Discrimination and Analysis of Misunderstandings in Power Engineering Project Economic Evaluation

Gu Zheng, Nan Zhe, Zhang Shuangying

State Grid Liaoning Electric Power CO, LTD. Power Electric Research Institute, Shenyang, Liaoning110015, China;

ABSTRACT. *The internal rate of return IRR is an important indicator in the economic evaluation method of power engineering projects, and it is widely used. However, due to the complex calculation of IRR and the uncertainty of the solution in unconventional projects, some scholars suggest using the external rate of return ERR instead of IRR. In fact, this is a misunderstanding. Through the "reinvestment theory", "computational complexity", "existence and uniqueness of solutions" and other aspects, detailed analysis and specific examples point out the misunderstanding of replacing IRR with ERR, and the argument is also Affirmed the significance of the existence of IRR. The calculation method of IRR was improved, and the iterative interpolation method was obtained. In non-conventional projects, the modified internal rate of return method MIRR can also be used to make up for the indispensable shortcomings of IRR.*

KEYWORDS: *Reinvestment theory; iterative interpolation*

1. Introduction

The internal rate of return is an important indicator for dynamic economic evaluation of power engineering projects. This indicator takes into account the time value of funds, and intuitively reflects the maximum possible profitability of power engineering project investment [1]. And this indicator is derived from internal The characteristics of the generated cash flow are determined by the cash flow specified by the internal conditions of the power engineering project. It reflects the pure profitability of the power engineering project itself, so it is called the internal rate of return. This indicator is not like the net cash flow. It is necessary to set a benchmark discount rate in advance to calculate the value, net annual value, etc. Therefore, in the economic evaluation of power engineering projects in China, the internal rate of return is used as a main indicator. However, due to the cumbersome calculation process of the internal rate of return, Unconventional projects may have no or multiple solutions, causing some inconvenience in practical applications. In response to these problems, some scholars have proposed the use of external rate of return instead of the internal rate of return. In some special cases, it does solve some

problems, but the fundamental basis for the external rate of return is to modify the unreasonable "reinvestment theory" in the original internal rate of return. Scholars have not yet reached an agreement on the existence of "investment theory", and there is no final conclusion. I believe that the traditional views put forward by most scholars and the advantages of listing various external rates of return instead of internal rates of return have led people into two major mistakes[2-5]. This article will conduct a careful analysis of the two major misunderstandings, which are specifically divided into "reinvestment theory" and "computational complexity and the existence and uniqueness of solutions", respectively expounding the irrationality of the external rate of return instead of the internal rate of return. At the same time, in view of the shortcomings of high computational complexity and insufficient accuracy in conventional projects, this article proposes an improved method for calculating the internal rate of return --- iterative interpolation method; for the situation where the internal rate of return has no or multiple solutions in unconventional projects, It provides a more accurate and convenient method for the evaluation of electric power engineering projects—modifying the internal rate of return method MIRR to make up for the indispensable deficiency of the internal rate of return in unconventional projects[6-9].

2. Misunderstanding analysis

The traditional view is that the "reinvestment theory" implied in the IIRR calculation process does not conform to objective reality. The so-called "reinvestment theory" means that the funds obtained by the power engineering project during the entire calculation cycle are non-static, and the investment in each period The funds obtained from the income can be reinvested immediately, and the reinvestment interest rate is the existing IIRR, and the reinvestment is repeated to form an appreciation, which constitutes the reinvestment theory. However, from the perspective of reinvestment opportunities, usually power projects The net cash flow obtained after the project is completed and put into production can no longer be invested in the power engineering project, that is, it cannot be calculated at the rate of return of the power engineering project. The reason is that the amount of funds recovered each year is less than the initial funds, and the time this fund can be used It is also relatively short. Under normal circumstances, if reinvested, the rate of return is not only lower than the initial investment rate of return, but may also be lower than the benchmark rate of return. [10-12] The traditional view is that the reinvestment rate assumption of the IRR method is unreasonable. Therefore, it is recommended to choose an appropriate interest rate as the real reinvestment interest rate-the benchmark discount rate. The benchmark discount rate comprehensively considers external dynamic conditions such as social profit rate and industry investment return rate, as the reinvestment interest rate is closer to objective reality. The calculated new index is IERR, so IERR is more reasonable and realistic than IIRR.

If the "reinvestment theory" is reasonable, those who advocate the use of the IERR indicator believe that the reinvestment interest rate used in the IERR calculation-the benchmark rate of return is closer to the objective reality. As we all

know, the benchmark discount rate is not calculated, but By investigating other factors such as the market and the decision-making parameters determined by the investment department, the determination process is affected by both subjective and objective factors, so it is impossible to accurately determine it. As a reinvestment rate, it fundamentally affects the accuracy of IERR. This leads to the inaccuracy of the sum of the final value of the cash flow in each year.

3. IRR improvement method

Below we divide power engineering projects into conventional projects and unconventional projects, and for the shortcomings in the calculation of IIRR, we will introduce corresponding solutions one by one.
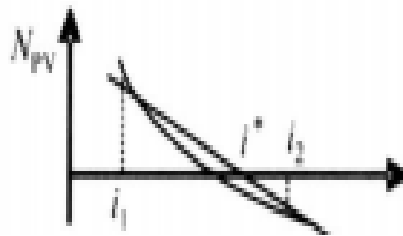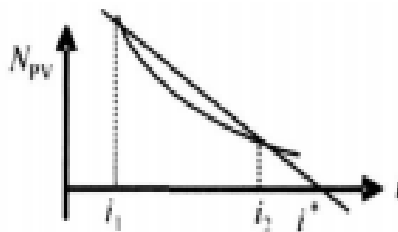

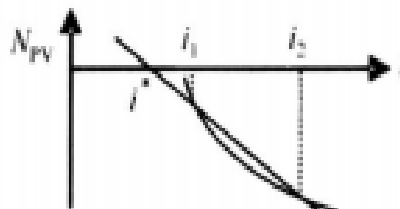*Figure 1. Connect A*

Figure 2. Connect B

Figure 3. Connect C

Through the above analysis and examples, the following conclusions can be drawn: The improved iterative interpolation method, although the initial selection value is quite different, does not affect the iteration, can quickly approach the accurate value, and the final error is small. Therefore, this method can be solved. The traditional interpolation method finds the defects of large amount of calculation and insufficient precision when looking for the initial value, and because it is repeated iteration, it is very convenient for computer calculation[13-16].

4. Conclusion

Through the above analysis and discussion, it can be seen that in the economic evaluation methods of power engineering projects, many scholars believe that the ERR method is better than the IRR method in several major aspects that are actually misunderstandings.

The analysis in this article demonstrates the rationality of the IIRR method, which is also the IIRR method. For the reasons for the current economic evaluation indicators of the main power engineering projects, some improvements have been made to the IIRR. The main conclusions are as follows:

1) The so-called "reinvestment theory" in the IRR method is actually an equivalent mathematical transformation to its formula The distorted understanding of the economic meaning of "IRR" is not the true meaning contained in the definition of the IRR method. Therefore, the ERR method is used to modify the "reinvestment rate" in it, and then replace IIRR. This statement has no scientific basis and does not conform to objective reality.

2) IERR may be simple to calculate for some special situations, but no matter how many equal or unequal amounts are invested in a power engineering project, higher-order equations may appear. According to mathematical principles, higher-order equations may have multiple or no solutions. There is not necessarily a unique solution.

3) Improved method for calculating IIRR 1 — Iterative interpolation method can reduce the computational complexity, facilitate computer calculations, and through multiple iterations, the accuracy requirements can be achieved.

4) Calculation of IIRR Improved method 2-MIRR method, can solve the situation of no or multiple solutions in unconventional power engineering projects, the solution process is simple, the result is unique, and the judgment is also consistent with the IRR method.

References

[1] National Planning Commission. Economic evaluation methods and parameters of construction projects [M], Beijing: China Planning Press. 2006.
[2] Luo Chenglian, Ji Yong, Liu Zunyi. Principle and Implementation of Static Synchronous Compensator (STATCOM) [M]. Beijing: China Electric Power

Press, 2005.

[3] Barker PP, De Mello R W. Determining the impact of distributed generation on power systems. I. Radial distribution systems [C]//Power Engineering Society Summer Meeting, 2000. IEEE. IEEE, 2000, 3: 1645-1656 .

[4] Zhang L, Sidhu T S. New Dynamic Voltage and Reactive Power Control Method for Distribution Networks with DG Integration [C]//Electrical Power and Energy Conference (EPEC), 2014 IEEE. IEEE, 2014: 190-195.

[5] Pouresmaeil E, Mehrasa M, Catalão J P S. A multifunction control strategy for the stable operation of DG units in smart grids [J]. IEEE Transactions on Smart Grid, 2015, 6(2): 598-607.

[6] Pan Guoqing, Zeng Dehui, Wang Gang, et al. Failure Analysis Method of Distribution Network with PQ Control Inverter Distributed Power Supply[J]. Proceedings of the CSEE, 2014, 34(4): 555-561.

[7] PAN G Q, ZENG D H, WANG G, et al. Fault analysis on distribution network with inverter interfaced distributed denerations based on PQ control strategy [J]. Proceedings of the CSEE, 2014, 34(4): 555-561.

[8] KONG Xiangping, ZHANG Zhe, YIN Xianggen, et al. Study on fault current characteristics and fault analysis method of grid with inverter type distributed power supply[J]. Proceedings of the CSEE, 2013, 33(34): 65-74.

[9] KONG X P, ZHANG Z, YIN X G, et al. Study on fault current characteristics and fault analysis method of power grid with inverter interfaced distributed generation [J]. Proceedings of the CSEE, 2013, 33(34): 65-74.

[10] Xu Li, Lu Juchun, et al. Technical Economics [M]. Wuhan: Wuhan University No. 41 Volume Publishing House. 2007.

[11] Rigg s J L. Eng ineering Economics[M] .M cGraw-Hill Book Company, 1982.

[12] Lu Ning, Wang Chengyu, Cai Aiyun, etc. The external rate of return replaces the internal rate of return Suitability analysis [J]. Journal of Chang'an University (Social Science Edition), 2005, 7(1): 47-51.

[13] Tao Shuren. Recognition of the economic meaning of internal rate of return [J]. Chemical Technology and Economics, 1999, 6:32-34.

[14] Sun Xuyuan. Discrimination on the implicit assumptions in the concept of internal rate of return [J]. Journal of Wuhan University (Humanities and Social Sciences Edition), 2000, 53(1): 66- 67.

[15] Rao Yangde. Discussion on the correction of internal rate of return in technical economy [J]. Industrial Technical Economics, 2003, (1):106-107.

[16] Tang Yifen, Luo Yunfeng. Analysis on the relationship between internal rate of return and cash flow model[J]. Journal of Huazhong University of Science and Technology, 2001, 29(10): 34- 36.