Level-K Thinking, Level-K-Value Strategy and Herd Behaviour Bias in Financial Decision-Making

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ABSTRACT

The goal of the research is to analyse empirically if the financial decision-making is influenced by herd behaviour bias and if this bias is present during both bearish and bullish market trend, so if the investor act with the same Level-K thinking and herd behaviour bias, independently if the market is bearish or bullish.

Key words: Herd behaviour, decision making, Level-K thinking, Level-K-Value, loss aversion, prospect theory, disposition effect, bounded rationality, Keynesian beauty contest.

INTRODUCTION

According to Nagel (1985) Level-K theory assumes that players in strategic games base their decision-making process on their predictions about the likely actions of other players. In its basic form, level-K theory implies that each player believes that he or she is the most sophisticated person in the game (overconfidence). Players at some level-K will neglect the fact that other players could also be level-K, or even higher. This has been attributed to many factors, such as overconfidence (Stahl and Wilson,1995).

To better understand decision making process and behavioural bias consider a "guessing game", where everyone in a classroom picks a number between 0 and 100. The person closest to half the average wins. The logic of the game is similar to the Keynes's beauty contest, that is concept introduced by Keynes to explain price fluctuation in stock market, for this the "guessing game", sometimes is called beauty contest game in honour to Keynes.

If we think that the maximum average number chosen is 100, the half of the maximum average (100) is 50 and so no one of the players has interested to choose a number above of 50. So now that we know that the maximum average number that could be chosen is 50 no one of the players has interested to choose a number above of 25 (the half of the maximum average), but if the maximum average number chosen is 25, no one of the players has interested to choose a number above of 12.5 (the half of the maximum average) and if we attribute the same logic to other players, continuing this line of thought, picking any number other than zero would be not the rational solution of the game, where zero represent the Nash Equilibrium, where assuming other players remain constant in their strategies, the player has no incentive to change strategy.

Level-K thinking analyses such games and in actual experiments, players never pick 0, that represent the rational game's solution. Who thinks he is the player with the best strategy, get a value different than 0, because he does not think that the others can be of some level-K as he is (overconfidence). If we attribute lower level-K thinking to the others, the solution of the game is wrong, but if we assume the others are able to think the same strategy of us, than we improve the response strategy, if we assume the same level-K to the others player, we arrive to the equilibrium 0. Every strategy that the player thinks that other

players will use are only a limited frame to possible strategies, and this frame's hypothesis is bounded rationality and narrows the frame of the others player's choice to a number that is a bias due to our thinking strategies attributed to the other players.

Under decision making process the choice that a person makes is the best choice he can thinks, due to bounded rationality, otherwise if he can think a better option respect to the one that he has chosen, he would use this option in the final decision (Di Toro, 2022).

Simon (1982) has introduced the concept of bounded rationality in human rationality, the idea that rationality is limited when individuals make decisions because there are limits to our thinking capacity, available information, and time.

In behavioural finance consequently bounded rationality means that the strategies that a person can developed are limited, so human are not able to see more beyond its choice, so we think that the other players are less or the same level-K thinking type. This creates a bias in problem solving in decision making process, because we think that our strategy is the best one and we are not able to consider all possible strategies that other players can use (upper strategies level- K+), otherwise would use this upper hypothesize as frame to make the decisions (Di Toro, 2022). This involves a limitation in the choice, because our strategy can be optimal only in relation to our hypothesis of strategies of the other players and our decision-making process could be based on a wrong's hypothesis, because we cannot see out of our frame of strategy (bounded rationality).

In the guessing game the player who attribute everyone the same logical capacity comes to the conclusion that the rational solution is 0, but this scenario does not happen empirically and that is the empirical proof of the bounded rationality and overconfidence.

The value chosen in the guessing game decision making depends on the weighted (w) average of all the choices (k):

$w_0 k_o + w_1 k_1 + w_2 k_2 + w_3 k_3$ where w is the weight (the number of players with the same choice) and k is the number chosen by k-type player.

Under decision making process the guessing game is an empirical proof that most people use their logical capacity as the maximum frame and maximum achievable result and for this reason consequently they act without considering: 1) that other people can have the same logical capacity, and 2) that there are people with more logic capacity and 3) they could miss to calculate other variables. This could lead a wrong choice in the strategy due to the bounded rationality.

For example, I noticed that many people if they want to have a confidential information from the other person, they ask indirectly some questions, separated by lapse time, which does not seem to be related to the information that they want to have. With the aim to make this indirect question appear like if are not connected. This observation is a real-life example of wrong thinking Level-K strategy, these strategies are made by people who think that the other person is not able to follow them and that does not give the other person the same logical capacity, so consider the other person level-K type less than him leading a wrong strategy in decision-making process.

Another example could be that under decision making process during an auction, if we assume that the other players give to the good in auction less value than us, this involves underbidding and we could lose the auction. But if we consider the other players give to the good the same value of us, this can improve our bid and avoid underbidding. Conversely if we attribute high private value to the good in auction this could lead an overbidding strategy, but at least we could win the auction.

The "guessing game" and auction example highlight that whenever a decision maker put a frame to all possible strategies, we are already working with a suboptimal choice. The same happens when we have to solve a problem or making decision, whenever we

assume a strategy that will make others, this is just a hypothetical scenario that could occur, so it is a constraint and frame in finding the best strategy.

The choice 0 although rationally correct, does not coincide with the choice actually made by the players in the experiments, which means that players because of bounded rationality, they choose a number based on assumptions of others' choice and therefore the result depends how the assumptions on the others' behaviour were correct, in the "guess game" the player attribute less thinking ability to the other's and this lead a wrong decision respect to the rational game solution, that he could find if he had attributed to the other players the same logic ability (same level-K thinking). The same logic applies in finance with the stock decision making process.

In finance decision making to sell or purchase security, it is important to anticipate the behaviour of the other players, it is important to guess what the other think about the security (buy/sell) and no what we think in line with the Keynesian beauty contest.

Hypothesize other investor 's strategy is only a hypothesis made by the bias of our minds' frame, since we attribute to others decision-making skills based on our abilities to develop strategy: we cannot develop a strategy that we are not able to think due to the bounded rationality.

For example, if we are in pizzeria maybe we probably estimate that there is a number of people Level- k-0 more than if we are in a physics class at the university. The fact that we are in a pizzeria could be a bias in the frame of reference that alters our perception of capacity smart thinking of others, and then in the pizzeria there may be highly rational subjects even more than in a physics course to the university, but given the bias of the place we associate low-probability event. This is just an example to explain that when in decision making under uncertainty, we do not know others player's strategy, therefore our hypothesis is only the fruit of our frame's bias, bound rational,

subjective value, historical feedback, all variable that affect behaviour in finance and economics decision making process.

Choosing 0 in level-K game is the winning solution if all are rational, but as evidenced by the level- k model there are different levels of rationality, so the choice 0 might not result in a winning strategy, since the other players choose are irrational and the choice different than 0. Which implies that chose 0 does not assure a winning payoff if others are not rational due to the bias of the overconfidence and bounded rationality.

Conversely, in the Level- k strategy, beauty contest and guessing game like as in the stock market, the payoff of the strategy depends entirely on the choice of others, so we cannot find on the stock market the dominant strategy for a player, that is a strategy that produces the best payoff for that player regardless of the strategies employed by other players. In the stock market investors are correlate each other and no independent.

In the stock market assuming for simplicity total rationality of investors and assuming that our hypothesis on the other's choices to buy or sell is correct (market direction), there is one more variable that we cannot predict: the number of shares purchased or sold, so we cannot predict an equilibrium price on the stock market or a dominant strategy.

Conversely when the market is in steady phase, almost no trade, this phase in my opinion could be explained by the herd behaviour and regret avoidance and lead a temporary market's equilibrium due to the fact that each investor attribute to the other investor the same level-K thinking.

During the steady phase due to the upcoming release of macroeconomic data that could determinate a price jump there is a risk increase of the choice under uncertainty that could increase the regret sentiment bias and increase the loss aversion bias (negative market jump) no investors have advantage to change strategy and all investors think that the other investors being in the same situation (the same level-K type

) is waiting for external events totally independent, so in steady strategy scenario our level-K hypothesis of others strategy is accurate and this lead in my opinion a temporary market's equilibrium.

As anticipated above in the beauty contest strategy applied to the fluctuation price of the equity, the exact choice of a title is due to the exact assumptions of choice that others investor will do. Although the logic is similar to the Keynesian beauty contest, the scenario of the financial market, in my opinion, is more complicated, because is true that all investors do the choice based on the other's investor expectations on the future price of the stocks (similar to the logic of beauty contest), that is linked to the future expected earning and expected number of share's purchased and sold. Differently from the beauty contest, the financial market has also "buy" and "sell" strategies that have opposite effect on the price direction with no upper price limit. Furthermore, in the financial market new information bring new complexity and expected price equilibrium of the game or stock selection, instead no new information is present in the beauty contest game and the fact that new investors (new buyer) can enter in the stock market increase the number of player and consequently the uncertainty of decision-making process and the price will continue to move dynamically and unpredictable.

In my opinion the model level-K thinking could explain the herd behaviour in the stock market, because in the herd behaviour the investor follows the others strategy and like in the beauty contest level- K thinking, the decision maker choice in base to the expected other strategy, instead of to choose in base the owned believes on the stock market. In my opinion the herd behaviour could be thought a Level-K thinking strategy, where the investor (Level-K) attribute to the others investor (Level-K-1) high probability to continue or start a "buy strategy" and based on this thinking he decides to follow the herd and start to buy.

The same logic could apply in case of herd behaviour linked to "sell strategy".

The stock market price is linked to the action of others (Keynesian 's beauty contest) for this reason my "rational" explanation of the herd behaviour is that the investor act like in common auction: the bidder adjusts the bid taking in consideration the bid of the others. Since finance is a non-cooperative game, the payoff you get depends by the others' action and strategy.

The return of our portfolio depends on the choices of other investors (beauty contest) and this reduces our stock picking capacity, because if the market does not buy the securities that we consider to be good investments, the stock picking has no effect and should also be kept in mind that in the market is present asymmetric information that allow the insiders trader seek advantage.

If everyone did the same strategy of buy, herd behaviour, the consequence would be a price increase, the last buyer has the risk as for the highest bidder of an English auction that make the highest bid and are not able to sell later because nobody is willing to buy at a price considered too high.

The herd behaviour that follows a "buy" strategy is like a vicious circle that would push the price up more than value like an overbidding. Being finance a non-cooperative game, it is enough that some investor will stop buy the shares to make sure that the last buyer cannot resell at a higher price and then collect a loss, like an overbidding in auction. The model level-K thinking could explain the herd behaviour in the stock market, if we think that the other investors will do a buy strategy, so we could start to buy to anticipate the expected market trend and then as a chain hypothesis the other run the same strategy starting also to buy.

In my opinion the stock market is like an English auction, because anytime you have complete information on the current price and at the ending English auction the bids fluctuate with small increments and so the

gap between the highest bid and the second bid is very similar to the increase of the price of a share, where the increment is a continuous function as for the Brownian motion. Instead, when is present in the market a bullish trend, the investor that continues to follow the market showing herd behaviour, could be explained by the level-K thinking, if the investor (level-K) believes that that all the other investors (level-K-1) will continue to buy in the future.

In the stock market when the price reaches the fair value for the investors the price is almost stable and this trend in my opinion is like the final stage of an English auction where the bid is almost stable and they change in small increments to indicate that the goods, based on the private value attributed by the players, has reached almost its maximum selling price.

During normal liquidity market condition, the price fluctuation occurs with small increment and therefore the potential loss in the instant immediately after the purchase of the security (short time) is less than in case there is a new relevant information that would make the jump price very huge (i.e. stock price jump after an acquisition/default of one company).

Waiting strategy and consequent steady market before of the release of major market news (e.g. ECB interest, Federal Funds Rate, US Jobs Claim, mergers & acquisitions) could result in a market fear to take wrong direction respect to the potential jump of the market/stocks linked to new relevant information and consequently no investor has advantage to move before the other investor, maybe could be considered the market in this holding phase as temporary Nash equilibrium.

This steady phase involves that the market is calm and the price are relatively stable of the title, low trade, since no players can have a better payoff by changing his strategy alone and everyone is waiting for the relevant information and the other strategy are accurate because all the investor consider the others investor as same level-K thinking, and similar to what happen in the

"guess game" this behaviour increasing the strategy response of all the player and bring the market to the equilibrium.

This temporary equilibrium is due to the waiting phase for the release of new relevant news, which could lead to a jump of the price in the markets and so before the release of the new public information makes a choice becomes riskier.

In this contest the hypothesis of steady strategy is attributed to all others investor (level-k) and all investors made the same assumptions (same level-K type) so no one has an incentive to change the strategy: the market remains stationary around an equilibrium price with almost no trade in response to the expectation of the new relevant news. This equilibrium could be due to the fact that if we assume that all players are rational with the same level-K thinking ability and there is no asymmetric information and nobody have an advantage taking positions before the news are public, this lead also an implicit herd behaviour during the "waiting phase". Because a jump of stock price in the sense opposed to our position in the market could be riskier if we take a wrong directional position (buy instead of sell), respect to the normal liquid market, where the price varies with small increments without huge jump and then the risk would be lower. Furthermore, in this waiting phase, the investor risk is also amplified by the loss aversion bias, indeed the loss could be huge if the investor takes wrong directional position respect to the new information. In my opinion both loss aversion bias and level- K thinking could explain the investor holding position strategy before the release of the new information.

So, it is the expectation of the news to bring the market in momentary equilibrium, since this external event (new news) makes more predictable the other's strategy due to the Level-K thinking, that as consequence attribute herd behaviour and loss aversion bias to all the other investors.

In the steady scenario our level-K hypotheses of others strategy are accurate

and in my opinion this situation brings the market to a stationary and momentary Nash equilibrium.

In case of wrong bet on the market direction, before a waiting phase linked to the material news release, could be viewed as first-price sealed-bid auction, where there is no information of the other bids (future direction of the market) and this can lead a huge difference between the highest bid to pay and second-best bid. Conversely in case of right bet on the market direction, the investor payoff is equivalent to the best bid in the Vick auction. Both events bring a gain or loss to the investor in theory with the same probability, but if we consider the loss aversion and regret bias during the waiting phase, the investor want strongly to avoid the scenario of the overbidding first-price sealed-bid auction and for this reason has no incentive to enter in the market before the release of the new information. Before the release of the market news, if the investor hold already the stock, due the loss aversion and regret bias, wants to avoid to change the waiting holding strategy with the betting strategy on the direction of the market (buy more stock or selling the stock already owned) and consequently has no incentive to move far away from the momentary market price equilibrium, due to holding and wait strategy done by total investors. Indeed, during the waiting phase, using a wrong bet directional strategy on the stock market could lead to the same economic loss payoff of an overbidding in the first-price sealed-bid auction and increase the feeling of the emotional loss payoff linked to the loss aversion and regret bias.

Let's analyse the case that the investor already holds the stock before the market information release. Assuming a negative jump, we could think the price of the security that we hold during the steady phase equivalent to the best offer in the first-price sealed (e.g., 50) and the price after the negative jump as the second best offer in first auction (e.g.,100), then we have a negative payoff of 50 in both the case market and first-price. In the scenario of a negative jump of market who hold the security is like if they had done overbidding in first-price-auction resulting in a negative payoff.

While in case of the positive jump is more like a Vicky auction, where the highest bidder wins but the price paid is the second-highest bid. We could think the stock price that we hold in the steady phase as the second-best bid in Vicky auction, while the highest bid is equivalent to the stock price after the jump, the payoff is positive in both case stock market and Vicky auction. Who hold the title in the steady phase and the new news has led to a positive jump, has the payoff similar to those win the Vicky auction but pay the price of the second bidder. In the Vicky auction the payoff of highest winner bidder comes from its maximum bid (e.g.,150) minus the value that are willing to pay the second highest bid (e.g.,100), with a gain of 50. So, if the value of the security that the investor already hold during the steady phase is 100 and after the jump is increase to 150, the investor gets 50 as a payoff, the same payoff gets the winner bid on Vicky auction. The stock price could be considered as a proxy of the discounted expected cash flow of the stocks and the bid trade-off between the cost of higher bids (overbidding, stock price goes up) and the higher probability of winning (to buy the stocks).

In the stock market the lack of liquidity the implies an increase in stock price (overbidding, "cost" of higher bids) with embed high risk of potential future loss in the case in the future there will change in average choice of the investor (sell sentiment) or less expected cash flow and consequently the price could go down. Because the lack of liquidity brings the investor to overbid this behaviour may result in more potential risk of loss in case there will be a reversal price trend due to the bearish trend.

For example, in private auction, in which the private subjective value of the good is different than the other players, the

subjective evaluation (private or emotional value) of the property may explain the overbidding behaviour: greater desire to possess the good (high private or emotional value).

Indeed, in antiques auctions, due to the high private value, the good is valued higher than the economic value of the material itself, and if we assume that other people are also a collector (Level-K-thinking) and consequently they assign a high private value (Level- K-value), this could lead us an overbidding behaviour during the auction.

The researcher has introduced the Level- K-Value idea, that consider the private emotional value of the decision or strategy beside to the rational Level-K-thinking. Maybe if a person wants to decide if to change the country to find work, not only could consider a number of scenarios that can help the rational choice, as in the Level-K model you think rationally to all the possible other choices or scenario and then choose accordingly, but in addition to this rational scenarios (Level-K), should be considered also the subjective emotional 's value (Level-K-Value) or private value.

This concept of economic and private value in the payoff of decision has been called Emotional Adjusted Value in the relative rationality theory that I have developed (Di Toro, 2022). According to the relative rationality theory, during the decision making should be not only estimated the probability of the economic payoff using rational strategy (Level-K- Thinking), but also should be assigned to each Level- K strategy a private subjective "emotional" value payoff (Level-K-Value), due to the subjective value of the personal choice, the emotional bias, the feedback, the own experience.

The concept of relative rationality may explain the irrational behaviour is we consider under decision making process both economic payoff (rationality) and the subjective emotional payoff of the choice (relative rationality), we get the real personal payoff of the choice that has been named emotional adjusted value. For example, for the decision to emigrate abroad, we should consider not only the probability of to find work in other Country and the relative salary (economic payoff), but also take into account the emotional payoff, that represent the private value of the choice considering both subjective "emotional cost" and "emotional revenues" of the choice (Di Toro, 2022). The same logic is applied in stock market where our company's assessment value is the result of our hypothesis on the other's investor company' s assessment value (beauty contest - Level-K thinking) that lead a bias due to the bounded rationality, but there is also a subjective bias due to the intrinsic private value associated to the company, such as the bias of publicity, size effect, good management, past performance, that could make us overweighted the subjective perceived value of the company (Level K-Value) and consequently our decision making process. According to the author and following the relative rationality theory, at every Level-K expected payoff should be also assigned a Level-K-Value, to consider not only the others strategy or economic payoff, but also consider their private "emotional" value of the strategy and payoff. So, with traditional Level-K you develop your rational strategy based on your expectation of the others strategy or payoff, with the introduction of the Level-K-Value, beside the potential economic and rational strategies of the players, should be also considered their "emotional" subjective value attribute to the Level-K' strategy. Hence, the Level-K-Value is a type of thinking strategy that consider both economic and emotional payoff of the strategy, so the strategy 's choice could be not perfectly rational because is influenced also by the emotional value of the strategy, in line with the relative rational theory for this thinking strategy could be also called Level-K-Emotional-Adjusted-Value.

PRESENTATION OF RESULTS
The goal of the research questions is analysing empirically if decision making is

influenced by herd behaviour bias and if this bias is consistent during the bearish and bullish market, so if the investor act with the same Level-K thinking strategy independently if is gaining or losing money. For each research question is present a table to represent the sample's answer.

The table shows the number of the sample that has participated and is showed the percentage's answer type. The survey has been conducted with a web-based survey thorough Likert-type survey using closing question. Is present a statistical result table that contain the standard deviation, average score, Z-score, p-value and the result of the test if the null hypothesis is rejected or not.

The research question is: the herd behaviour bias influences decision making?

a) Null Hypothesis (Ho): would state that there is no impact of herd behaviour bias on decision making.

b) Alternative Hypothesis (H₁): There is significant impact of herd behaviour bias on decision making.

Below is analysed the sub-question number 1 relative to the research question.

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1. Assuming that you need to do an investment would you prefer to invest in 10 companies that are already in the portfolio of the top bank and top fund investment managers or would you rather self-choose (stock picking) 10 companies which none of the big funds or banks invests. Do you prefer to invest in the companies that are already in the portfolio of the top bank/fund managers, rather than personally choose the company?

a) Null Hypothesis (1Ho): would state that there is no impact of herd behaviour bias on decision making. You prefer personally to choose the company.

b) Alternative Hypothesis (1H₁): There is significant impact of herd behaviour bias on decision making. You prefer to invest in the companies that are already in the portfolio of the top bank/fund managers, rather than personally choose the company

The reason behind this research question is to investigate the potential herd behaviour respect to the alternative behaviour of individual stock picking. The following tables show the answer and statistic result of the empirical research question.

Table 1 Answer Choices Sub-Question 1

Answer Choices	Responses %	Responses
Strongly disagree	1,45%	6
Disagree	13,25%	55
Neither agree nor disagree	40,24%	167
Agree	41,45%	172
Strongly agree	8,92%	37
Total	100%	415

Table 2 Statistical Results Sub-Question 1

Standard Deviation	Average Score	Z-score value	Reject null hypothesis? If Z score > 1,645	p value	Reject null hypothesis? If p-value < 5%
1,25	3,6	9,778	Yes	0,00%	Yes

Z-score is higher than the one-side Z-score critical value 1.645 for 95% confidence level and the p-value is less of .05 significance level, the null hypothesis is rejected. The empirical research supports the alternative hypothesis that the investor prefers to invest in the companies that are already in the portfolio of the top bank/fund managers, rather than personally choose the company. There is significant impact of herd behaviour and consequently the decision maker utilize indirectly a level-K strategy and beauty contest approach, because give more importance to the investment view of the banks and investment fund, rather than the owner investment view. The decision could be explained also considering the emotional impact of the regret bias because of the fear associated a wrong decision.

Herd instinct in finance is the phenomenon where investors follow what they perceive other investors are doing rather than their own analysis. Wrong stock picking could also make a regret bias associated with wrong individual analysis respect to follow the herd and consequently in case of wrong

stock picking the regret feelings is amplified the loss aversion sentiment.

Below is analysed the sub-question number 2 relative to the research question.

2. The equity stock market starts to lose 10% in 1 day. Do you will follow the market and sell your stock?

a) Null Hypothesis (2Ho): would state that during bearish market there is significant impact of herd behaviour bias on decision making. You prefer to follow the market and sell your stock. Herd behaviour during bearish market.

b) Alternative Hypothesis (2H1): during a bearish market there is no impact of herd behaviour bias on decision making. You prefer to do not follow the market and keep your stock. No Herd behaviour during bearish market.

The reason behind this research question is to shows that the investor has no herd behaviour during a bearish market, so if is losing money the loss aversion united with the regret bias dominates the herd behaviour bias.

The following tables show the answer and statistic result of the empirical research question.

Table 1 Answer choices Sub-Question 2

Answer Choices	Responses %	Responses
Strongly disagree	12,84%	14
Disagree	17,43%	19
Neither agree nor disagree	50,46%	55
Agree	11,01%	12
Strongly agree	8,26%	9
Total	100%	415

Table 2 Statistical Results Sub-Question 2

Standard Deviation	Average Score	Z-score value	Reject null hypothesis? If Z score < -1,28	p value	Reject null hypothesis? If p-value < 10%
1,06	2,8	-1,970	Yes	2,44%	Yes

Z-score is lesser than the one-side Z-score critical value -1.28 for 90% confidence level and the p-value is less of .10 significance level, we reject the null hypothesis. The

empirical research supports the alternative hypothesis that during a bearish market there is no impact of herd behaviour bias on decision making. Investor do not follow the market and keep their stock, so there is no herd behaviour bias during bearish market. The investor is focused on his loss feeling that will lead to continue to hold the stock, instead of to apply the rational strategy of cut the loss. The investor hope that there will be a reversal price trend so the "relative rationality" of the decision maker could be explained using the Level-K-Value, where the emotional bias (loss aversion and regret) changes the investor prediction on the strategy of the other investors, so the decision maker due the emotional bias predicts that the other investors will change strategy and will start to buy instead of to continue to sell.

During a bear market the investor is losing money and due to the loss aversion and regret bias do not show herd behaviour bias. Due to the loss aversion and the high pain attribute to the loss, the investor prefers to do not follow the market selling the stock but prefer to keep holding the stock showing a risk seeking behaviour, because the stock could further loss value.

The loss aversion could emphasize the pain associated to the regret sentiment, that is the reluctance to admit that wrong investment decision was made and so the investor will keep the stock during a bear trend to avoid loss and regret. In order to avoid loss and feeling regret the investor makes emotional, rather than logical decisions, so Level-K-Value thinking apply during the bearish market.

During a bearish market, the research test confirms the disposition effect, so keeping to long the losing stock due to loss aversion and regret bias.

To summarize during a bearish market to avoid that the investor regrets his previous acquisition decision keep the stock hoping that will increase the value later. During the bearish market another factor to consider is the emotional impact of the loss aversion, that is the tendency to prefer avoiding losses

to acquiring equivalent gains, for this the investor continue to keep the losing stock.

Below is analysed the sub-question number 3 relative to the research question.

3. If the equity stock market starts to gain 10% in 1 day. Do you will follow the market and start to buy equity stock?

a) Null Hypothesis (3Ho): would state that during a bullish market there is no impact of herd behaviour bias and level-K thinking on decision making. Investors prefer to do not follow the market and do not buy stock.

b) Alternative Hypothesis (3H₁): during a bullish market there is significant impact of herd behaviour bias and level-K thinking on decision making. Investors prefer to follow the market and start to buy stock.

The reason behind this research question is to investigate if the investor has herd behaviour bias and level-K thinking during a bullish market, and so asymmetric behaviour respect to the bearish market. The following figure and tables show the answer and statistic result of the empirical research question.

Table 3 Answer Choices Sub-Question 3

Answer Choices	Responses %	Responses
Strongly disagree	6,42%	7
Disagree	9,17%	10
Neither agree nor disagree	44,95%	49
Agree	33,94%	37
Strongly agree	5,50%	6
Total	100%	415

Table 4 Statistical Results Sub-Question 3

Standard Deviation	Average Score	Z-score value	Reject null hypothesis? If Z score > 1,28	p value	Reject null hypothesis? If p-value < 10%
0,93	3,2	2,245	Yes	1,24%	Yes

Z-score is higher than the one-side Z-score critical value 1.28 for 90% confidence level and the p-value is less of .10 significance level, the null hypothesis is rejected. The empirical research supports the alternative hypothesis that during a bullish market there is a significant impact of herd behaviour bias and Level-K thinking on decision making and the investors prefer to follow the market and start to buy stock, showing herd behaviour (instinct emotional bias) or the investor could also use a Level-K thinking strategy during uptrend market. Investors decide to follow the market and the decision could be predictable, because the decision is affected from the other players (herd behaviour and Level-K strategy). Under decision making under uncertainty, according to the empirical result, we could expect that during a bull market the investors are willing to follow the market and start to buy the stock.

If the investor does not hold yet the stock, we could affirm that the economic agent, during a bull market, act as a Keynesian beauty contest (Level-K thinking), where is more important to guess which is the expectation and strategy (buy/sell) of the others than our market's expectation. For this reason, during a bullish market maybe the investors could decide to follow the market not only due to the herd instinct behaviour, but could also start to buy following a rational level-K strategy decision-making process, based on the observation of the actual market trend that influence the investor prediction about the likely that others player will continue to "buy".

During a bull market, because the trend is positive the investor starts to buy showing herd behaviour, opposite behaviour respect to the bearish market where there is no herd behaviour due to loss aversion bias.

The empirical test has provided asymmetric behaviour of the investor, due to loss aversion and regret bias there is no herd behaviour during the bearish market, conversely with bull market there is a herd behaviour of to follow the market.

The asymmetric market behaviour proof that within the investor's mind the gain and loss are treated differently and a further proof of the loss aversion theory.

Below is analysed the sub-question number 4 relative to the research question.

4. If the market starts to panic and other investors start to sell the stocks (equity shares). Do you will also sell your stock?

a) Null Hypothesis (4Ho) would state that during bearish market there is significant impact of herd behaviour bias on decision making. You prefer to follow the market and sell your stock. Herd behaviour during bearish market.

b) Alternative Hypothesis (4H$_1$): during a bearish market there is no impact of herd behaviour bias on decision making. You prefer to do not follow the market and keep your stock. No Herd behaviour during bearish market.

The following tables show the answer and statistic result of the empirical research question.

Table 5 Answer Choices Sub-Question 4

Answer Choices	Responses %	Responses
Strongly disagree	12,77%	53
Disagree	26,51%	110
Neither agree nor disagree	38,80%	161
Agree	16,87%	70
Strongly agree	5,06%	21
Total	100%	415

Table 6 Statistical Results Sub-Question 4

Standard Deviation	Average Score	Z-score value	Reject null hypothesis? If Z score < - 1,645	p value	Reject null hypothesis? If p-value < 5%
1,04	2,7	-5,873	Yes	0,00%	Yes

Z-score is lesser than the one-side Z-score critical value - 1.645 for 95% confidence level and the p-value is less of .05 significance level, the null hypothesis is rejected. The empirical research supports the alternative hypothesis that during a bearish market there is no impact of herd behaviour bias on decision making. Investor do not follow the market and keep their stock, so there is no herd behaviour bias during bearish market. Therefore, due to loss aversion and regret bias a Level-K-Value strategy applies during the bearish market. The research question gives the same empirical result of the research sub-question 2. During a bearish market, due to the loss aversion and regret bias, there is no herd behaviour and the investor due to the emotional bias (Level-K-Value) change the expected others strategy (predicts "buy" instead of "sell" for the future). Furthermore, is confirmed the disposition effect (keep losing stock) during downward market trend.

SUMMARY OF RESULTS

The research empirically prove that the decision making is influenced by herd behaviour bias and Level-K strategy during a bull market, conversely during a bear market trend the investor act without herd behaviour but with Level-K-Value strategy, showing inconsistence of human behaviour in managing gain and loss. According to the research findings is confirmed the disposition effect with bearish market.

The sub-question number 1 supports the alternative hypothesis that the investor prefers to invest in the companies that are already in the portfolio of the top bank-fund managers, rather than personally choose the company. There is significant impact of herd behaviour and consequently utilize indirectly a level-K strategy approach, because give more importance to the other strategy (banks and investment fund), rather than the owner strategy.

Another explanation could be the regret bias of the investor that prefer do not bear the risk of the stock picking, and so regret to have chosen the wrong stock.

The empirical research number 2 show that the investor does not follow the market and keep their stock, so there is no herd behaviour bias during bearish market, but he follows a Level-K-Value strategy thinking.

The behavioural explanation to keep holding a not performing stock could be linked to the loss aversion bias and regret bias.

During a bearish market, the research test confirms the disposition effect, so keeping to long the losing stock and loss aversion.

The sub-question number 3 results support the alternative hypothesis that during a

bullish market there is a significant impact of herd behaviour bias on decision making and the investors prefer to follow the market and start to buy stock, showing herd behaviour (instinct), but could also use a Level- K strategy (rational) during uptrend market. The empirical test has provided asymmetric behaviour of the investor when the market is bearish (no herd behaviour) respect to a bull market (herd behaviour). This is an inconsistence asymmetric behaviour, the explanation could be the loss aversion and regret bias experienced during the bearish market.

The sub-question 4 gives the same empirical result of the research question 2. During a downward market trend, loss aversion and the regret sentiment are stronger bias than the herd behaviour.

According to the research finding of the Kahneman and Tversky (1979) the losses have a greater emotional impact than a gain of the same amount, this theory is noted with the name prospect theory. so known as the.

Based on results from controlled studies of Kahneman and Tversky, loss aversion shows how individuals assess their loss and gain perspectives in an asymmetric manner.

This empirical research confirms the existence of loss aversion behaviour and confirms the disposition effect with bearish market, keeping asset that have drop in value.

Indeed, another bias that the research has confirmed is the existence of the herd behaviour during a bullish market, but conversely the research's result has shown no herd behaviour for the investor during a bear market.

To summarize the empirical research has showed the following behavioural bias:

- no herd behaviour during a bearish market,
- disposition effect with bearish market,
- hold asset during bearish market,
- Level-K-Value strategy thinking with bearish market, emotion is incorporated in the choice,
- Herd behaviour during a bullish market,

- Possible rational Level-K strategy thinking during a bullish market,
- during bullish market the investor has asymmetric behaviour respect to the bearish market.

Herd behavior (instinct) and Level-K thinking strategy (rational) apply to the bull market trend, but during a bearish market the choice is influenced by the emotional factor of loss aversion and regret bias and lead a Level-K-Value thinking strategy (relatively rational) and no herd behavior, loss aversion is stronger than the herd emotional behavior.

Beside the human instinct and emotional explanation of the herd behaviour to follow the crowd, with which the author agrees, the researcher tries also to analyse the herd behaviour in finance as fruit of potential Level-K thinking strategy, where the investor is rational and the decision making is line with the Keynesian beauty contest, where is more important to guess other strategies than follow our own investment idea. So, the herd behaviour to follow the market, could be also considered as special beauty contest strategy where the investor, based on the observation of the actual market trend, assumes that all other investors will continue the "buy" strategy and based on this prediction become rational to use a "buy" strategy and follow the crowd. So, the herd behaviour could be also explained by the rational Level-K thinking strategy, instead of by the emotional instinct explanation. The same logic applies with the "sell" strategy. The herd behaviour strategy could be considered as the essence of the Keynesian beauty contest logic, where is more important to guess and follow the average others strategy, that to act uncorrelated to the others, giving space for a Level-K thinking strategy as rational explanation of to follow the crowd, but using Level-K strategy the herd behaviour become rational and not due to the instinct. So, the herd behaviour and the beauty contest (Level-K Thinking), are conceptually equal (follow the others), but with different roots (instinct vs rational

behaviour) and at least for the bull market they bring to the same strategy of to follow the market, as showed during the research. Consequently, the strategy to follow the market could be due to the herd "instinct" behaviour or could be due to the "rational" Level-K Thinking (Keynesian beauty contest).

The research has shown that during the bearish market is not present herd behavior. One theoretical explanation could be that the investor is "blinded" by the loss and regret bias and do not follow the crowd. The decision of no herd behavior is moved by the loss aversion and regret emotional factor, but the logic explanation could be that the investor hopes that there will be a reversal price trend and the stock will recovery value. So, applying the Level-K thinking the investor, biased by his emotion, predicts that the other players will change the actual "sell" strategy and they will start to "buy" pushing up the price and the loss will be recovered. When the market is bearish the emotional factor changes the decision maker expectation of the others investor strategy, this could be considered a Level-K-Value strategy, where the rational "unbiased" economic strategy is influenced by the emotional factor. During a bearish market, could happen that the (Level-K) unbiased expectation of the others strategy, including the associated probability, is influenced by the emotional factor and brings the investor to think that other players will change the strategy from buy to sell (Level-K-Value), so the expectation is now biased by the emotional factor (Di Toro, 2022).

During a bearish market, the investor strategy could be also based on the expected strategy of the others, in line with the Keynesian beauty contest and Level-K thinking, but due the loss aversion and regret bias, the investor instead of to draw the expectation (probability) looking rationally at the actual "sell" market trend, now due to the emotional factor, he expects that the other investors will make a "buy" strategy and this could explain the relative rationality of keeping the stock during a bearish market.

 The investor emotional bias during a bearish market could change the unbiased expected strategy of the other investors and the hold strategy could be explained by the relative rationality theory (Di Toro, 2022).

So, the regret and loss aversion change the rational expectation of the Level-K thinking that becomes a Level-K Value strategy, where the expectation of the others investor strategies (level-K thinking) is influenced also by the emotional value of the strategy (Level-K-Value) in line with the relative rationality theory and for this could be also called Level-K-Emotional-Adjusted-Value.

Hence, Level-K-Value consider both economic and emotional payoff of the strategy and thanks to the Level-K-Value thinking could be "relatively rational" to continue bear the loss and hold the stock during a bearish market, due to the fact that the loss aversion and regret bias indirectly create an emotional bias on the expectation on the other players strategies and bring the investor to thinks that the other investors will change strategies and will start to buy instead of to sell.

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