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Design of Foreign Investment Risk Model Based on Computer Big Data Technology

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Abstract: *The location of foreign direct investment is one of the frontier issues of modern location theory research. Using discrete-time survival analysis methods that can control for multiple lifetimes and unobserved heterogeneity, this paper examines whether foreign-invested enterprises defined in different ways in China have "free-flow" characteristics. Then this paper establishes a multi-objective optimization model of venture capital. At last, this paper proves its feasibility and effectiveness with an example. This model can comprehensively and comprehensively evaluate the economic benefit and risk size of the venture capital scheme and help to make correct decisions.*

Keywords: *computer; big data; foreign investment risk; investment risk model; multi-objective optimization*

1. Introduction

After more than 40 years of reform and opening up, China has made remarkable achievements in utilizing foreign capital, ranking first among developing countries in terms of foreign capital utilization for more than 20 consecutive years. There are numerous studies examining the important role of foreign investment in various aspects of China's economic development, and there seems to be no doubt that the continued adherence to the policy of attracting foreign investment. Not only that, the "Decision on Temporarily Adjusting Relevant Administrative Regulations, State Council Documents and Departmental Rules and Regulations Approved by the State Council" issued by the State Council in 2016 mainly involves two aspects: on foreign-funded enterprises and Sino-foreign joint ventures. Various matters of the enterprise have been changed from approval to filing management; it is open to various fields such as steel, and foreign investment is allowed to be wholly owned or controlled. However, what is not commensurate with this development trend and its position as a foreign host country is that few studies have paid attention to the relative exit behavior of Chinese foreign-invested enterprises. The scientific analysis of this issue is very important for us to reasonably evaluate the past foreign investment policies; and to a certain extent, it may also answer and respond to the new generation of bilateral investment agreements, and how to view the reform and innovation of the foreign investment management system in the free trade zone. It provides important reference for issues such as promotion and reproduction.

Enterprise dynamics is one of the important features of a market economy. It is the learning model that provides the theoretical explanation for it. It was originally a passive learning model, that is, the Bayesian noise selection model proposed by some scholars. Assuming that the enterprise does not know its own factor endowments, efficiency, etc. in advance, it only knows its own productivity after entering the market to carry out operations, and then decides whether to exit, maintain the same scale, expand the scale or reduce production capacity through the trade-off between productivity and cost. continue to operate. Then there is the active learning model. Some scholars take innovation as the basis of the exogenous process, assuming that the productivity of each enterprise changes independently according to the exogenous Markov process, the output is a function of input and external shocks, and the entry needs to pay sunk costs, and Enterprises have active learning ability and can improve profitability through investment activities; determine the profit-maximizing output under the condition of knowing external shocks, corresponding to the given output and input prices at equilibrium, and the productivity is lower than a certain critical value companies exit the market. However, the external shock proposed by the above learning model is relatively general, and there is no specific reference. In recent years, some scholars believe that the heterogeneity trade theory combines the industrial dynamic model under the condition of heterogeneous enterprises with the general equilibrium trade model, and discusses the behavioral choices and influences of enterprises under the external shock of trade opening. Although these studies have many differences in motivations and channels, their main conclusions are basically the same, that is, trade liberalization leads to the expansion of high-efficiency firms and the contraction or exit of low-efficiency firms. On the whole, although the heterogeneity trade theory has broadened the horizons of international trade theoretical research, it only regards trade opening as the source of external shocks, and basically does not consider the impact of foreign capital on enterprise dynamics, which is still its limitation. Although there is a lack of literature that theoretically regards foreign investment as an external shock and studies its impact on enterprise dynamics, especially enterprise exit, empirical research in this area has developed rapidly, but these literatures mostly focus on the study of foreign capital's impact on local enterprise exit or exit. survival impact. Some scholars believe that foreign capital can reduce the exit risk of local enterprises through spillover effects; some scholars believe that the entry of foreign capital not only enhances the degree of competition in the product market, but also reduces the price-cost markup of enterprises by reducing product prices; it also improves the factor market. The degree of competition in China reduces the price-cost markup of enterprises by raising factor prices, and eventually leads to an increase in the risk of local enterprises withdrawing. In addition, some scholars have also found evidence that foreign investment increases the exit risk of upstream enterprises in the host country through backward linkages, and reduces the exit risk of downstream enterprises through forward linkages. At present, there are relatively few studies on the relative exit risks of domestic and foreign-funded enterprises, and the conclusions are not clear. Some scholars believe that, from a theoretical point of view, on the one hand, foreign-invested enterprises are part of the global production network of multinational companies and have advantages in internationalization; when the host country's economic situation deteriorates, domestic-funded enterprises can more easily The allocation of production factors around the world, that is, the relative exit risk of foreign-funded enterprises is higher. On the other hand, due to the disadvantage of outsiders, foreign enterprises need to pay higher entry costs. From this perspective, the relative exit risk of foreign-funded enterprises will be lower. Similarly, the results of relevant empirical studies are also quite different. Some scholars believe that the relative exit risk of foreign-invested enterprises is lower. In addition to domestic and foreign ownership, there are numerous macro, industry and enterprise-level variables that may affect the risk of a firm's exit. Specifically, from the macro level: the overall economic status of a country or region has always been regarded as an important factor leading to the exit of enterprises. Some scholars have found that the exit behavior of enterprises has the characteristics of "counter-cyclical". The exit risk of enterprises increases during economic depression and decreases during economic expansion. Moreover, the current economic growth situation not only affects the market environment in which companies operate, but also affects companies' expectations for the future market. When companies expect market conditions to deteriorate in the future, the risk of exit increases significantly. From the perspective of the industry: First, the exit of enterprises is related to the life cycle of the industry, and industrial growth will reduce the risk of enterprise exit. Studies by some scholars provide evidence that industrial growth has a negative impact on firm exit. Secondly, under the condition of perfect market mechanism, there is a close relationship between the entry and exit of enterprises in the industry. Some scholars named the positive effects of the previous entry and exit of enterprises in the same industry on the exit of the current period, respectively named the competition effect and the multiplier effect. Some scholars have provided evidence for the existence of competition effect and multiplier effect. Thirdly, the minimum effective scale for obtaining scale effect is different for different industries. If the minimum effective scale of the industry is larger, it will be more difficult for new entrants and existing incumbent enterprises to achieve this scale of production, so the risk of exit is also higher. correspondingly higher. Some scholars have found that the larger the minimum effective scale of the industry, the higher the risk of its enterprise exit. Finally, the higher the concentration of the industry, the greater the possibility of collusion among incumbent firms to resist new entrants.

The location factor analysis of foreign direct investment is one of the hot issues in the research of regional economics, business administration and even economic geography. The classic location theory holds that production cost is the main factor determining the location of a manufacturer, and foreign businessmen usually choose the lowest cost production location. This cost usually refers to production costs, including labor costs and transportation costs. In recent years, the cost school has made great progress and incorporates Coase's transaction cost theory into its analysis, arguing that the location selection of international investment depends on the level of transaction costs. Some scholars believe that, unlike local companies, foreign investors face high search costs, such as the costs of finding local

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production inputs, identifying local market potential, recruiting skilled labor, and managing a diverse production system. Such costs prompt foreign investors to adopt strategies to avoid investment risks and choose locations with low transaction costs [1]. This paper proposes a mathematical model of multi-objective programming, which solves the problem of market investment scheme, making the value of return as large as possible and the value of risk as small as possible. In order to facilitate the solution, we convert the nonlinear into linear, and use the weighting coefficient method to convert the two objective functions into an objective function, which reflects the risk level. In addition, when considering the transaction fee, the problem is very complicated due to the constraint of a minimum given value. In order to simplify, we simplify the problem to only consider the excess transaction fee, which is also conducive to solving. Finally, the optimal choice and benefit and risk table of the problem are solved by MATLAB.

2. Establishment of foreign investment risk model

There are n kinds of assets (such as stocks, bonds, ...) $S_i(i=1,\cdots,n)$ in the market for foreign investors to choose, and a company has a considerable amount of capital of M that can be used as an investment for a period of time [2]. The firm's financial analyst evaluates these n assets, estimates the average rate of return r_i for purchasing S_i during this period, and predicts the risk-loss rate q_i for purchasing S_i. Considering that the more diversified the investment, the smaller the overall risk, the company determined that when using the funds to purchase several assets, the overall risk can be measured by the largest risk of the S_i invested.

There is a transaction fee for buying S_i, the rate is p_i, and when the purchase amount does not exceed a given value u_i, the transaction fee is calculated on the purchase u_i (. In addition, it is assumed that the bank deposit interest rate in the same period is r_0, and there is neither transaction fee nor risk. Given the relevant data given by n = 4, try to design an investment portfolio plan for the company, that is, use the given funds to selectively purchase several assets or deposit in the bank to earn interest, so as to make the net income as much as possible large, and the overall risk is as small as possible. Try to discuss the above problems in general, and use the given data to calculate.

n represents the number of market assets. S_i represents the type of market asset (where S_0 represents the investment bank). m_i represents the proportion of funds that choose to invest in S_i (where m_0 represents the proportion of funds of investment banks). r_i represents the average yield on the purchase of S_i. q_i represents the risk-to-loss ratio of buying S_i. p_i is the transaction rate for buying S_i and U_i is the transaction fee. u_i represents the transaction fee when the transaction volume is low. M represents the total given investment capital. f represents the amount of net income. g represents overall risk.

This problem is a multi-objective programming problem, that is, to propose an investment plan that not only maximizes the benefits, but also minimizes the risks [3]. When investing each type of fund, there is a corresponding set of data, namely the rate of return r_i, the risk loss rate q_i, and the transaction rate p_i. For banks, $r_0=5\%, q_0=0, p_0=0$. However, when considering transaction fees, it needs to be considered in segments:

$$U_i=\begin{cases}0 & Mm_i=0;\\ u_i & Mm_i\le u_i;\\ Mm_i & Mm_i>u_i.\end{cases} \tag{1}$$

When considering the overall risk, we require the minimum value, and the risk is measured by the largest risk in all investment projects, that is, it is required to find a set of minimum solutions in the maximum risk value, which is actually a minimum maximum value. question. The two are contradictory, and we need to find a suitable investment solution between the two to solve the problem.

Create a multi-objective programming function:

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$$\backslash\max \ \ f=\sum_{i=1}^{4}(Mm_i r_i - U_i p_i)+Mm_0 r_0 \quad (2)$$

$$\min \ \ \text{g=max}\{Mm_i q_i\} \quad (3)$$

Restrictions:

$$s.t\begin{cases}\sum_{i=0}^{4}Mm_i+\sum_{i=1}^{4}U_i p_i=M \\ U_i>0, 0\le m_i\le 1\end{cases} \quad (4)$$

3. Solving the model

The complexity of the problem lies in the fact that the transaction fee has a constraint of the minimum given value. If some of the investment amounts are lower than the given value, the problem will be very troublesome [4]. We will judge whether the minimum given value is reached for each of the four investments twice. Then there is a total of $2^8=256$. Transaction fee in this case where the investment amount exceeds the minimum given value:

$$U=\sum_{i=1}^{4}U_i=\sum_{i=1}^{4}p_i u_i=103*0.01+198*0.02+52*0.045+40*0.065=9.9300$$

Obviously, the data is small and we can ignore it. In the best convenient situation, the investment amount in all 4 exceeds the minimum given value, which will make the problem clear and clear at a glance. However, in the assumption that M is quite large, we have all the more reason to ignore the case where the transaction fee is lower than the given value, and reduce the problem to consider only the transaction fee in excess. Relisted as:

$$U_i=\begin{cases}0 & Mm_i\le u_i; \\ Mm_i & Mm_i>u_i.\end{cases} \quad (5)$$

At this time, M is regarded as a unit quantity, so,

$$\max \ \ f=\sum_{i=1}^{4}m_i(r_i-p_i)+m_0 r_0 \quad (6)$$

$$\min \ \ \text{g=max}\{m_i q_i\} \quad (7)$$

$$s.t\begin{cases}\sum_{i=1}^{4}m_i(1+p_i)+m_0=1 \\ 0\le m_i\le 1\end{cases} \quad (8)$$

Now the problem is still more complicated, we use the weighting coefficient method for the two objective functions, and introduce the weighting coefficient λ . Converted to an objective function:

$$\min \ F=\lambda g+(1-\lambda)\cdot(-f) \quad 0\le\lambda\le 1 \quad (9)$$

λ reflects the risk level. In $\lambda=0$, foreign investors only pay attention to the benefits and ignore the risks. In this way, the benefits may be maximized, but the risks are also maximized. In $\lambda=1$, foreign investors are always worried about the risks and do not consider the benefits [5]. All in the bank. For the second objective function is a nonlinear, it is very troublesome to solve, but the formula always has a maximum value m_5 , then there is $m_i q_i\le m_5$, so the formula can be transformed into a constraint to make the problem simple.

$$\min \ F=\lambda m_5-(1-\lambda)\cdot(\sum_{i=1}^{4}m_i(r_i-p_i)+m_0 r_0) \quad (10)$$

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$$s.t\begin{cases}\sum_{i=1}^{4} m_i(1+p_i)+m_0=1 \\ m_i q_i - m_5 \le 0 \quad i=1,\cdots,4 \\ 0\le m_i \le 1\end{cases} \tag{11}$$

The above linear programming model can be easily solved by the linprog linear programming function of the MATLAB optimization toolbox. We take $\lambda = 0, 0.1, 0.2, \cdots, 1$, and the programming search solves the best choice and benefits and its risks are shown in Table 1:

Table 1: Portfolio Scenarios

λ	**0~0.03**	**0.04**	**0.05~0.2**	**0.21~1**
S_1	0.0000	0.0000	0.0000	1.0000
S_2	0.9901	0.3690	0.2376	0.0000
S_3	0.0000	0.6150	0.3960	0.0000
S_4	0.0000	0.0000	0.1080	0.0000
Investment bank	0.0000	0.0000	0.2284	0.0000
Income	0.2673	0.2165	0.2016	0.0005
Risk	0.0248	0.0185	0.0238	0.0000

4. Results of the problem

The relationship between return and value at risk in the portfolio table is shown in Figure 1:

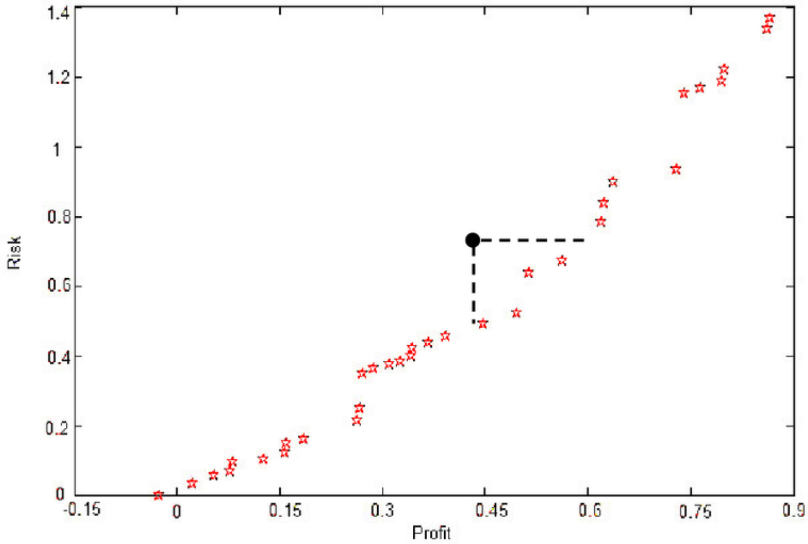

Figure 1: The relationship between return and value at risk

As the benefits increase, the risks also increase. This is in line with the laws of ordinary life. It can also be seen from the figure that when the risk is 0, the return value is 0.05, which is exactly the return value of all investment banks at this time.

In this paper, the weighted coefficient method is used to transform the multi-objective programming into a single-objective linear programming problem:

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$$\min\ F = \lambda m_{n+1} - (1-\lambda)\cdot(\sum_{i=1}^{n} m_i(r_i - p_i) + m_0 r_0)$$
$$s.t\begin{cases}\sum_{i=1}^{n} m_i(1+p_i) + m_0 = 1 \\ m_i q_i - m_{n+1} \le 0 \quad i=1,\cdots,n \\ 0 \le m_i \le 1\end{cases} \tag{12}$$

For $n=15$ in the general case, the following calculation is performed. Since it is generally assumed that the investment amount is small, it can be ignored [6]. Verify the transaction fee in this case:

$$U = \sum_{i=1}^{15} U_i = \sum_{i=1}^{15} p_i u_i = 181.6730 \tag{13}$$

It can be seen that for fairly large M, this value is not time-consistent. Using the same method to calculate the best choice, benefits and risks are shown in Table 2:

Table 2: Portfolio scenarios at time $n=15$

λ	**0**	**0.01**	**0.02~0.03**	**0.04~0.05**	**0.06~0.07**	**0.08**	**0.09**	**0.1~1**
S_1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0518	0.0000
S_2	0.0000	0.0000	0.0000	0.0000	0.0453	0.0425	0.0403	0.0000
S_3	0.9434	0.0498	0.0456	0.0427	0.0407	0.0383	0.0362	0.0000
S_4	0.0000	0.0000	0.0000	0.0611	0.0582	0.0547	0.0518	0.0000
S_5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Deposit bank	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
Net income	0.4094	0.3207	0.3166	0.3107	0.3031	0.2909	0.2794	0.0500
Value at risk	0.5660	0.0299	0.0273	0.0256	0.0244	0.0230	0.0217	0.0000

The relationship between return and VaR in the portfolio table above is shown in Figure 2:

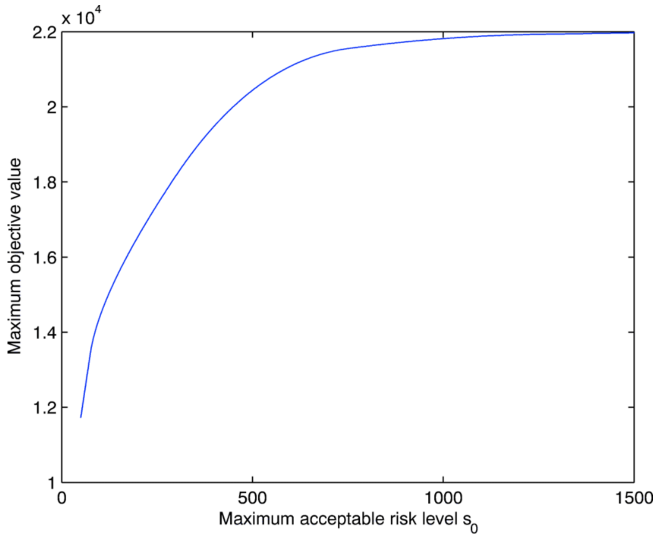

Figure 2: The relationship between return and risk at time $n=15$

As can be seen from the figure, as the benefit value increases, the risk also increases. We can build a return-risk function by simple curve fitting to find the optimal combination.

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5. Model testing and sensitivity analysis

When we simplify the model, the solution set is given under the premise of $Mm_i > u_i$, that is, to satisfy every investment: $m_i > \frac{u_i}{M}$. For this condition, since the given value of u_i is generally small and M is sufficiently large, it is easy to satisfy [7]. But when our model is at $0 < m_i \le \frac{u_i}{M}$, the solution given is no longer optimal.

Under the condition that the applicability is satisfied, we have to find a minimum investment amount $M_{\min} = \max\{\frac{u_i}{m_i}\}$, and see the sensitivity in different situations. The corresponding $M_{\min}$ values for different λ values are shown in Table 3:

Table 3: $M_{\min}$ for different λ values

λ	**0~0.03**	**0.04**	**0.05~0.2**	**0.21~1**
$M_{\min}$	199.9798	536.5854	833.3333	Not consider

In general, the value of $M_{\min}$ is small compared to the sufficiently large M; and it can be seen that within the large range of $\lambda \in [0.21,1]$, all are deposited in the bank, regardless of the minimum value. In the case of increasing n, the gain value is larger and the risk value is smaller. That is to say, the more diversified the investment, the smaller the overall risk and the greater the net return [8]. Due to the large number of data values in each group of investment projects and easy to change, it is more complicated to refer to. In this problem, the bank interest rate is a single quantity. Now let's examine the impact of different r_0 on the problem. r_0 takes 5%, 10%, 15%. It can be seen from the calculation again that the resulting benefit value and risk value have not changed. Therefore, it can be seen that when M is large, it is inappropriate to choose a bank. Because the yield of other assets is higher than that of banks to a certain extent, but the corresponding risk is also increased.

6. Conclusion

In this problem, a multi-objective linear model is given, considering the advantages and disadvantages of investment to a certain extent, and the weighting coefficient method is used to simplify the problem under the condition that M is sufficiently large. The foreign investment risk analysis becomes a linear programming model. The solution is obtained using the optimization toolbox in MATLAB.

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