MATHEMATICAL MODELS OF DISCOUNTING METHODS IN EVALUATION OF INVESTMENT PROJECTS

Karshiboyev Kh.K.

Samarkand Institute of Economics and Service,

Head of the Department of "Higher Mathematics",

Associate Professor, PhD. ***karshiboev@mail.ru***

Annotation: This scientific article analyzes the mathematical foundations of the theory of the time value of money and discounting methods in assessing the economic efficiency of long-term investment projects. The relevance of the study is that in a modern economy with inflation and opportunity costs, calculating the future nominal income of the project leads businesses to incorrect conclusions. To solve the problem, the mathematical model of Net Present Value (NPV) and the formula of compound interest were used. Using the example of a conditional production enterprise, the future cash flows of the investment project were discounted to the present day, and the real economic efficiency of the project was calculated. As a result of the study, the decisive importance of the NPV indicator in making investment decisions for local enterprises was mathematically proven.

Keywords: investment project, discounting, time value of money, net present value (NPV), discount rate, capital investment, economic efficiency.

INTRODUCTION

One of the golden rules of a market economy is: "A soum today is worth more than a soum tomorrow." There are three main reasons for this: inflation (the depreciation of money), alternative options (the ability to deposit money in a bank and earn interest), and uncertainty (future risks). Therefore, before any enterprise invests its funds in new projects (for example, building a new factory or purchasing

modern technology), it is necessary to calculate the future income of the project using accurate mathematical models, which are adjusted to the present.

The problem raised in the article is precisely related to the "financial foresight" in investment planning. Many inexperienced managers simply add and subtract the total costs of the project from the total nominal income it will bring in the future. This can lead to very large financial errors and the collapse of the enterprise. The relevance of the research is explained by the development of mechanisms for the correct use of the discounting apparatus in making investment decisions. The purpose of the work is to explain the algorithm of the net present value (NPV) formula and demonstrate its practical advantages on the example of a specific business case.

LITERATURE REVIEW

The theory of the time value of money is the basis of financial mathematics, and its scientific foundation was created by the American economist Irving Fisher at the beginning of the 20th century. Later, this theory was transformed into a modern business planning standard by such major corporate finance specialists as R. Brealey and S. Myers. Today, in world practice, NPV (Net Present Value) and IRR (Internal Rate of Return) are the main indicators in the assessment of large investment projects.

In Uzbekistan, the scientific work of T.Sh. Shodiev and F.O. Khusanov on the issues of assessment and modeling of investment projects is of great importance. In particular, F. Khusanov, in his research entitled "Methods of optimal decision-making in modeling economic processes", covered various approaches to optimizing capital investments and assessing risks. Nevertheless, in practice, many small and medium-sized business entities still use simple but unreliable methods such as "payback period" rather than complex mathematical discounting methods. This creates the need to explain these mathematical models in a simpler and more practical language.

RESEARCH METHODOLOGY

In financial mathematics, the Net Present Value (NPV) model is used to evaluate investment projects. The purpose of this method is to reduce all expected future cash flows to their present value using a certain percentage (discount rate) and compare them with the initial costs.

First, let's look at the formula for calculating the present value (PV - Present Value) of a single future payment:

$$PV = \frac{FV}{(1+r)^t}$$

Where:

FV – future value of money (Future Value);

r – discount rate (coefficient taking into account inflation and alternative rate of return, in percentages);

t – time period (number of years).

If the project generates income for several years, the NPV formula is formed by bringing all of them to the present and subtracting them from the initial investment:

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+r)^t} - I_0$$

Here:

CF_t – expected net cash flow in each t -year (Cash Flow);

I_0 – initial capital investment to start the project (Initial Investment);

n– total project life.

Mathematical decision-making rule: If $NPV > 0$, the project is profitable for the enterprise and should be accepted. If $PV < 0$, the project is financially unprofitable and should be canceled.

DISCUSSION AND RESULTS

To demonstrate the practical significance of the mathematical theory, we will analyze a new project of the conditional "Sanoat-Tex" LLC enterprise. The enterprise management plans to purchase new production equipment worth $I_0 = 500$ million soums. According to expert calculations, this equipment will bring the following net cash flow (CF) to the enterprise over 3 years:

At the end of year 1: 200 million soums;

At the end of year 2: 250 million soums;

At the end of year 3: 300 million soums.

Currently, the average annual interest rate (discount rate) for commercial loans or deposits in banks is set at $r = 15\%$ (0.15).

If the head of the enterprise does not know the discounting method, he evaluates the project using simple arithmetic: Total expected revenue $=200 + 250 + 300 = 750$ million soums. Profit $750 - 500 = 250$ million soums. He comes to the hasty and erroneous conclusion that "the project is very profitable."

Now we mathematically discount the same project using net present value (NPV):

$$NPV = \frac{200}{(1+0.15)^1} + \frac{250}{(1+0.15)^2} + \frac{300}{(1+0.15)^3} - 500$$

We calculate the value of each year separately:

The present value of the first year's income: $200/1.15 = 173.91$ million soums.

The present value of the second year's income: $250/(1.15)^2 = 250/1.3225 = 189.04$ million soums.

The present value of the third year's income: $300/(1.15)^3 = 300/1.5208 = 197.26$ million soums.

We add all discounted revenues and subtract the initial cost:

$NPV = 173.91 + 189.04 + 197.26 - 500 = 560.21 - 500 = 60.21$" (mln soums)" .)

Analysis of the results:

Mathematical calculations showed that although the project seems to bring a net profit of 250 million soums in nominal terms, taking into account the depreciation of money over time (15% rate), the actual net value that the project will add to the wealth of the enterprise is only 60.21 million soums. Nevertheless, since the $PV > 0$ rule is met, it can be concluded that the implementation of this project is financially feasible.

CONCLUSIONS AND SUGGESTIONS

As a result of the analysis conducted using discounting methods in the evaluation of investment projects, the following practical suggestions were formulated:

Firstly, it is necessary to completely abandon the method of calculating projects requiring large capital investments in nominal terms (simply adding together today's and future money). Since the purchasing power of money decreases over time, investment decisions must be based solely on the discounted cash flow (NPV) model. Otherwise, a project that looks profitable on paper may actually lead the enterprise to bankruptcy.

Secondly, the correct determination of the discount rate (□r) is a decisive factor in the fate of the project. If, in our example above, bank interest (or inflation) had been 25% instead of 15%, the current value of the project would have been less than 500 million soums, and the NPV would have been negative, and the project would have been canceled. Therefore, when calculating the discount rate, it is recommended that enterprise financiers carefully study the key rate of the Central Bank of Uzbekistan, the risks in the industry, and the average profitability of the industry.

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