

Modified NPV Model as a New Evaluation Approach of Investment Decision

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Abstract: This paper is proposed to explore an appropriate strategy for evaluating enterprises' investment decisions. As a consequence of the scarcity of market resources and limited enterprise budget, when expanding business, it is necessary for enterprises to decide which project is worthy of investment and their priority. The data is collected from an insurance enterprise, which faced an investment decision in 2015. The enterprise received the applications from Dalian, Qingdao, and Ningbo branches, concerning constructing their subordinate institutions. Through assessing with the widely applied Net Present Value (NPV) model, which performs as a gold rule in this field. The net cash flow is the direct yield for an enterprise, and it is calculated by discounting predictable future income until 2020 and subtracting initial investments in 2015, containing time value of money presented as discount factor. According to calculation, the NPV value of establishing institution in Ningbo Branch is the highest, which signifies that it is cost-effective and should be prioritized. In this research, the risk factor of discount rate fluctuation is considered and incorporated into the original calculation structure, forming a modified version—Net Present Value at risk (NPV at risk). There are differences between the values of two models, which will be an important impact for enterprises' investment decisions.

1. Introduction

By the end of 2021, the investment end of the insurance industry had continued to release policy dividends. China Banking and Insurance Regulatory Commission has frequently issued statements of deregulation in certain fields, including the opening of investment projects of new facilities and products, the approval of high profits and large-scale business, and optimization of the rating requirements etc. Therefore, the insurance industry is well grounded and guaranteed to implement corporate expansion in 2022. Owing to the scarcity of social resources and limited budget, trade-off exists among different investment projects, for instance, the selection of establishing institution. Mature enterprises own branches, and each branch will apply for capital resources to head office as a consequence of market opportunities, project requirements or foreseeable benefits. For enterprises, it is required to decide the investee according to the reports of branches and the evaluation of policy, market and demand. Enterprise expansion is a common phenomenon over the world, and the model which determines enterprise's decision of expansion investment is significant. It will directly influence future earnings.

This paper investigates the evaluation model for enterprises to make investment decisions. Limited resources force enterprises to take the priority of branch expansion seriously. For evaluation models, the NPV model has been most widely applied recently. In Application of NPV Method in Venture Capital Project Evaluation Gao [1] expounds how NPV operates in evaluating venture capital projects, including the determination of final value, discount rate, present value and equity ratio with the consideration of the stage of capital investment. It finally verified that the NPV method is suitable for venture capital evaluation while it needs to be modified with after-tax profit and P/E ratio etc. Besides, Bai [2] has suggested that NPV will introduce coefficient of critical success factors, which directly contribute to condition of the diversification project. In his paper entitled Application of NPV Method in Diversification Project, the time of delivery is a success factor for transportation industry. After

multiplying and prescribing, results obtained are more accurate but different with those calculated by traditional NPV model. Other models that can evaluate investment decisions are less complete than NPV. Whenever there is a contradict, NPV has always been the primary principle. According to Lu [3], within the Comparison between NPV and IRR method, although NPV is the golden rule, IRR has several advantages. It is calculated without using discount rate as benchmark which weakens the effects of inflation or opportunity cost, and it reflects fund utilization efficiency. However, all backward characteristics are possible to be compensated through optimization, like combining the benefit indicator NPV with the efficiency indicator——Net Present Value Index.

Objectively speaking, limitations of NPV are unavoidable. NPV can hardly reflect real circumstances because of market fluctuations. Tang [4] once illustrated in Evaluation of the Option in NPV Rule During Investment, that in reality, there are few static nodes where investors can either execute or abandon. Therefore, dynamic analysis and probability status are required to be investigated in NPV model. Understanding the variation of discount rate and the significance of option is recognized as the source of value. Moreover, in Objections to The Current NPV Method, Yuan [5] argued that although the initial investment in the current NPV model deducts funding costs, the discount rate is still subject to funding rates. Without taking into account financing cost, every calculation will repeatedly offset it, which increases the cost of capital and over-adjusts the amount of cash outflow. Therefore, enterprises should pay attention to the treatment of financing costs, ensuring the deviation of NPV exists within the ideal range.

As a consequence, scholars have carried out researches for improving it. According to Limitations of NPV Method and Its Improvement, Wang [6] affirmed the value of NPV model for financial feasibility evaluation of investment projects at beginning. His paper is divided into four sections, including the basic principle of NPV method, limitations, and improved ideas combined with the value of options. In terms of the modification, Wang recommended to calculate discount rate by utilizing Capital Asset Pricing Model (CAPM), and to apply its lowest rate instead of an interval. Meanwhile, he also emphasized the timing of investing and advocated to deal with the changeable market environment with new form of NPV+ROV. Similarly, Shu and Yuan [7] also proposed measures for optimization in Defects of NPV Method in Investment and Its Improvement. Authors firstly acknowledged NPV model and then criticized its authority from the perspective regarding excessive deduction of financing cost, double calculation of interest cost, and the difficulty in reflecting the reality with weighted average. It is advised to adjust the discount rate based on perceived risk and strengthen the management of options with Black-Scholes model. Additionally, Guo [8] dissected and compared the derivative products of NPV model in Discuss the Evolution of NPV rule: APV and EVA. As NPV owns its applicability, Guo indicated the necessity of sensitivity analysis, which covers the predictability of cash flow and the influence degree of discount rate. Adjusted Present Value (APV) considers the variation of the cost of capital and is separately calculated based on different sources of cash flow, including equity and debt. The basic expression of Economic Value Added (EVA) is residual income, which is directly measured by deducting capital cost from after-tax net operating profit. Weakening discounting process simplifies the decision-making process, and EVA became increasingly popular as it focused on shareholder value creation. In particular, NPV lacks coverage of risk. In Firm Projects and Social Behavior of Investors, Hudakova [9] claimed that NPV of similar project and industry is usually normally distributed. After adding statistics knowledge, she designed a risk parameter which equals to the difference between the industry average NPV and the NPV obtained by a particular enterprise. Projects are analyzed in front of the whole industry and the impact of market risk are considered. In order to improve the model for reflecting the reality, adding risk segments is beneficial for enterprises to consider all possible events. As far as Zhang [10] concerned, NPV at Risk is expressed with a given confidence level as normal distribution is adopted to interpret the confidence level of NPV value. In the NPV at Risk in Economic Evaluation of Multi-investor Construction Projects, owing to the long period, large investment base and high risk of construction projects, the NPV at Risk approach is more appropriate by combining weighted average cost of capital model and Monte Carlo method.

In this paper, risk factor is designed as the difference between predicted annual discount rates and their average, referring to the concept of variance in statistics, and it is added to denominator in the term of every discounting returns. By analyzing the institution construction project of Changan, it is discovered that there are differences between the calculated values of NPV and its improved version with risk factor. Traditional NPV model discounts expected future cash inflows to the present at average rate of 11.7% and receives the difference with the costs of relevant projects in Qingdao, Ningbo, and Dalian. Based on the NPV rule, if the budget can be satisfied, the branch with larger NPV is supposed to be preferentially invested, which is Ningbo, meaning that the discounted net cash value of establishing institutions in Ningbo Branch is bigger, with a simultaneous consideration of construction payment and possible revenue. However, the NPV model with risk parameter improves the regulation of discount rate. Instead of calculating a single weighted average 11.7% of all expected discount rates, the volatility of the discount rate in following years is introduced. On account of the large differences among the original NPV values and little distinction of those discount rates, the final results of expansion decisions are equal. Nevertheless, the results may be different when utilized data for calculating. In reality, owing to the varying market environment, plenty of unavoidable risks are hidden in the implementation process of every project, and the future inflow of cash cannot be guaranteed. Hence, the structure of NPV model with risk parameter owns more reference value.

2. Data

The data utilized in this research is obtained from the insurance market, which was converted by a City branch of Changan Liability Insurance Co., LTD. Changan Liability Insurance Co., Ltd. was established on November 07, 2007, covering liability insurance, property loss insurance, credit insurance and guarantee insurance etc. In terms of its scale, Changan Liability Insurance Co., Ltd. has established provincial-level and city-level institutions and approximately 300 branches nationwide, providing more than 14 trillion Chinese yuan of society risk protection and serving nearly 20 million customers. This research concentrates on its decisions on enterprise expansion: under the premise of limited capital, it is required to consider the priority of branch selection, for investing in their institution construction.

This paper investigates a project which was expected to launch in three city branches of Changan Liability Insurance Co., LTD, including Qingdao, Ningbo and Dalian.

Therefore, it is necessary to undergo feasibility analysis, for instance, forecasting net cash flow which is a direct yield for firms, according to market and previous information. Among which, the initial cash investment is called preparation cost by the insurance industry, including the rental cost of institutional construction, labor training cost, water and electricity costs, etc. Future estimated annual cash flow is divided into cash inflow and outflow. Premium is inflow, while outflow generally contains sales expenses, administrative expenses, customer service expenses, legal taxes and fees. Concrete data is listed in Table 1 and exhibited in Fig. 1.

The preparation of its investment contains firstly, estimating the growth rate of cash flows on account of historical trend. Secondly, investors are supposed to recognize current year's cash flow as the base, combine the estimated growth rate thus forecast cash flows in next few years.

Moreover, the discount rate in insurance industry is calculated for the reserve, which is defined as the net cash flows after deducting premiums payable for future liabilities, performing as an insurer's biggest expense. On the basis of the "Benchmark Yield Curve for Measurement of Insurance Contract Reserves" compiled by China Central Government Bond Registration and Clearing Co., LTD., Changan drew on the higher annual discount rates (lower estimated cash flow for conservative calculation) in previous years, which was 10.5%, and adopted in 2015. The discount rates in following years' calculation were retrieved with a view to predictable insurance market fluctuations.

Table 1 The Predicted Cash Flows of Three Branches from 2015 to 2020 and Related Discount Rate of Each Year

Branch	2015	2016	2017	2018	2019	2020
Qingdao	-1.83	2.66	2.98	3.28	4.10	3.78
Ningbo	-2.44	3.55	3.74	4.07	4.48	4.86
Dalian	-1.43	2.06	2.18	2.29	2.35	2.55
Discount Rate (%)	10.5	11	11	11.5	11.5	11.5

a. Note: Cash Flow Unit: Million Chinese yuan
 Source: Insurance industry data released by the market [11]

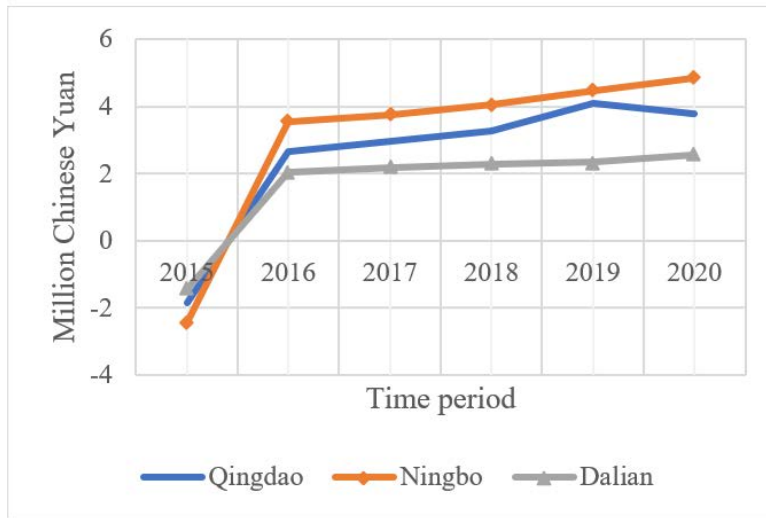


Fig 1 The Estimated Future Cash Flow from 2016 to 2020 Concerning Institution Investment of Changan in 2015

3. Model

This paper investigates enterprise expansion project, that it is necessary to consider the priority of branch selection owing to limited resources. Different branch appeals are evaluated with the assistance of NPV model and its modified version——NPV at risk in this research:

3.1 NPV

The establishment of institutions is a significant decision with far-reaching influence for every enterprise. The consumption level, market demand and operating capacity of different locations are different, which can directly affect the profitability and continuity of enterprises in the future. Due to restricted initial investment, enterprises cannot set up subsidiaries in all ideal regions, that is, expansion is limited, so it is necessary for enterprises to select a location for establishing an institution. NPV has recently considered as a golden rule as it focuses on net cash flow, which is the direct earnings of the business, and also takes into account the time value of money expressed as a discount factor. In general, investors are willing to choose higher projects with positive NPV to maximize proficiency.

$$NPV = C_0 + \sum_t (CF_t \frac{1}{(1+\bar{r})^t}) \quad (1)$$

The formula is listed above, where C_0 is on behalf of initial investment in cash, CF_t represents cash inflow in year t, and \bar{r} is the average rate of the predicted discount rate.

3.2 NPV at risk

However, with the diversification of the market, the NPV model lacks consideration of the predictable risks of establishment and later operation of institutions, and there is great uncertainty

about whether the target institution can achieve its expected cash flows. In this research, risk factor is incorporated into the calculation process of NPV model, thus NPV-at-risk method is proposed. In particular, the paper uses the risk premium to represent the risk factor, which is processed by calculating the weighted average of discount rates and make a difference between the average and current discount rate. Therefore, the NPV at risk can be shown as:

$$NPV_{risk} = C_0 + \sum_t^{\infty} (CF_t \frac{1}{(1+\bar{r}_t)^t(1+r_p)}) \quad (2)$$

The formula is listed above, \bar{r}_t is market rate in each year and r_p is risk premium.

4. Result

Based on the data collected, calculation results of NPV and NPV at risk models are separately filled in the following tables.

Table 2 The NPV of Three Branches from 2015 to 2020

Branch	NPV
Qingdao	10.27
Ningbo	12.54
Dalian	6.89

a. Note: Cash Flow Unit: Million Chinese yuan

As Table 2 shown, the initial screening condition is if the NPV value is greater than zero. In terms of the above case, opening subsidiary institutions in Qingdao, Ningbo and Dalian can all generate positive revenue. Therefore, when the budget can be satisfied, the branch company with the larger NPV is supposed to be preferentially selected for investment, which signifies that the discounted NPV value is larger. Therefore, investing in Ningbo Branch is more efficient for enterprise development. However, it is also necessary to consider the initial investment, which is the preparation cost of investing in every branch for constructing corresponding institution. Under the NPV model, investment in Ningbo Branch seems to be more profitable at present, while its input is relatively higher, which is nearly 2.44 million yuan. As a consequence, enterprises should determine whether existing funds are available to support the project investment.

Table 3 The NPV at risk of Three Branches from 2015 to 2020

Branch	NPV
Qingdao	10.28
Ningbo	12.54
Dalian	6.85

a. Note: Cash Flow Unit: Million Chinese yuan

As Table 3 shown, investing in Ningbo Branch for constructing institution is also more efficient for enterprise expansion. The final outcome is similar to the one reached by the NPV model. In this circumstance, owing to the limited variation of annual discount rate and the large cash flow base, the different calculation processes of two models does not influence project selection, though the value varies. It is still essential to utilize an appropriate approach as the eventual decision may change with different models. As the market environment is continuously changing, combining risk factor to the present NPV model is beneficial as it offers more rigorous reference for enterprises.

5. Conclusion

In conclusion, this paper investigates the evaluation approach of investment decisions launched by enterprises and analyzes the traditional NPV model and its modified version which proposed with a combination of the risk factor. Throughout the paper, it is demonstrated surrounding with the case of deciding the priority of constructing subordinate institutions by an enterprise of its city-level insurance

branches, including Ningbo, Qingdao and Dalian. After calculating with NPV model, investing in Ningbo Branch will bring more substantial returns. In view of the market fluctuation and the potential error by using the average discount rate, this paper redesigns NPV formula and introduces the risk factor to denominator, forming NPV at risk. There is a difference between the obtained values of the two models. However, owing to the large differences among NPV values of three branches, the eventual decision is not affected under this circumstance, while it is still necessary to be considered in other situations. The direction of investment is of great significance. When facing expansion, enterprises should evaluate the benefits and expenses of each investment appeal according to the model. In addition to the expected future cash inflows and the preparation outflow there are still quantities of elements that will influence the investment decision, for instance, the fluctuation of discount rate discussed in this research, and the risk of receiving future income etc. This is a financial issue that all business managers should pay attention to. The selection of projects will directly contribute to enterprise's condition and social status, including the demand for its products and services, how it coordinates with the booming market, its profits and the degree of target achievement. However, this paper only covers the risk of encountering different discount rates, abandoning the traditional structure of applying the weighted average as a single data in NPV calculation. In the future research, scholars are recommended to take other influential factors into account and bring them into the framework of NPV gradually, so as to optimize and complete NPV model for better reflecting the actual net estimated value.

References

- [1] Z. Gao, "Application of NPV Method in Venture Capital Project Evaluation," in *Journal of Dalian Railway Institute*, vol. 26, no.3, 2005.
- [2] S. Bai, "Application of NPV Method in Diversification Project," in *Sichuan Accounting*, pp.3-37, 2003.
- [3] J. Lu, "Comparison Between NPV and IRR Methods," in *Industrial Technical Economy*, vol. 16, no.3, pp.73-75, 1997.
- [4] M. Tang, "Evaluation of the Option in NPV Rule During Investment," in *Decision-making Reference*, no.3, 1998.
- [5] Y. Yuan, "Objections to The Current NPV Method," in *Finance and Accounting Monthly*, 1999.
- [6] S. Wang, "Limitations of NPV Method and Its Improvement," in *Finance and Accounting Newsletter*, no.8, pp.87-88, 2009.
- [7] H. Shu, "Defects of NPV Method," in *Journal of Jiangxi University of Finance and Economics*, no.19, pp.36-40, 2002.
- [8] G. Guo, "Discuss the Evolution of NPV rule: APV and EVA," in *Modern Management Science*, no.4, pp.25-27, 2003.
- [9] J. Hudakova, "Firm Projects and Social Behavior of Investors," pp.1-14, 2005.
- [10] W. Zhang and Y. Wu, "NPV at Risk in Economic Evaluation of Multi-investor Construction Projects," in *Optimization of Capital Construction*, vol.23, no.6, 2002.
- [11] City branches of Changan Liability Insurance Co., LTD