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Asymmetric Volatility Bias and Loss Aversion in Investment Decision-Making

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ABSTRACT

The goal of the research is to investigate if the investor considers the volatility as asymmetric. The researcher as called this behaviour asymmetric volatility bias, because in the mind of the investor the volatility is associated only to the risk, without consider the potential benefit of the volatility during an upward trending market. The research aims to investigate if the asymmetric volatility bias is a confirmation of the existence of the loss aversion bias.

Key words: Asymmetric volatility bias, volatility, loss aversion, prospect theory.

INTRODUCTION

The research question has the goal to investigate if the asymmetric volatility bias really exists within the investor's mind and consequently the downside volatility is more weighted than the upper side volatility and this could be explained through loss aversion of the investor, where according to the loss aversion theory, the investor has greater aversion to losses than gains (Kahneman and Tversky, 1979).

PRESENTATION OF RESULTS

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 investor considers the volatility as asymmetric?

Where, within the researcher view, the asymmetric volatility means that within the investor mind high volatility is considered as a measurement of the risk only, without consider the potential volatility benefit for upwards market trend.

a) Null Hypothesis (Ho): would state that the investors do not consider the volatility as a measurement of the risk only but consider the potential benefit of the volatility for upwards market trend also. Symmetric volatility and risk seeking investor.
b) Alternative Hypothesis (H_1): the investors consider the volatility as a measurement of the risk only, without consider the potential benefit for upwards market trend. Asymmetric volatility and risk averse investor.

The research question has the goal to investigate if within the investor mind high volatility is considered as a measurement of the risk only, without consider the potential volatility benefit for upwards market trend.

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

1. Assuming that stock A is on the efficient frontier curve, but stock B are not on the efficient frontier curve, but both stocks have the same expected return, but different volatility. (So, the stocks lie on the same line respect to the return, but with different volatility). Stock A with expected return +10%, volatility 10% and Stock B expected

return 10%, volatility 40%. Assuming you have to buy only one stock, would you prefer to buy stock A instead of stock B?

a) Null Hypothesis (1Ho): would state that the investor is risk seeking and consider the volatility as symmetric.
b) Alternative Hypothesis ($1H_1$): the investor is risk averse and considers the volatility as asymmetric.

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	3,37%	14
Disagree	12,53%	52
Neither agree nor disagree	33,01%	137
Agree	39,04%	162
Strongly agree	12,05%	20
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%
0,97	3,4	8,401	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 considers the volatility as asymmetric, so the investors consider the volatility as a measurement of the risk only, without consider the potential benefit for upwards market trend, showing a volatility asymmetric bias and a risk averse behavior.

In both Economics and Finance, risk aversion is the tendency of people to choose outcomes with low uncertainty over high uncertainty outcome (prefer certainty over uncertainty), even if the monetary expected value of the uncertainty outcome is equal to or even higher than the expected value of the more certain outcome.

The research result show that the investor is risk averse, because investors choose the title A with less volatility. Indeed, risk averse investor will choose always stock with low volatility and low probability to have extreme negative result.

In psychology risk aversion is a preference for a sure outcome over a gamble with higher or equal expected value.

Risk aversion is exhibited when lower standard deviation is preferred to higher standard deviation and investor chooses the preservation of capital over the potential for a higher-than-average return.

Even if in the finance theory the two concepts of risk averse and loss averse are considered separate, according to the researcher view, the fact that the investor is risk averse, hence avoid risk at the expense of a potential higher-than-average return, so choose less volatility and has a first goal to preserve the capital and do not lose money, it means indirectly that to avoid loss is better than have gain, so risk aversion is an indirectly proof of loss aversion. Because the risk averse investors prefer to keep is wealth, so is concern more of the downside volatility than the upper volatility and is more concern of the bearish market than the bullish market, hence in the investor mind, the loss have more impact than the gain.

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

2. Assuming that stock A and B are both on the efficient frontier curve. The efficient frontier is the set of optimal portfolios that offer the highest expected return for a defined level of risk or the lowest risk for a given level of expected return. Stock A with expected return + 20% and volatility 15% and Stock B with expected return +30% and with higher volatility of 25%. Assuming you have to buy only one stock, would you prefer to buy stock A instead of stock B?

a) Null Hypothesis (2Ho): would state that the investor is risk seeking and consider the volatility as symmetric.
b) Alternative Hypothesis ($2H_1$): the investor is risk averse and considers the volatility as asymmetric.

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

Table 3 Answer Choices Sub-Question 2

Answer Choices	Responses %	Responses
Strongly disagree	1,45%	6
Disagree	18,55%	77
Neither agree nor disagree	35,18%	146
Agree	36,14%	150
Strongly agree	8,67%	36
Total	100%	415

Table 4 Statistical Results Sub-Question 2

Standard Deviation	Average Score	Z -score value	Reject null hypothesis? If Z score > 1,645	p value	Reject null hypothesis? If p-value < 5%
0,92	3,3	6,643	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 is risk averse and considers the volatility as asymmetric. According to the researcher definition asymmetric volatility means that volatility is considered as a measurement of the risk only, without consider the potential benefit for upwards market trend.

Conversely, high volatility with a bullish market can be also favourable to the investment, but risk averse consider only the downside volatility effect.

In theory risk averse investor can accept extra risk, more volatility, in exchange of higher return. The efficient frontier curve is based on the risk-return trade off, investor can have higher return only if is willing to accept higher volatility. The efficient frontier is built on assumptions that may not accurately portray realistic situations. For example, it assumes that all investors think rationally and avoid risks (risk aversion). According to modern portfolio theory degrees of risk aversion are defined by the additional margin return an investor need to accept more risk.

In line with modern portfolio theory the title B has high expected return and high risk, instead stock A has less risk and less expected return. Due to the fact that both stocks are on the efficient frontier both titles maximize the risk-return trade-off, for this reason the investor should be indifferent to choose A or B, but the empirical test show that investor choose A and so is risk averse.

The possible explanation could be loss aversion bias associated with the volatility. Indeed, even if the stocks are equivalent under the modern portfolio theory in terms of risk-return trade-off (efficient frontier), the investor choose the stock with less volatility, so indirectly means that he always prefers the scenario with the lowest potential loss (risk averse) and so indirectly means that the loss have more impact than the gain (loss aversion).

Indeed, buy stock A it means to have less potential higher loss and gain respect to stock B. Conversely, stock B, thanks to the higher volatility, has greater probability than A to get extreme higher loss and gain.

In my view choosing title with low volatility and lower probability of extreme low return (risk averse), is another example to remark people's tendency to strongly prefer avoiding losses to acquiring gains in line with the loss aversion theory. If we consider the 5% percentile of the expected return distribution of the stock A and B the expected return is respectively -4.7% and -11.1% so choosing stock A the investor could lose 6,45% lesser than B. Instead, if we consider the 95% percentile of the expected return distribution of the stock A and B, the expected return is respectively 44.7% and 71.1% so choosing stock B the investor could gain more than 26,45% respect to A. We can say that choosing A the investor prefers do not lose extra 6.45% in case of negative scenario, than choosing B and win an extra 26,45% in case of positive scenario. In other words, in the investor mind and feeling, to reduce the potential extra loss of 6.45% is judged more

important than the potential extra gain of 26.45% and this is indirect proof of loss aversion.

Let's assume a normal distribution of the return and applying the empirical rule that state that 68% of data are within the first standard deviation, 95% of all the data will fall within two standard deviations and 99.7% falls within three standard deviations, we can calculate the cumulative distribution function that is the probability that random variable values is less than or equal to x.

Table 5 Cumulative Distribution Function

Stock	Expected Return <= - 80%	Expected Return <= -20%	Expected Return <= 0%	Expected Return 0%-50%	Expected Return 50%-80%	Expected Return > 80%
Probability of stock A	0%	0,38%	9%	89%	2%	0%
Probability of stock B	0,001%	2%	12%	67%	19%	2%

Choosing stock, A there is less probability of incur in loss (9% vs 12%) so is the preferred choice for risk averse, instead risk seeking investor could choose stock B with higher expected negative return respect to stock A, but with higher potential extra return great than 50% and 80%. Risk seeking investor accept greater risk in exchange for potential higher return. Nevertheless, the risk seeking can be view as a loss aversion behaviour also.

Indeed, if we consider the above example of stock B with higher volatility, the risk seeking investors are willing to exchange 2% of probability to gain more than 80% (top right-side of distribution, 98th percentile), with the 2% (bottom side of distribution, 2nd percentile) of probability to lose more than – 20%.

Therefore, a parity of 2% probability of better and worst scenario, to lose more of 20% the investor needs to be compensated with a gain more than 80%.

Consequently, in the mind of the investor a loss of 20 EUR needs to be compensated with a gain of 80 EUR, the monetary loss is weighted more than the gain (20 EUR vs 80 EUR, loss aversion), because risk seeking investors are willing to lose more than 20% only if they can gain more than 80%, with the same probability. Or in other words a parity of the same amount of expected return (+80% vs – 80%) the investor is willing to get a return higher than 80% with a probability of 2%, but at the same time, we are willing to get return lower than -80% with probability 0.001% only. So, we can gain more than 80% with 2% of probability and lose more -80% with 0.001% probability, hence we weight loss more than gain, because we are willing to lose huge amount (-80%) only if we are compensated to have more probability to gain the same huge amount (+80%). Therefore, can be interpreted as exchange 0.001% of -80% loss with 2% of 80% gain. The investor is willing to bear a huge lost with low probability only if is compensate with higher probability to have huge gain. For example, we are willing to risk losing 80 EUR with probability of 0.001%, but we want to be compensated with higher probability (2%) of win 80 EUR, so investor weight loss more than gain also if is risk seeking. For this reason, loss averse is different concept than risk aversion, indeed also risk seeking investor is loss averse.

In my view, when the investor decides to invest is because the expected return is positive, so assuming normal distribution the expected mean is on the right-side respect to the zero and consequently there is higher probability to have positive return than negative return and this is another indirect proof that in theory all investors have greater aversion to losses than gains. So, to the potential risk of lose money they want to be compensate with more probability of gain. For example, for the above stock A and B there is respectively a 91% and 88% probability of positive return and only 9% and 12% probability of negative return, so in the potential loss should be compensate by higher probability of gain.

Indeed, assuming normal distribution and considering the fact that investor decide to invest only when the expected return is positive, so on the left side of the expected return there are both positive and negative number (e.g. 20% expected return, from 0 to 20% are on the left side of the normal

distribution, but still positive), and on the right side of the expected return are all positive number, it means than more than 50% of the expected return are positive, hence the probability of positive expected return is higher than the probability of negative expected return. Therefore, all the investors make the investment with the hope to get positive return and consequently indirectly weighting more the loss than the gain, because is willing to risk losing money only if are compensated to higher probability of gain, so the loss must be counterbalanced to higher probability of gain. In my opinion, if the investor consider that the investment has positive expected return, this could be considered also a mathematic explanation of the loss aversion bias. No investor will buy a stock that has a negative expected return other hand he should expect to lose money, so the investor always chose investment that have positive expected return (good past performance) and indirectly confirms the loss aversion bias. If we consider a new investment in a start-up without track performance history, due the fact that in theory the loss and gain should be happen with the same probability the expected value of the return should be zero. But in reality the investor if decide to invest in the start-up it means that his subjective expected return is positive, other hand will not invest (risk of losing money and expected return zero) and this positive expectation could be considered an emotional bias linked to the investor positive attitude and beliefs and let the investor to invest and consider the expected value positive instead of zero for a new investment without tracking records.

Hence, due to the positive expected return of the investment, in theory the investors have a more than 50% probability to have gain respect to the loss, it means that the investors are willing to enter in the investment and to accept loss only in exchange of higher probability of gain, so the investors enter in a deal where the monetary loss is weighted more than the gain.

SUMMARY OF RESULTS

The research question has demonstrated that within the investor mind high volatility is considered as a measurement of the risk only, without consider the potential volatility benefit for upwards market trend.

Consequently, the asymmetric volatility bias demonstrates that the investor is risk averse and indirectly has greater aversion to the loss than gain (loss averse).

Furthermore, the investor do not invest in an asset where already know that will lose money (maybe except for safety asset with low negative return during huge uncertainty time), but the investor decides to invest because the expected return is positive, so assuming normal distribution the mean is on the right-side respect to the zero and consequently there is higher probability to have positive return than negative return and this is another indirect proof of loss averse behaviour, so greater aversion to the losses than to the gains. The researcher has showed that if the expected return is positive and the return follow a normal distribution, loss averse is valid for both risk seeking and risk averse investor, due the fact that the probability of gain is higher of the probability of loss or in another word the monetary loss is weighted more than the equivalent monetary gain, so loss must be compensated with higher probability of gain. Is like to take a gamble where the positive expected return has higher expected value than the negative expected return. Is similar to one of the gambles that has been used to demonstrate the loss aversion bias, where the investor is willing to enter in a gamble where has 50% probability of lose 10 EUR and has 50% probability of win 20 EUR, so the expected value of the gain is higher. Hence, the investor wants to be economically compensated more to bear the potential risk of lose 10 EUR. Indeed, in another experiment the investor has refused a gamble where he has 50% probability of lose 10 EUR and has 50% probability of win 10 EUR, so with the same expected value for both gain and loss.

The sub-question number 1 show that the investor is risk averse, choosing a parity of expected return, the stock with less volatility and has asymmetric bias. Because the risk averse investors prefer to keep is wealth, so are more concern of the downside volatility than the upper volatility and is more concern of the wealth effect of the bearish market than the bullish market effect, hence in the investor behaviour the loss have more impact than the gain.

Let's assume that in normal economic conditions the returns are normally distribute, hence they have 50% probability to be higher or less of the expected return. If the return a normally distributed and the investment has positive expected return, there is more than 50% probability to have gain than loss and indirectly the investor is willing to invest because accept loss in exchange of higher probability of gain. So, the investor is loss averse independent if is risk seeking or risk averse, because weights the loss more than the gain.

The sub-question number 2 supports the alternative hypothesis that the investor is risk averse and considers the volatility as asymmetric.

The investors choose the stock with less volatility, so indirectly means that he prefers the scenario with the lowest potential loss, so the investor is risk averse. The possible explanation could be the loss aversion bias associated with the volatility, even if the stocks are equivalent under the risk-return trade-off, the investor choose the stock with less volatility (risk averse) due to the loss aversion, because less volatility indirectly means that the loss have more impact than the gain.

Both sub-question number 1 and 2 demonstrate that the investor, before to buy a stock, think to protect is wealth choosing the stock with less volatility (risk averse), but conversely as for the results of other research they I have done, when the investor holds already the stock, from risk averse he becomes risk seeking in line with loss aversion theory and disposition effect.

Therefore, in case the stock has negative performance the investors continue to keep it, due to loss aversion, so in this case do not think to protect his wealth (risk averse behaviour), but he prefers to take more risk (risk seeking) to continue holding the stock during a bearish market, hoping the market will recovery.

According to the research the average investor could be considered risk averse, this is in line with the modern portfolio theory developed by Markowitz (1952), that assumes that investors are risk averse, meaning that given two portfolios that offer the same expected return, investors will prefer the less risky one. Indeed, this in line with the empirical result of the first sub-research-question.

Furthermore, the researcher has showed that both risk-averse and risk-seeking investor present loss aversion behaviour.

Conflict of Interest: None

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