have a higher discount rate of Delay a Loss than women's.

The explanation that can be given for this phenomenon is that for higher loss aversion for women than men and Considering the Dimmock and Kouwenberg (2010) equations for the delay a Gain, loss aversion has a direct relationship with the discount rate of delay a Gain, and according to the equation of

the delay a loss, there is an inverse relationship between the loss aversion of individuals and the discount rate for delay of losses.

The results of our study are consistent with previous studies and show that there is the asymmetry of Delay- speed up and Sign effect in Tehran Stock Exchange. The results also shows that the discount rate Delay a Gain for women is higher than men's and discount rate Delay a loss for women is less than men's; due to the greater loss aversions of women than men; Therefore, the Sign effect can be expected to be stronger in women.

The results of this study show that the discount rate of individuals in different situations is different due to the difference in loss aversion and is not the same as predicted by traditional models of discounted utility, so assuming the same discount rate for gains and losses and women and men can cause Valuation becomes unrealistic.

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#### Note

<sup>1</sup> DG refers to delay of gain, DL refers to delay of loss, SG refers to speed-up of gain, and SL refers to speed-up of loss.