РОЗДІЛ 3. ЕКОНОМІКА ТА УПРАВЛІННЯ НАЦІОНАЛЬНИМ ГОСПОДАРСТВОМ

NET PRESENT VALUE (NPV) AS A REINFORCEMENT OF THE DECISION-MAKING PROCESS IN TERMS OF INVESTMENT SELECTION

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Drozdowski G.
Department of Economics and Finance, Jan Kochanowski University in Kielce, Poland
Dziekański P. [1]
Department of Economics and Finance, Jan Kochanowski University in Kielce, Poland

Adequate competition, technical and technological development require enterprises to constantly change and make new investments. Investment is the ongoing expenditure of resources for future benefits. Investments usually involve the commitment of considerable cash resources and manifest themselves in the growth or replacement of tangible fixed assets. Each investment has an individual investment life cycle. The distribution of inflows and outflows associated with the preparation, implementation and operation of an investment. NPV is the net present value, or present value of future cash flows. This indicator predicts what income can be expected from a given investment in terms of the present value of money. Objective decision-making instruments can be constructed using the NPV method. NPV, as the difference between the present values of cash inflows and cash outflows analyzed over a period of time. NPV makes it possible to compare the money that needs to be paid to complete a planned investment with all the cash flows that the company will generate in the future. The NPV method is considered to be the most theoretically correct method for evaluating the profitability of investment projects. There is also a steady increase in interest in it in business practice. The advantages of the NPV method is that it takes into account the entire life cycle of the investment, all cash flows and changes in the value of money over time. A positive NPV value means that the investment contributes to an increase in the value of the company.

Key words: *invetigation process, decision-making process, net present value (NPV).*

Introduction. The appropriate level of competition, technical and technological development require constant changes and new investments from enterprises. The multiplicity of types of investments causes that the instruments of their evaluation must be appropriately selected. Investment projects require the expenditure of adequate financial resources. Decisions in this area shape strategic (development) plans [1].

An investment is an ongoing expenditure of resources for future benefits. The present is relatively known, while the future is a mystery [2]. Investment can be viewed as the movement of money (in the form of expenditures on physical and financial equipment, expenditures on research and development, education, advertising), or as the movement of goods (in the form of changes in inventory, equipment, purchase of production facilities). Investments usually involve a considerable amount of money and result in an increase or replacement of tangible fixed assets. Such investments include new investments, expansions, modernizations, replacement investments [3]. In terms of investment profitability analysis, production, costs, revenues, risks, etc. are evaluated [4]. Also included in the evaluation are operating profit and net profit, period and rate of return, net present value, discounted rate of return, internal rate of return, or modified internal rate of return [5].

Using the net present value (NPV) method depends not only on the value or time distribution of net cash flows, but also on the discount rate used in the calculation. The higher the discount rate, the lower the discount factors and consequently the lower the NPV. The occurrence of negative cash flows in the initial phase of the investment project, and positive only in subsequent years, makes the NPV for such a project is lower than for the project, which realizes lower but constantly positive net cash flows [6]. NPV cannot be viewed as a universal measure used in corporate budgeting decisions. The rules governing the project selection process depend on the economic environment, so they can have many limitations and specific guidelines [7].

Literature review. Discount methods are described as one of the most appropriate and comprehensive methods of investment profitability assessment. They are most often used in economic practice [8]. Each investment has an individual investment life cycle. It is a multifaceted process that considers the expenses of preparing and implementing the investment and the cash flows resulting from its operation [9]. In its structure, it takes into account economic, technical, social and environmental issues. An investment project consists of integrated phases: pre-investment, investment and operational [10].

The distribution of inflows and outflows associated with the preparation, implementation and operation of an investment. It depends on objective factors (e.g. type of project), and subjective factors (e.g. organization of the investment process) [11]. Approaching a capital project through the lens of cash flow is a practical approach. They indicate the

[1] ORCID: https://orcid.org/0000-0003-4065-0043

maintenance of liquidity throughout the life of the project along with the generation of net cash.

NPV (net present value) is the present value of future cash flows. This indicator shows how much revenue can be expected from the investment in terms of the present value of money. The expected (future) cash flows for a given period are divided by the appropriately compounded discount rate. The value of the discount rate typically reflects the cost of borrowing (interest on debt). Under conditions of uncertainty, the economic reliability of project finance requires robust economic indicators [12].

Z wykorzystaniem metody NPV można zbudować obiektywne instrumenty decyzyjne. Zaletą metody NPV jest jej addytywność, multiplikatywność, wyrażenie korzyści netto przedsięwzięcia jako przepływ pieniężny, uwzględnienie zmian wartości pieniądza w czasie, ujmowanie korzyści netto z całego ekonomicznego cyklu życia przedsięwzięcia, czy umożliwia prostą interpretację uzyskanych wyników [13]. In order to use the advantages of the NPV method, which undoubtedly include its widespread use in evaluating the effectiveness of investment projects, it is necessary to eliminate the limitations (e.g. selection of an appropriate level of interest rate). In addition, the NPV method includes an assessment of the profitability of the investment under study during its total duration, gives the possibility to define the criterion of profitability, is universal.

NPV is an inefficient, non-universal measure due to information limitations between firms' headquarters and their subsidiaries (e.g., lack of information on risk margins). NPV does not take into account differences in the situation of firms resulting from their location in stable and emerging markets. Other disadvantages include the assumption of a flat yield curve, the assumption that the rate of reinvestment of positive flows is equal to the assumed discount rate [14]. NPV is based on assumptions and estimates. One assumption is that capital projects will be completed within a certain period of time. However, a project may require unforeseen expenses to start or additional expenses to complete. In addition, the correct calculation of depreciation must be used to correctly calculate the cost, which affects the revenue. Therefore, the NPV method should not be considered as the only source for evaluating the profitability of an investment. The decision to make or reject a particular investment should be based on more than one method [15]. It can be complemented by the internal rate of return. It allows to make a more accurate choice of the optimal investment project.

Method and material. The aim of the paper is to present NPV as a method of investment profitability assessment. The presented approach gives managers more information and thus opportunities in decision making. Net Present Value (NPV) is a criterion for evaluating investment projects that is consistent with the company's goal of maximizing owners' income achieved through maximizing the value of the company. NPV, as the difference between present values of cash inflows and cash outflows analyzed over a certain period [16]. Net present value allows you to compare the money you need to pay to complete a planned investment with all the cash flows the company will generate in the future [7]. Use the cost of capital used to finance the project adjusted for project risk as the discount rate.

Theoretical assumptions of the method presented include: the calculation period is finite, the expected pattern of net cash flows over the life of the investment is known, the investment has a typical staggered net cash flow, the capital expenditures incurred are irreversible, the yield curve is flat over the life of the investment, the positive net cash flows of the project are reinvested at a reinvestment rate equal to the discount rate, the net cash flows of the project occur at year-end, the accumulation of net benefits is a measure of profitability [17]. NPV method is considered to be the most theoretically correct method of assessing the profitability of investment projects. There is also a steady growth of interest in it in economic practice. In spite of this, significant methodological limitations are perceived, i.e. lack of flexibility, partial debt financing, omission of future possibilities, risk valuation [18].

Using this method gives precise and reliable results. The NPV method assumes comparing the amount of expenses with all the financial flows. The method takes into account the time value of money, indicates the cumulative value of cash flows from the entire economic life of the investment project.

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

$$NPV = CF_0 \text{ x } a_0 + CF_1 \text{ x } a_1 + CF_2 \text{ x } a_2 + \ldots + CF_n \text{ x } a_n - I_0$$

$$a_n = \frac{1}{(1+r)^n}; n = 0, 1, 2, 3, \ldots, n;$$

where:

NPV – net present value of the project;

CF_i – net cash flows (inflows-expenditures) generated by the project in subsequent years of its operation;

I_0 – value of initial expenditures;

n – number of periods, subsequent year of the calculation period;

r – required rate of return;

a_n discount factors for subsequent years at a selected constant discount rate r.

The discount rate used is the sum of three components (i.e., the risk-free investment rate, the risk premium, and the expected inflation rate). The discount rate r, as the expected rate of return on the investment, should also reflect the market cost of capital.

Having calculated the NPV, the investor can make decisions:

a) if NPV > 0 (investment appraisal profitable), then the decision is made to implement the project, i.e. to pursue the specified strategy;

b) if NPV < 0 (evaluation of investment not profitable), then the project should be rejected, which means that the specified strategy will not be implemented;

c) if NPV=0 (neutral investment appraisal), then the investor requires additional analysis of the project [19].

On the other hand, if you have to choose from several possible projects, the maximisation criterion is used (NPV → max) [20].

Results. NPV, as a financial measure commonly used in capital budgeting, expresses the difference between current cash inflows and current cash outflows. With NPV, it is possible to assess the cash flows associated with a project. Thus, it can be assumed that NPV helps in making the right decision from the perspective of shareholders and other decision makers.

The time-varying parameter r, treated as a constant in the NPV model, limits the rationality of the management process because changes seemingly common to all firms create different opportunities and determine individual risks. The fundamental question for this problem, however, is the following: How can firms manage information in an environment of high volatility of multiple price parameters? In such a case, it is necessary to distinguish between short-term details and the knowledge needed to identify options for action in the long term. Therefore, the subject of special attention is the precise determination of the magnitude of the decision parameters [21].

There is also a need to account for inflation, which can be unstable. This will result in a significant decrease in NPV and the need to consider a lower discount rate.

The higher the high risk discount rate, the lower the corresponding discount factors and consequently the lower the NPV in the following years of the calculation period.

Conclusion. Net present value, the sum of discounted cash flows over the life cycle of an investment, can play an important role in evaluating physical investments. When using the net present value method, it should be remembered that the NPV obtained depends not only on the value or time distribution of net cash flows, but also on the discount rate adopted for the calculation.

The advantages of the NPV method is that it takes into account the entire life cycle of the investment,

Table 1

Results of the NPV evaluation of the investment project – periods 5 and 10, fixed interest rate 5%

quantity	n (period)	Cash flow	r (discount rate)	discount factor	discounted cash flow
initial invetigation	0	-500 000.00	5.00%	1.0000	-500 000.00
flow 1	1	100 000.00	5.00%	0.9524	95 238.10
flow 2	2	200 000.00	5.00%	0.9070	181 405.90
flow 3	3	150 000.00	5.00%	0.8638	129 575.64
flow 4	4	100 000.00	5.00%	0.8227	82 270.25
flow 5	5	100 000.00	5.00%	0.7835	78 352.62
				NPV=	**66 842.49**
quantity	n (period)	Cash flow	r (discount rate)	discount factor	discounted cash flow
initial invetigation	0	-500 000.00	5.00%	1.0000	-500 000.00
flow 1	1	100 000.00	5.00%	0.9524	95 238.10
flow 2	2	200 000.00	5.00%	0.9070	181 405.90
flow 3	3	150 000.00	5.00%	0.8638	129 575.64
flow 4	4	100 000.00	5.00%	0.8227	82 270.25
flow 5	5	100 000.00	5.00%	0.7835	78 352.62
flow 6	6	150 000.00	5.00%	0.7462	111 932.31
flow 7	7	100 000.00	5.00%	0.7107	71 068.13
flow 8	8	200 000.00	5.00%	0.6768	135 367.87
flow 9	9	150 000.00	5.00%	0.6446	96 691.34
flow 10	10	100 000.00	5.00%	0.6139	61 391.33
				NPV=	**543 293.47**

Source: own study

Table 2

Results of the NPV evaluation of the investment project – periods 5 and 10, interest rate changes every year

quantity	n (period)	Cash flow	r (discount rate)	discount factor	discounted cash flow
initial invetigation	0	-500 000.00	4.00%	1.0000	-500 000.00
flow 1	1	100 000.00	5.00%	0.9524	95 238.10
flow 2	2	200 000.00	6.00%	0.8900	177 999.29
flow 3	3	150 000.00	5.00%	0.8638	129 575.64
flow 4	4	100 000.00	4.00%	0.8548	85 480.42
flow 5	5	100 000.00	3.00%	0.8626	86 260.88
				NPV=	**74 554.32**
quantity	n (period)	Cash flow	r (discount rate)	discount factor	discounted cash flow
initial invetigation	0	-500 000.00	4.00%	1.0000	-500 000.00
flow 1	1	100 000.00	4.00%	0.9615	96 153.85
flow 2	2	200 000.00	5.00%	0.9070	181 405.90
flow 3	3	150 000.00	6.00%	0.8396	125 942.89
flow 4	4	100 000.00	5.00%	0.8227	82 270.25
flow 5	5	100 000.00	4.00%	0.8219	82 192.71
flow 6	6	150 000.00	3.00%	0.8375	125 622.64
flow 7	7	100 000.00	3.00%	0.8131	81 309.15
flow 8	8	200 000.00	4.00%	0.7307	146 138.04
flow 9	9	150 000.00	5.00%	0.6446	96 691.34
flow 10	10	100 000.00	6.00%	0.5584	55 839.48
				NPV=	**573 566.24**

Source: own study

Table 3

Results of the NPV evaluation of the investment project – periods 5 and 10, real interest rate (interest rate 8%, inflation rate 5)

quantity	n (period)	Cash flow	Real interest rate	discount factor	discounted cash flow
initial invetigation	0	-500 000.00	2.86%	1.0000	-500 000.00
flow 1	1	100 000.00	2.86%	0.9722	97 222.22
flow 2	2	200 000.00	2.86%	0.9452	189 043.21
flow 3	3	150 000.00	2.86%	0.9190	137 844.01
flow 4	4	100 000.00	2.86%	0.8934	89 343.34
flow 5	5	100 000.00	2.86%	0.8686	86 861.58
				NPV=	**100 314.36**
quantity	n (period)	Cash flow	Real interest rate	discount factor	discounted cash flow
initial invetigation	0	-500 000.00	2.86%	1.0000	-500 000.00
flow 1	1	100 000.00	2.86%	0.9722	97 222.22
flow 2	2	200 000.00	2.86%	0.9452	189 043.21
flow 3	3	150 000.00	2.86%	0.9190	137 844.01
flow 4	4	100 000.00	2.86%	0.8934	89 343.34
flow 5	5	100 000.00	2.86%	0.8686	86 861.58
flow 6	6	150 000.00	2.86%	0.8445	126 673.14
flow 7	7	100 000.00	2.86%	0.8210	82 102.96
flow 8	8	200 000.00	2.86%	0.7982	159 644.64
flow 9	9	150 000.00	2.86%	0.7761	116 407.55
flow 10	10	100 000.00	2.86%	0.7545	75 449.34
				NPV=	**660 591.98**

Source: own study

Table 4

Results of the NPV evaluation of the investment project – periods 5 and 10, real process rate (interest rate 8%, inflation rate 5)

quantity	n (period)	Cash flow	Real interest rate	discount factor	discounted cash flow
initial invetigation	0	-500 000.00	0.95%	1.0000	-500 000.00
flow 1	1	100 000.00	-1.83%	1.0187	101 869.16
flow 2	2	200 000.00	-1.82%	1.0374	207 475.99
flow 3	3	150 000.00	-1.80%	1.0561	158 409.31
flow 4	4	100 000.00	0.92%	0.9641	96 412.92
flow 5	5	100 000.00	2.78%	0.8720	87 197.47
				NPV=	**151 364.86**
quantity	n (period)	Cash flow	Real interest rate	discount factor	discounted cash flow
initial invetigation	0	-500 000.00	0.95%	1.0000	-500 000.00
flow 1	1	100 000.00	-1.83%	1.0187	101 869.16
flow 2	2	200 000.00	-1.82%	1.0374	207 475.99
flow 3	3	150 000.00	-1.80%	1.0561	158 409.31
flow 4	4	100 000.00	0.92%	0.9641	96 412.92
flow 5	5	100 000.00	2.78%	0.8720	87 197.47
flow 6	6	150 000.00	2.80%	0.8471	127 068.47
flow 7	7	100 000.00	2.83%	0.8225	82 253.72
flow 8	8	200 000.00	2.86%	0.7982	159 644.64
flow 9	9	150 000.00	2.88%	0.7742	116 128.10
flow 10	10	100 000.00	2.88%	0.7525	75 248.11
				NPV=	**711 707.91**

Source: own study

all cash flows and changes in the value of money over time. A positive NPV means that the investment contributes to the value of the company. The NPV concept is not universal and does not take into account situations in unstable markets characterized by fluctuating interest rates.

Modification of the classical NPV formula to a new form assuming different interest rates and variable time of their occurrence allows for more realistic results. The use of the traditional NPV model creates the possibility of rejecting investment projects that may become profitable in the case of favorable changes in the price of money in later periods. Changes in interest rates shaped by monetary institutions make it difficult to estimate their level in the medium and long term, which significantly reduces the financial rationality of investments.

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