Unexpected Risk (M) on the Stock Portfolio

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Abstract. According to individual variance and covariance formula of traditional formula, linear model and the CAPM, this paper aims to provide a comprehensive analysis of the various components of the investment risk and return rate about their effects on the performance of the stock portfolio. Similarly, relevant variables in the model in order to accurately and prove investment factor caused by the combination of the change of the benefits and risks, this paper will collect TELSA motors and NIO to auto stock data from the Dow Jones stock market (USA) in nearly a year, which could explore the portfolio relationship between the two listed companies and can be able to identify the factors that influence the investment decision. The analysis includes several aspects: the direct influence of accidental risk quantity on variance; the relationship between the amount of unexpected risk M and the rate of stock return; the causes of the overall investment risk; the portfolio benefits and strategy changes represented by coordinate parameter points in CAPM model under different correlated risk variances; the relationship between the portfolio strategy of the two listed companies, the proportion of capital investment and the prediction of the fluctuation tendency between risk and return. The results show that the variation factor of risk return might significantly determine the degree of risk aversion and return of investment while the extreme investment might not be suitable for the portfolio allocation of two companies.

Keywords: CAPM; variance; risk and yields of portfolio stock and individual stock.

1. Introduction

Risk management and portfolio stock strategy for different scale capital market investment strategy has become a new issue of concern to bankers and investments. There is an interesting and essential link between economic growth and financial progress simultaneously [1]. The increase of disparate economic assets broadens the investment strategy to a certain extent, especially the stock investment. Furthermore, numerous empirical studies conducted in the past have demonstrated a connection in equities capital markets, economic transformation and growth. [2]. Therefore, there are many kinds of investment instruments and methods in financial markets. The main content has concentrated on the different form of financing transactions such as common stock issuance, repurchase, and debt issuance in previous studies [3]. Moreover, Shareholders should have a long-term perspective and invest heavily in stocks [4]. As the scale of capital markets and the unprecedented expansion of the market, the traditional humanities sent investment theory has been unable to meet the complexity of stock market investment. The research explored that one of the crucial issues in financial engineering is portfolio optimization [5]. In order to evaluate this risk and attain the portfolio optimization goal. The new quantitative sent investors to the statistical variance calculation method and the new portfolio investment model, CAPM containing the equity portfolio in risk-free interest rate market and risk variance under the interest rate market a variety of curve. Therefore, variance of individual stock value investment and portfolio is of profound significance in the research of stock risk. In fact, the profitability risk term represented by the variance can be seen as a variable in the stochastic process. The variance (VR) statistic is one of the most commonly used methods in mathematics in order to detect the random walk variables in financial and economic quantitative data [6]. This study will focus on systematic linear analysis of unexpected risk variables (M) and other related dependent variables.

2. Research Methods

2.1 Sample Data Preparation

2.1.1 Hypothesis

Following from the risk M hypothesis in variance equation and CAPM model. There are three predictions for result are:

H1: Unexpected risk M has a negative impact on individual stock and portfolio returns

H2: The unexpected risk M has a detrimental effect on the portfolio variance and the variance of risk in a single state and it is proportional to the similar fluctuation situation.

H3: Under the CAPM model, the unexpected analysis M has a negative impact on the anticipated stock portfolio return rate in the capital market.

2.1.2 Data sample

This research data set is from Yahoo Financial Stock Market Live, Quote, Busisness website NasdaqGS - NasdaqGS Real Time Price. Currency in USD. It contains the real-time terminal adj stock prices of TESLA and NIO cars in the last year. Owing to the size of the data, only part of the data is shown in the image, but the final results are based on all specific stock terminal prices over the year. These chart data were collected, counted and calculated by the researcher and the author.

The research adopts the pricing analysis method of inner variable change, multi-stage and scale with the data. The investigation included Tesla Motors and NIO, two U.S.-listed companies. According to the data and variable requirements used in this study, the main variable adopts its own specific hypothesis variable M. In consequence, each variable in the formula and model is independent in the sense of an individual, and M can be regarded as an additional unexpected risk variable entering the system. Meanwhile, unexpected risk is set as an unexpected situation, referred to as inevitable risk: natural disasters and market capital collapse under extreme panic, etc.

2.2 Variable Declaration

2.2.1 Dependent variable

The explained variables (dependent variables) of this study are the variance of return risk and the expected rate of return of portfolio investment. In this study, the value change of return rate and risk variance of the final portfolio at the end of time T is used to measure. In order to maintain the consistency of horizontal analysis, the total results will be measured as percentage change.

2.2.2 Specific independent variable

The pivotal independent variable of this study is the risk of accident M. According to the actual situation and complex changes of the bond market, in order to distinguish the characteristics of this variable from ordinary independent variables, this study assumes that this variable is characterized as a one-time impact, which is regarded as a quantitative without considering the physical situation.

2.2.3 Control variables

There are many factors affecting stock return rate. In order to fix the impact of other irrelevant variables on risk variance and return rate under CAPM model, this study tries to control the attributes and meanings of the remaining variables into the same state.

2.3 Analysis Model

This paper concentrates on the impact of the unexpected risk variable M on the volatility of individual stock and portfolio investment risk variance. This model will illustrate the analysis of the change process of risk. Moreover, risk could be considered to an action or activity with the potential consciousness to some extent, including a non-subjective or subjective alternative. For example, stock investment often has the characteristic of certain risk loss. In addition, lots of traditional value analysis models lacking the concept of mathematical system are blindly optimistic about unknown risks. The

nature of excessive optimism is related to the classifies of stock issued [7]. Moreover, the method of risk assessment of different securities will be the decisive element. inventory assessment methods had developed a new statistical model with abundant formal to estimate uncertainty and lots of parameters instead of the traditional descriptive model of the assumed equilibrium at the beginning of the last century [8].

Similarly, risk is possible to result in a gain or loss, which outcomes are seen as desirable or undesirable. Therefore, risk has two components: exposure (events that affect returns) and uncertainty (probabilities). In general, researches regard the probability density of risk as a standard term to evaluate the expected future return rate of equity portfolio investment, which is used to observe the fluctuate return rate and portfolio volatility. The tighter the distribution, the less risky an investment is. In fact, owing to in different periods and investment categories, the dependent variable of this model is the risk variance while the risk might be analyzed deductively according to a random process. Therefore, researches introduce the variable risk Mi, that is, the unexpected risk to some extent causes the loss of the return rate of individual stocks in different periods.

3. Experimental Procedure and Results

3.1 Measuring Individual Asset Return and Risk Standard Deviation

The consciousness of rationally increasing risk in financial investment stems from the recent years because of the world epidemic, war, and the sudden break of industrial output. The traditional variance calculation method cannot meet the risk and return assessment of modern economic and financial system. The selection of the reintroduction of risk expression clearly reflects the strategic deployment of investors to the inevitable special surprises, not only focusing on the transformation of the investment income pattern, but also including the anticipation of the new socio-economic equilibrium point. All risk variances are based on individual stock returns over different periods, because risk and return are somehow related.

Advance condition: Individual stock return status and the total return of individual stocks in different states.

$$r_i = \frac{(P_{close\ i} - P_{open\ i})}{P_{open\ i}} \tag{1}$$

$$r\hat{} = E[r] = \sum_{i=1}^{n} P_i\, r_i = P_1 r_1\hat{} + \ldots + P_n r_n \tag{2}$$

Annotation:

- $r\hat{}$ = the anticipated return on a single stock
- P_i = the probability that status i will occur.
- n = the number of situations
- r_i = return the investment (rate) in different state i.

In stage one, the individual stock variance depends on the stock return and the portfolio return. Statistician could use the variance measure of basic probability statistics to measure the dispersion degree of random variables or a group of data.

$$\sigma^2 = Var(r) = \sum_{i=1}^{n} P_i (r_i - M_i - r\hat{})\hat{}2 \tag{3}$$

Annotation:

- r_i = the rate of return on the investment of risky a risky asset on state i
- P_i = the probability that status i will occur
- $r\hat{}$ = the anticipated return on single stock including total return in different states
- n = the number of conditions

$$Cov(r_i, r_j) = \sigma_{i\,j} = \sum_{i=1}^{n} P_i * (r_{1i} - M_i - r_1\hat{}) * (r_{2i} - M_i - r_2\hat{}) \tag{4}$$

Annotation:

- σ_{AB} = the covariance between the assets A and B (i=A, j=B)

- P_i = the probability that status i will occur
- r_{1i} and r_{2i} are rates of return on assets 1 and 2 respectively on diverse state i
- n = the number of conditions
- r^A and r^B are the expected rate of returns on assets A and B respectively.

This study analyzes the impact of a specific amount M of unexpected risk variance on the volatility of individual stock and portfolio investment risk variance. Since the dependent variables of the model are the variance of return risk and the expected return rate of portfolio investment, these variables change deductively at different discrete time states, which is consistent with the time discrete distribution process. Based on the traditional general risk calculation framework and CAPM model, the direct introduction of variables will not lead to the change of model attributes, which is in line with the objective and neutral assessment method. In addition, the unexpected risk variable remains purely in multiple linear problems and uncertainties.

As for the standard deviation of TESLA and NIO accident risk variable M on the variance of individual and the portfolio investment, the final calculation results of the chart show that the intervention of unexpected risk M has a negative impact on the returns of TESLA and NIO individual stocks. Furthermore, the variance of risk rate of return increases significantly in TESLA, but the variance of risk of NIO decreases, which means that the introduction of accidental risk M cannot increase the risk absolutely. To summarize, risk M could be hinged on on the value of M that will greatly increases the loss risk of single value investment.

Table 1. Price and variance data of TESLA

Date	Open price	Adj Close price	Ri1	Pi1	Er1 Old	Er1 NEW	M	Old variance 1	New variance 1
21/9/23	251.67	251.21	-0.18%	0.000%	0.000%	0.000%	0.10%	0.00000%	0.00000%
21/9/24	248.63	258.13	3.82%	0.405%	0.015%	0.015%	0.20%	0.00059%	0.01023%
21/9/27	257.71	263.79	2.36%	0.612%	0.014%	0.013%	0.30%	0.00034%	0.01257%
21/9/28	262.40	259.19	-1.22%	0.480%	-0.006%	-0.008%	0.40%	0.00007%	0.00545%
⋮ :									
22/9/14	292.24	302.61	3.55%	0.223%	0.008%	-0.047%	24.60%	0.00028%	0.00171%
22/9/15	301.83	303.75	0.64%	0.527%	0.003%	-0.127%	24.70%	0.00002%	0.00732%
22/9/16	299.61	303.35	1.25%	0.565%	0.007%	-0.133%	24.80%	0.00009%	0.00718%
22/9/19	300.09	309.07	2.99%	0.116%	0.003%	-0.025%	24.90%	0.00010%	0.00108%
22/9/20	306.91	308.73	0.59%	0.342%	0.002%	-0.083%	25.00%	0.00001%	0.00503%
22/9/21	308.29	300.80	-2.43%	0.226%	-0.005%	-0.062%	25.10%	0.00013%	0.00525%
					Total r^ Old	Total r^ New		Total Old Var2	Total New Var2
					0.028%	-12.278%		0.12726%	0.65983%

Table 2. Price and variance data of NIO

Date	Open price	Adj Close price	R1i	P1i	Er2 Old	Er2 NEW	M	Old variance2	New variance2
21/9/23	36.20	36.01	-0.52%	0.000%	0.000%	0.000%	0.10%	0.00000%	0.00000%
21/9/24	35.59	35.38	-0.59%	0.405%	-0.002%	-0.003%	0.20%	0.00001%	0.04698%
21/9/27	35.43	36.77	3.78%	0.612%	0.023%	0.021%	0.30%	0.00088%	0.09715%
21/9/28	36.28	35.05	-3.39%	0.480%	-0.016%	-0.018%	0.40%	0.00055%	0.04132%
⋮ :									
22/9/14	21.47	21.94	2.19%	0.223%	0.005%	-0.050%	24.60%	0.00011%	-0.02230%
22/9/15	21.51	21.51	0.00%	0.527%	0.000%	-0.130%	24.70%	0.00000%	-0.06482%
22/9/16	21.10	20.15	-4.50%	0.565%	-0.025%	-0.165%	24.80%	0.00114%	-0.09544%
22/9/19	19.75	20.90	5.82%	0.116%	0.007%	-0.022%	24.90%	0.00039%	-0.00775%
22/9/20	20.70	20.41	-1.40%	0.342%	-0.005%	-0.090%	25.00%	0.00007%	-0.04787%
22/9/21	20.12	18.30	-9.05%	0.226%	-0.020%	-0.077%	25.10%	0.00185%	-0.04912%
					Total r^ Old	Total r^ New		Total Old Var2	Total New Var2
					-0.093%	-12.400%		0.16982%	-0.15870%

In the first stage, according to the sample stock price data and analysis result in Table 1 and Table 2, the change value of probability P of I in each stage of the study control is the same. The calculation results show that the returns of the two stocks after adding the amount of unexpected risk M are significantly less than the original value with the same trend, but the changes of risk variance are different. Moreover, the covariance of the portfolio investment of the two stocks is also significantly increased in the case of both positive and negative returns phenomenon. This means that unavoidable risks seriously affect investors' value investment in a single stock and portfolio investment, which dramatically enhance the possibility of losses.

When the basic variance and covariance operation formulas are used, the echo assumption condition is satisfied, that is, the independent variable of accident risk M has the same response to the dependent variable at different levels. But the actual analysis is often difficult to meet, can only approach the ideal state. When the M variable is added, the directness leads to the decline of the return rate of investors at a single time state point of a specific stock TESLA or NIO, expressed as RI-m. Consequently, there is a controversial point worth discussing: Ri return rate at different stages is not necessarily greater than or equal to 0, and there is also a negative return rate. The number in parentheses could be negative going to negative infinity or positive going to zero. However, the change of the squared term of the value will not be a standard general function of y=Ax+B increasing and decreasing phenomenon. These values will show different distribution points on the coordinate. Admittedly, the variance will continue to rise sharply, and the risk will continue to be amplified when the unexpected loss caused by M is much larger than the total return rate of each period and individual stock.

3.2 Portfolio Investment

Table 3. Portfolio of stock between TESLA and NIO

Date	R porfolio old	R porfolio New	Cov(r1i,r2i) old	Cov(r1i, r2i) new	Wi TESLA	Wj NIO	Variance on the portfolio (old)	Variance on the portfolio (New)
21/9/23	-0.308	-0.408	0.000000%	0.000000%	62.85%	37.154	2.178	49.788
21/9/24	3.594	3.394	0.000000%	-0.000115%	94.86%	5.138	0.455	10.393
21/9/27	3.703	3.403	-0.000091%	0.000433%	5.53%	94.466	0.488	11.146
21/9/28	-2.928	-3.328	0.000539%	0.000293%	21.34%	78.656	1.566	35.797
⋮ :								
22/9/14	3.038	-21.562	-0.000051%	0.010514%	62.45%	37.55%	2.188	50.001
22/9/15	0.030	-24.670	0.000172%	0.031329%	4.74&	95.26%	0.422	9.634
22/9/16	-3.911	-28.711	0.000000%	0.038946%	10.28%	89.72%	0.860	19.661
22/9/19	3.608	-21.292	-0.000314%	0.004850%	78.26%	21.74%	1.587	36.277
22/9/20	-0.763	-25.763	0.000202%	0.022031%	32.02%	67.98%	2.031	46.410
22/9/21	-7.503	-32.603	-0.000028%	0.021214%	23.32%	76.68%	1.668	38.129
	Total R old	Total R New	Total Cov old	Total Cov new			Total Var(Old)	Total Var(New)
	34.571	-3128.029	0.093293%	2.132265%			393.269	8988.397

In the second stage, in order to avoid risks, investors often choose the portfolio investment of several different stocks, so as to retain flexible financing, close and add positions, and reduce the potential risk distribution.

The variance of the portfolio is given by:

$$\sigma^2{}_p = \sum_{i=1}^{n} \sum_{j=1}^{n} w_i w_j \mathrm{Cov}(r_i, r_j) \quad (5)$$

Annotation:

- $\sigma\text{^}2_p$ = the variance on the portfolio
- n = the number of various investment assets in the securities, shares or stocks portfolio
- Cov (r_i, r_j) = the covariance between assets i and j to describe relationship of two different returns
- σ^2_p = Variance on the securities, shares or stocks portfolio

• Wi, Wj= the different proportion between one asset called i and another asset called j in the portfolio.

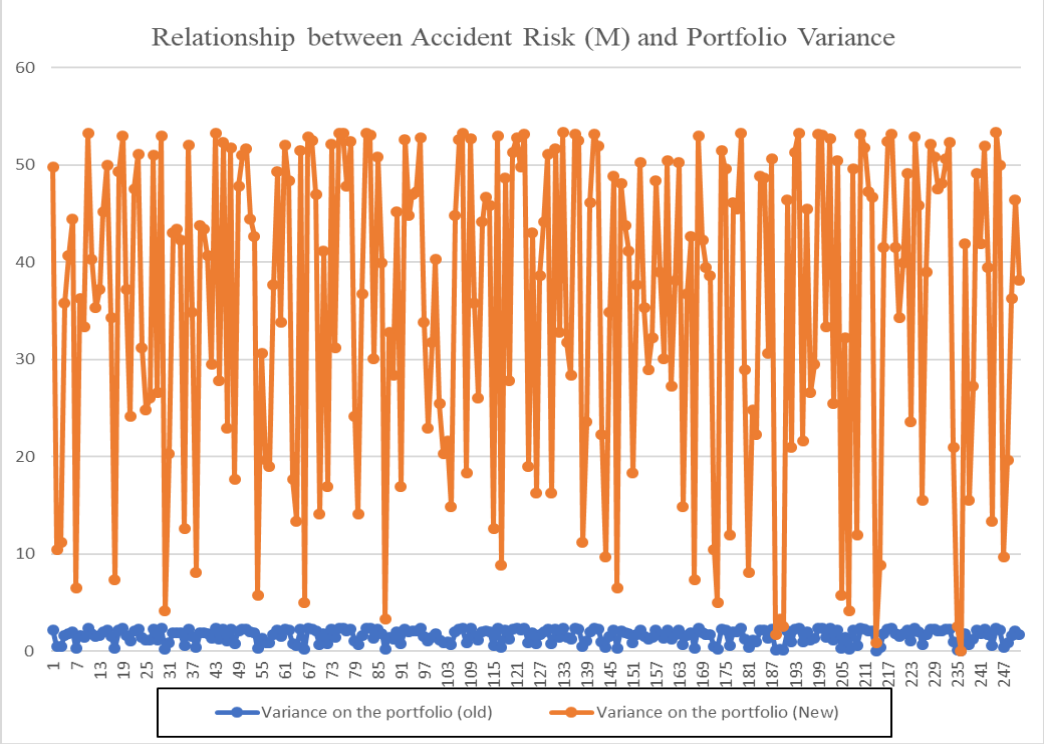

Figure 1. Relationship between accident risk (M) and portfolio variance (Photo credit: Original)

Based on the analysis of variance of individual stock risk in the first stage and the analysis of covariance formula in statistics, investors will invest in TESLA and NIO with a reasonable proportion of assets with the proportion of TESLA (W1) and weight percentage of NIO (W2). The study analyzed the variance change of portfolio investment (in Table 3) under 251 different W portfolios. In order to ensure the randomness of the distribution, all the weights (W) are arranged out of order. The research shows that when the unexpected risk M is equal to both stocks at the same time, the portfolio investment will cause more losses. After the introduction of risk quantity M, it is found that the covariance of two stock portfolios in different periods sometimes grows up and sometimes descend. However, overall, after one year, the aggregate risk covariance has increased significantly by more than 22%. In addition, the risk variance of stock portfolio not only rises up significantly during each time period, but also the difference between the final variance value and the initial value is extremely large. The results show that unexpected risk can be devastating to portfolio investment.

In addition, based on the Figure 1 distribution and after introducing the risk M quantity, the research unexpectedly discovers some new variations. The similarity lies in that the variance of old and new stock portfolios at different time points also moves back with the form of wave frequency within a certain interval. The difference is that the group and variance with M amount fluctuate more sharply and span vastly. By contrast, the original variance fluctuation is more concentrated and the difference is not huge.

3.3 The Capital Asset Pricing Model (CAPM)

In the third stage, with the development of world capital, the complexity of investment is more obvious feature. Tremendous investors from a wider range of countries can invest in foreign securities [9]. CAPM is one of the cores of modern financial economics. Similarly, Capital Asset Pricing model (CAPM) is a special method used to determine the price of investment securities, which depends in part on the risk they represent [10]. This model gives us a framework were intended to accurately

predict the risks, it wants to observe the relationship between the risks and the expected return on the asset. Moreover, the model allows investors to quantify the expected return on assets that are not yet traded in the market, for example, during an initial public offering in which new shares come to market. Therefore, it is essential to analyze the relationship between unexpected risk and CAPM expected return.

$$E(r_k) = r_f + \beta_k\,(E(r_M) - r_f) \tag{6}$$

$$\beta_k = \frac{Cov(r_k, r_M)}{(\sigma_M)\text{^}2} \tag{7}$$

$$\beta_p = \frac{Cov\,(w_1 r_1 + \ldots + w_n r_n, r_M)}{(\sigma_M)\text{^}2} \tag{8}$$

$$r_s\text{^} = \sum_{i=1}^{n} w_i r_i\text{^} = w_1 r_1\text{^} + \ldots + w_n r_n \tag{9}$$

Where:

- r_k = the return rate of the stock portfolio K
- r_M = the return rate of the market
- β_K = sensitivity of portfolio K to market risk
- $E(r_k)$ = the expected rate of return on stock portfolio given by the CAPM
- $E(r_M)$ = the market rate of return

Based on the reality, there are riskless interest rate assets and risky assets in the market. Under the same market expected return rate and risk-free interest rate, the unexpected variable M cited in the study will lead to a sharp decline in the return rate of both stocks at different time points. At the same time, portfolio returns on stock investments have fallen sharply. Similarly, the sensitivity of portfolio S(covariance) to market risk has fallen down in the portfolio investment market has also been successively affected by the downward trend. In conclusion, the expectant return of the stock portfolio predicted by a CAPM model in this market will also decline catastrophically and the introducing of unexpected risk M could be a tremendous impact on financial investment.

4. Conclusion

The stock portfolio investment has become a popular form of business investment for both public and private fund companies. However, there is still a lack of comprehensive analysis and a unified explanation of the investment model's various components and the scope of factor regulation. This study finds that unavoidably unexpected risk M not only has a serious negative impact on the return rate of individual stocks and portfolios, but also increases the risk variance of single stock value investment and portfolio distribution investment to a large extent. Meanwhile, the degree of risk aversion and return on investment may be greatly influenced by the variance (risk M) factor, although an extreme stock investment could not be appropriate for the portfolio allocation of two companies. In addition, the results are basically consistent with the preliminary hypothesis. Under the capital asset pricing model, the expected return rate of portfolio in the market is obviously negatively impacted. In addition, it should be noted that the types of investment assets involved in this variable involve stocks, options, bonds and derivative financial products, so the research has certain limitations. At the same time, the setting of the value of the unexpected risk variable is a fixed value in the ideal state. However, in real life, the change of M is difficult to be qualitative and quantitative, which will cause great errors. Moreover, there are some fuzziness and limitations in the process of variation. Moreover, the latter part of H2 hypothesis is incorrect. In the process of increasing the risk variance, it does not increase linearly in accordance with a certain proportion, but the volatility increases between a certain upper and lower limit. In the future, the fluctuation variation rules and related unexpected risk variables within the fluctuation interval need to be further refined in order to facilitate the in-depth study of this risk quantity.

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