

A study on portfolio management strategies to maximize investment returns of listed companies

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Abstract. Listed companies can solve the problem of capital redundancy after financing through venture capital, but due to the risky nature, it becomes increasingly difficult to get a good capital return, therefore, it is an effective way for listed companies to utilize their capital by diversifying and reducing risks through portfolio investment to obtain high returns. In this paper, based on the characteristics of listed companies, we analyze the risk investment methods and risk factors of listed companies, and then construct a log-optimal portfolio model under VaR and CVaR risk control and verify it, so as to provide scientific basis for the portfolio investment decision management of listed companies.

Keywords: Risk investment, maximizing returns, portfolio strategy.

1. Introduction

Venture capital portfolio theory was first proposed by Gorman et al [1], who argued that the investment choices of venture capitalists should include different types of ventures in order to reduce investment risk. Venture capital is the process of transforming scientific and technological achievements into real productivity, which is the act of entrepreneurship and the birth of a new industry. This is why venture capital is also commonly referred to as entrepreneurial investment [2]. Venture capital plays an important role in the development of SMEs, especially technology-based SMEs [3]. How to effectively measure and manage financial risks, to achieve sustainable development of the financial system and to maintain the competitiveness of the financial sector, is also crucial. In this paper, we summarize the necessity of risk investment for listed companies and analyze the way and necessity of their participation in risk investment based on the current situation of risk investment for listed companies in a more comprehensive and scientific manner, thus putting forward corresponding countermeasures and suggestions, and propose a risk investment portfolio model based on information control based on the log-optimal asset portfolio model of risk control [4-7]. The model is based on the log-optimal portfolio model of risk control [4-7].

For the log-optimal portfolio problem, there are two types of research: one is the in-depth study of the log-optimal portfolio theory, mainly using the knowledge of stochastic process to simulate the fluctuation of market prices, and then using the knowledge of information entropy to analyse the research, such as the return vector X as a smooth sequence of processes to study [8]. The second is the study of log-optimal portfolio solution algorithms, mainly on the basis of traditional optimization algorithms, using some new algorithms to solve, such as adaptive algorithms, evolutionary algorithms, genetic algorithms, etc. Liu Li et al [9] constructed a log-optimal investment model based on the non-buying case; in addition, Song Bo et al [10] constructed a similar model using the risk control doctrine.

2. Analysis of the ways and risks of venture capital investment by listed companies

2.1. Ways of venture capital investment by listed companies

- 1) Direct investment. Listed companies invest directly in entrepreneurial enterprises.
- 2) Equity participation or joint venture to set up venture capital companies. Listed companies can research the market of venture capital industry and select enterprises with good performance for

capital investment, or they can jointly set up venture capital enterprises with other listed companies, without any listed companies participating in the management of them, not for the purpose of controlling them, and only for the sharing of interests among shareholders. Such a way of investment is not conducive to the listed companies to improve their own technological development. However, due to its convenient operation and risk dispersion, it is a common investment mode chosen by listed companies at this stage.

3) Holding the establishment of its own venture capital company. Self-investment in the establishment of venture capital enterprises, can ensure its independent control and management, can control the direction of its investment, then you can choose and the listed company's own business similar to the project for investment, to achieve the advantages of management, can carry out professional analysis, not only to achieve investment interests, but also for the development of enterprises to control more technology enterprises, for the enterprise to find new economic growth points. To obtain the latest technology in the industry, in order to promote the listed company in its core business of market competition to occupy an advantageous position.

4) Indirect investment. Indirect investment means that the listed enterprise firstly invests in the establishment of a professional venture capital company or venture capital institution, which is equipped with professional talents, excellent management system and flexible organisational structure to carry out the venture capital work. The advantage of this approach is that the amount of capital invested is very flexible and can be determined according to the business situation of the company. It is also possible to make joint investments with other listed companies, forming a mutually beneficial development model and helping to diversify risks, plus the establishment of specialised enterprises or institutions, so that the core business of the listed company will not be affected. This type of investment is more suitable for listed companies that do not have sufficient capital.

Listed companies venture capital can use their listed status to finance high-tech industries, familiar with the operating environment of the capital market, the capital obtained through the stock exchange is almost no pressure to repay capital and interest. At this stage, most listed companies have a considerable amount of capital on deposit, which, together with their low-cost financing methods, can raise idle social capital. In addition, many listed companies have already gone through the industrial growth period, and now belong to the industrial maturity period, also need to find new development point, need to find new investment point to promote their own development.

As a potential source of capital for the venture capital industry, listed companies will become an important source of capital after the government for a long time to come. The strong financial backing of listed companies will make them a reliable source of venture capital, and will also be an excellent catalyst for their own development, optimising their own industrial structure, fostering new profit growth points and helping to build a sense of innovation in society.

Venture capital in listed companies can solve the problem of capital investment. However, there are certain misunderstandings in the process of financing for listed enterprises at the present stage: firstly, enterprises cannot find projects with investment points and make blind investments, and the investment direction of funds is very easy to change; secondly, most listed companies have already experienced the industrial growth cycle, and at the present stage, their market share in their main business is stable and their cash flow is abundant, and at the same time, as the industry has already entered the industrial maturity or even the recession period, most listed companies have already experienced the industrial growth cycle. At the same time, as the industry has entered the maturity or even the decline of the industry, most listed companies are not willing to make additional investments in existing industries. At this stage, more and more listed companies are entrusting professional venture capital firms to operate their capital. Although the industry is potentially risky and has a great deal of uncertainty, by using professional analysis, the level of risk can be greatly reduced and a relatively satisfactory return on investment can be obtained.

2.2. Risk analysis of listed companies' venture capital investment

1) The constraint of strategic development of listed companies makes listed companies choose projects related to their own experience for investment when they make risky investment, which is based on the principle of prudence, although the familiarity with the project can effectively achieve risk avoidance, but at the same time it may miss some high-quality investment projects.

2) Listed companies participate in venture capital because of their own development needs. At this particular time of economic development, the support of science and technology is very necessary. Only by fighting a good science and technology war, constantly innovating and developing new technologies and products can enterprises stand out in the fierce competition in the industry market, so listed enterprises invest in high-tech industries, arguably out of consideration for their own development.

3) The professional background of listed companies limits the access of venture companies to quality resources. The reason why many invested enterprises reject the capital investment of listed companies is that some listed companies have impure purposes in the process of investment. Compared to independent investment institutions, which are only interested in the benefits of investment, listed companies may not only focus on investment returns, but may also be interested in the technology of the company's research projects. Some leaders of investee companies fear the loss of leadership in the company. Investee companies may fear the expertise of the listed company, fearing that it will use its expertise to steal patents or technology in pursuit of its own growth. In addition, there is a competitive relationship between the investee and the listed company, and the growth of the start-up may affect its core business. But it is also these disadvantages that can deprive innovative technology industries of access to valuable capital and thus miss out on the best opportunities for growth.

4) Incompatibility between the corporate culture of listed companies and venture capital decisions. The corporate culture of most listed companies advocates a conservative and prudent way of operation. At present, many listed companies are evolved from traditional state-owned enterprises, and there are certain deficiencies in both the mechanism and human resources management, without establishing a good sense of innovation and a correct understanding of the importance of technology. The complexity of the organisational structure and the need to go through layers of analysis when making venture capital investments often delay the best time to invest and are not conducive to the comprehensive development of the enterprise.

3. Construction of a portfolio management strategy for venture capital investments in listed companies

3.1. Basic assumptions of the risk portfolio model

The basic assumptions of the venture capital portfolio model are reflected in the following aspects.

1) Investment consensus. It is assumed that all investors in the market agree that all assets will be liquidated when the capital flow is: market $x_j > 0$, $j=0, 1, \dots, k$.

2) Frictionless markets. Assume that there are no costs associated with trading in the capital market, including fees, taxes, etc., and that short selling is allowed to occur without limit, so that any investor can sell short any asset or assets in his name, and the number of assets can be divided indefinitely.

3) Competitive market. It is assumed that the market for the investment industry is perfectly competitive, with no government intervention or monopoly, and that each investor's price does not affect the price of the asset, but is determined by all investors, who are also the price takers.

4) No arbitrage assumption. Assume that there are arbitrage opportunities in the asset trading market, and that the price function satisfies the following relationship:

$$p\left(\sum_{j=0}^k N_j x_j\right) = \sum_{j=0}^k N_j p(x_j) \quad (1)$$

For all possible N_j , $j = 0, 1, \dots, k$. If $\sum_{j=0}^k N_j x_j > 0$, then $\sum_{j=0}^k N_j p(x_j) > 0$

3.2. Log-optimal asset portfolio model under VaR risk

1) Definition of VaR. Value at Risk (VaR) is a measure of risk created in the early 1990s. In simple terms, VaR is the maximum potential loss of a portfolio over a certain time interval and at a certain confidence level.

2) The establishment of a log-optimal asset portfolio model under VaR risk control. Let an investor purchase m securities, the return of the i th security is x_i ($i=1, 2, \dots, m$), represented by the vector $x=(x_1, x_2, \dots, x_m)^T$. Assume that the investor allocates the proportion of investment in these m securities as $\omega=(\omega_1, \omega_2, \dots, \omega_m)^T$, which satisfies $e^T\omega=1$, $\omega \geq 0$ (short selling is not allowed), where $e=(1, 1, \dots, 1)^T$, and assumes that the return vector x follows a normal distribution.

Let r_p be the return on the portfolio, then we have $E r_p = \mu^T \omega$, $\sigma_p^2 = \omega^T \Sigma \omega$, where μ is the expected return on the portfolio and Σ is the covariance matrix of the return on the portfolio, and r_p also follows a normal distribution. By the definition of VaR, $P(r_p < -\text{VaR}) = \alpha$, and by the large number theorem and the properties of the normal distribution we have:

$$P\left(\frac{r_p - E r_p}{\sigma_p} < \frac{-\text{VaR} - E r_p}{\sigma_p}\right) = \alpha \quad (2)$$

The above equation translates to $\text{VaR} = -E r_p - \sigma_p \Phi^{-1}(1-\alpha)$. Where: $\Phi^{-1}(x)$ is the inverse of the standard normal distribution function, $\alpha=1-\alpha$. Let $\text{VaR}=Q(\omega)$, and $Q(\omega) = -E r_p - \sigma_p \Phi^{-1}(1-\alpha)$, which is the risk control function based on VaR risk.

Based on the VaR risk control function, the set of all asset portfolios with investment risk not exceeding r is $B_r = \{\omega \in B | Q(\omega) \leq r\}$. The log-optimal asset portfolio model based on the VaR risk control function is thus obtained as

$$\max_{\omega} E\{\log(\omega^T x)\} \quad (3)$$

3.3. The log-optimal asset portfolio model under CVaR risk

1) Definition of CVaR. The conditional value at risk (CVaR) is intuitively the "average of 100 (1- α) % of maximum losses", which is the conditional mean of losses over VaR, also known as the average excess loss, tail VaR, average shortfall, etc. It reflects the excess of losses over VaR. It reflects the average of all possible values at which losses exceed the VaR value and is a better indicator of the true risk faced by a portfolio than VaR.

2) The development of a log-optimal asset portfolio model with CVaR risk control. Let an investor choose m risky assets, whose return vector is $x=(x_1, x_2, \dots, x_m)^T$, and assume that the proportion of the investor's investment allocated to m risky assets is

$$\omega = (\omega_1, \omega_2, \dots, \omega_m)^T \quad (4)$$

It satisfies $e^T\omega = 1$, $\omega \geq 0$ (no short selling is allowed).

For the asset portfolio problem, the loss function is

$$L(\omega, x) = -\omega^T x \quad (5)$$

By the distribution function of L as $F(x, \alpha)$, then.

$$\text{CVaR}(\omega, \alpha) = (1 - \alpha)^{-1} \int_{L \geq \text{VaR}(L, \alpha)} (-\omega^T x) dF(x, \alpha) \quad (6)$$

Then, the risk control function based on CVaR risk is $\text{CVaR}(\omega, \alpha) \leq r$, and the full set of feasible asset portfolios is

$$B_r = \{\omega \in B | \text{CVaR}(\omega, \alpha) \leq r\} \quad (7)$$

Where, $B = \{\omega \in \mathbb{R}^m | e^T\omega=1, \omega \geq 0\}$. The log-optimal asset portfolio model based on the CVaR risk control function is thus obtained as

$$\max_{\omega \in B} E\{\log(\omega^T x)\} \quad (8)$$

3.4. Validation of the log-optimal asset portfolio model under VaR risk control

The six listed stocks, S1, S2, S3, S4, S5 and S6, were selected to obtain the optimal portfolio by genetic algorithm, and the daily return prices from 11 November 2004 to 19 August 2008 were selected as samples for analysis, as shown in Table 1:

Table 1. Changes in the optimal portfolio as risk levels change.

Risk level	S1	S2	S3	S4	S5	S6
0.025 0	0.004 413	0.465109	0.024 020	0.503 419	0.003 039	0.001 120
0.027 5	0.000 244	0.336 227	0.000 195	0.633 091	0.000243	0.001 246
0.030 0	0.000 175	0.247 837	0.011 522	0.740 197	0.000269	0.001 310
0.032 5	0.000 251	0.157 816	0.009 469	0.832 235	0.000 229	0.001 376
0.035 0	0.000 147	0.150 271	0.000 147	0.849 287	0.000147	0.001 396
0.037 5	0.000 147	0.150 266	0.000 148	0.849 290	0.000148	0.001 396

When comparing return levels, there is theoretically a very wide range of values, but in practice, for simplicity, the logarithmic vector of returns is chosen to calculate the logarithmic vector of returns for the five stocks:

$$(-0.000\ 906, 0.000\ 806, -0.000\ 076, 0.001\ 503, -0.001\ 581)^T. \quad (9)$$

The logarithmic return vector of the five stocks was calculated as follows: N=500, hybrid probability Pc=0.6, variance probability Pm=0.01 and maximum number of generation's g=500, using a genetic algorithm. The changes in the portfolio under the VaR model for different risk levels are shown in Table 2 at a constant confidence level of $\alpha=0.05$, or when the risk level changes.

Table 2 shows that as the level of risk increases, the return on the chosen portfolio increases, but this increase is subject to an upper limit and does not increase with the level of risk once it reaches a certain level. This shows that risk and return go hand in hand in the process of risky investments, and that in order to achieve high returns one must accept high risk.

Table 2. Optimal asset mix with different parameters.

stock code	investment portfolio				
	q=0.000 1 a=0.95	q=0.000 1 a=0.975	q=0.000 1 a=0.99	q=0.000 15 a=0.95	q=0.000 2 a=0.95
S1	0.089 284	0.078 195	0.046 789	0.064 534	0.050 538
S2	0.256 005	0.233 782	0.262 280	0.233 968	0.251 083
S3	0.016 621	0.014 874	0.020 826	0.001 526	0.008 250
S4	0.121 615	0.129 845	0.130 888	0.113 885	0.103 741
S5	0.497 832	0.529 834	0.514 756	0.571 425	0.575 425
S6	0.018 643	0.013 470	0.024 461	0.014 663	0.010 963
VaR	0.020 578	0.025 765	0.029 932	0.020 174	0.019 294
CVaR	0.026 956	0.031 426	0.036 730	0.026 876	0.027 149

3.5. Validation of the log-optimal asset portfolio model with CVaR risk control

The six listed stocks, S1, S2, S3, S4, S5 and S6, are still selected for the optimal portfolio by genetic algorithm.

The log returns of the six stocks were -0.000 651, 0.001 299, -0.000 250, -0.001 167, 0.000 050 and -0.000 272 respectively. n=1 000, the probability of crossbreeding Pc=0.8, the probability of variation Pm=0.01 and the maximum number of generations g=1 000 were taken in the genetic algorithm.

Table 2 shows that the optimal portfolio chosen by the VaR risk model has the highest proportion of investment in Dongfeng Enterprise Industry, while the proportion of investment in the remaining stocks is not high. The CVaR model, however, chose the highest proportion of Shanghai Airports, which was also lower than the mean-variance model.

In addition, once the confidence level within the interval is increased, the proportion of stocks with high risk levels will be higher. This means that only when the confidence level is at a high level can stocks with high returns and low risk levels account for a greater proportion of the investment and meet the needs of investors. The lower the given rate of return, the wider the range of options available in the portfolio, and the more risky the investment. Conversely, if the given rate of return is too high and the range of investments is firmly trapped within a specific band, the level of risk is greatly increased.

4. Risky portfolio strategies for listed companies

The stock market is a market in which information is the core indicator, and the timeliness, truthfulness and availability of information disclosed in the stock market is an important indicator of the maturity of the market. At the present stage of stock market regulation and management, it is a major and complex task to strictly combat financial statement whitewashing, improve information quality and create a healthy and positive investment environment for investors, which requires not only improving the internal governance structure of enterprises, but also raising the professional level of investors, supervising the relevant entities in the process of preparing financial statements, establishing and improving the existing accounting standards and audit system, and improving relevant laws and regulations. This requires not only improving the internal governance structure of the company, but also improving the professionalism of investors, monitoring the process of preparing financial statements, establishing and improving existing accounting standards and auditing systems, and improving relevant laws and regulations. Firstly, there is a need to provide truthful and effective financial reports; secondly, the government should improve the existing system to avoid the incentive to whitewash reports. At present, many listed companies are engaged in whitewashing their financial statements, largely due to the incorporation of political factors into their profit levels. In addition, it is important to integrate performance assessment in the management of remuneration, not only to look at the profit situation of financial statements, but also to improve the admission and issuance system of the stock market, actively broaden the scope of auditing of certified public accountants, improve their professional quality and responsibility, and play a good role in social supervision.

4.1. Risk diversification

In investment management, there is a popular saying that "you can't put your eggs in the same basket." In other words, if all the capital in the investment process will be invested in a project, then if the investment project fails, it may cause the investor very serious financial crisis, so in the process of investment should do as much as possible to allocate capital to different investment projects, actively use the principle of dispersion, select the enterprise investment preference, high degree of technical familiarity with the project area for This is to establish a scientific and reasonable risk portfolio, so that even if one of the projects fails, it may be compensated for in other projects, artificially avoiding the risk.

4.2. Joint investment

In the investment of high-risk, large amount of capital investment projects, you can take the joint investment approach to risk avoidance, effectively form a benefit-sharing, risk-dispersed investment situation, do a good job of risk control management, but also to improve the project's risk tolerance capacity.

4.3. Field research

After the decision to invest or complete the investment, the investor needs to conduct in-depth investigation and management of the enterprise, especially after the investment needs to do a good job of guiding management, in the operation of funds, project operation, market development sent

professionals to guide, set up a professional project team, deep into the invested enterprise to control the management of risk, to reduce investment risk.

4.4. Scientific management

As a venture capital company, the management mode of the internal structure of the enterprise and its ability to make the right investment portfolio, so as to obtain a high return on investment is very closely related. In the company's management mode not only should be integrated into the management concept of modern enterprise system, but also need to focus on the development of innovation ability, to establish an innovative, rigorous, hard-working corporate culture. Throughout the world's best companies, the development of innovation is the core driving force behind their development. Companies with poor internal management and low levels of efficiency are unlikely to be able to cope with the fierce and complex competitive environment of the venture capital market.

5. Conclusion

Through the analysis of risky investment methods and risks of listed companies, the log-optimal asset portfolio model under VaR risk and CVaR risk is further investigated and verified numerically respectively. This model is a modification of the VaR risk model, which gives investors a clearer understanding of the risk they face in their asset portfolios, and therefore, this model can be a better measure of risk.

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