Analysis of Investment Projects by Discounting Methods

Mariana Zamfir
"Valahia" University of Târgoviște, Faculty of Economic Sciences, Romania
meri.zamfir@yahoo.com

Abstract

Investments are how the medium and long-term development of the enterprise is fixed. For each investment project, it is necessary to calculate and compare the resources invested with the results obtained. This research paper aims to analyse the efficiency of investment projects using discounting methods. Some highlights on the analysis of investment projects are presented, identifying the main outflows of funds and inflows of funds that are considered in the analysis of investment projects. Investment selection indicators are analysed: net present value and profitability index. The theoretical presentation is accompanied by a case study of an economic entity in Romania. The results of the research can be used by any economic entity to support investment projects.

Key words: capital, discount, investment, net present value, profitability index
J.E.L. classification: G11, M10, M41

1. Introduction

The investment decision is a strategic decision and is an integral part of the firm's overall policy. In investment decisions, there is a relatively long period between advancing funds and receiving the benefits from the funds spent. Because of this time lag, investment decisions are affected by the opportunity cost, which reflects the interest that could be earned by placing the money in the capital market.

The financial effects of the investments will be experienced over several years. The role of the accountant and management controller is to collect the necessary data from various sources, identify the financial and fiscal implications, analyse the data collected using one or more techniques and present it to the decision-maker. In other words, the accountant and management controller must provide managers with the information needed to support the investment decision.

The objective of this scientific work is to create added value by conducting a study in the field of management control and investment management aimed at analysing the efficiency of investment projects using discounting methods. Discounting is a method of quantifying the influence of the time factor on investment efficiency. This makes it possible to compare cash flows existing at different dates by equating future cash flows with their present value.

The formulation of the research hypothesis complements the definition of the proposed objective. In order to answer the objective pursued in the research paper we proposed the following hypothesis: „The time lag between the time of advancing funds and the time of obtaining the benefits from the invested funds requires the use of discount indicators in the analysis of investment projects".

2. Theoretical background

The term investment has been defined by many authors over the years. Investment is a permanent (often indefinite) allocation of capital, in the acquisition of physical and/or monetary assets, to enable profitable activities (Năstase, 2011). Investments are considered „resources committed in the hope of achieving benefits over a long period" (Mieilă, 2009) or money, or other resources spent in the hope of receiving more money or other benefits in the future.

The investment policy must be based on universally recognised and accepted criteria in project selection (Mieilă, 2012). The most common types of decisions involving investment in the production sector are decisions concerning development investments, the aim being to increase production capacity (establishment of new enterprises, expansion or development of existing enterprises etc.); decisions concerning replacement investments, the aim being to replace existing fixed assets due to their wear and tear; decisions concerning the choice between renting, buying or leasing; decisions concerning modernisation investments (their role is to achieve a reduction in costs and thus an increase in productivity); decisions concerning social expenditure for staff employed in production units etc.

A feasibility study is required to make the investment decision. It provides a technical, economic and financial basis for such a decision. Combining different methodologies to develop the feasibility study can lead to better decision-making results (Zamfir, 2017). For each investment project, it is necessary to calculate and compare the resources invested with the results obtained. The analysis of an investment decision depends, in particular, on four key parameters: outflows, inflows, lifetime and discount rate.

Depending on the nature of the investment project, the main types of outflows that are taken into account concern (De Rongé *et al*., 2009): the amount of capital invested in fixed assets (intangible, tangible and financial), which are most often incurred at the beginning of the investment project; the amount of change in the working capital requirement generated by the investment, which may vary over the life of the investment; maintenance and repair costs over the life of the new investment; additional operating costs caused by the new investment.

The main types of cash inflows considered in the analysis of investment projects (De Rongé *et al*., 2009), refer to: the additional revenue streams that are generated by the new investment; the reduction of costs caused by the operation of the new investment; the residual value of fixed assets at the end of the life of the investment; the recovery, at the end of the investment project, of the additional working capital needs incurred over the life of the project.

The analysis of investment projects is carried out through a series of indicators that can provide details for the quantitative and qualitative characterisation of the use of resources. Indicators can be static indicators and discount indicators. Appropriate financial ratios should be used to reflect value creation and modern indicators within value-based management offer a good alternative currently (Vasilescu, 2011). One of the most commonly used cash flow valuation methods in valuation practice is called *discounted cash flow* (DCF) (CECCAR, 2019).

3. Research methodology

The data for this research were obtained from the current records of an economic entity in Romania. Some of the information needed for the research was obtained by interviewing staff working in the economic entity's accounting and management control departments where the research was carried out. In addition to interviewing staff, we used financial accounting documents and statistical data that were necessary for the study. Documentary theoretical research was essential to the scientific approach. The applied research undertaken complements the theoretical approach by conducting a study on the analysis of an investment project using discounting methods.

In the analysis of investment projects, a limitation of static indicators is that they do not take into account the influence of time. Even if the investments and effects resulting from the commissioning and operation of the objective are used up and achieved in different periods, the static indicators do not take into account this time lag between the two processes (Mieilă, 2009).

The analysis of investment projects involves being able to compare cash flows available at different dates and being able to equate a flow that will be realised in the future with its present value. Discounting is based on the following reasoning: 1 leu available in a year has a value less than or equal to $(1+i)^{-1}$, i being the discount rate. In other words, 1 leu available in n years is today only $(1+i)^{-n}$ lei (Leclere *et al*., 2000).

Updating is done using a *discount rate*. The discount rate is a given constant of the economy at a given point in time and represents the expression of a certain type of societal behaviour (Mieilă, 2009). There are several views on the choice of discount rate. It depends on the investor's financial situation, the growth rate of the economy, the market interest rate and inflation. The discount rate

reflects the economic environment, which changes over time. Its choice must take into account its predictable evolution.

In the work „Investment management (2009)", Mieilă M. considers that if the project is financed at a fixed interest rate, the size of the discount rate is given by the size of the interest rate and a risk coefficient, and if the project is financed at a variable rate, the size of the discount rate will take into account the average interest rate forecast for the execution and operating period, plus a risk coefficient and the inflation rate, if applicable.

The discount rate represents the potential return of the alternative option that was given up for the realisation of the investment project, or in other words, the discount rate is based on the opportunity cost of capital.

Discount calculations can be performed at any time. The main milestones in the economic life of an objective are (Prelipcean, 2008): when the investment decision is taken; when the investment work starts; when the investment is put into operation; when the loan repayment starts; and when the fixed assets are retired. Between these milestones, various specific activities take place: between the adoption of the investment decision and the start of the work is the period of preparation of the technical and economic documentation of the investment objective, including obtaining the necessary approvals and consents. This is followed by the period of execution of the investment work on the site, which lasts until the fixed assets are commissioned. Economic entities may benefit from a grace period before the start of repayment of loans received. The effective operating life of the investment objective is from commissioning to decommissioning of the fixed assets.

The *net present value* is calculated from the present for each subsequent period until the end of the life of the investment. It takes into account the annual income and expenditure as well as the annual net cash flow generated by this investment (cash flow).

Net cash flow is calculated for each period:

Gross operating result - Income tax = Net operating result

Net operating result + Depreciation = Cash flow CF

The net present value is determined as the sum of the discounted cumulative net cash flows over the effective operating period of the investment objective, according to the relationship:

$$\mathrm{NPV} = \sum_{h=1}^{D} \mathrm{CF}(1+\mathrm{i})^{-h}$$

in which:

D - the number of effective periods of operation of the objective;

h - period;

i - discount rate.

The present value of future cash flows is calculated using what is called the cost of capital (or minimum required profitability ratio) as the discount rate (Shim *et al*., 2008). The reference moment for calculating the total present value of the investment and the cash-flow is the moment when the work starts (n = 0). When the execution of the works is short, less than one year, and the exploitation of the investment starts immediately, the net present value is calculated according to the formula:

$$\mathrm{NPV_{tp}} = -\mathrm{I_t} + \sum_{h=1}^{D} \mathrm{CF}(1+\mathrm{i})^{-h}$$

in which:

NPV_{tp} - total net present value;

I_t - the total investment.

If the duration of the work is more than one year, the formula becomes:

$$\mathrm{NPV_{tp}} = -\sum_{h=1}^{d} \mathrm{I_{hp}} + \sum_{h=1}^{D} \mathrm{CF_{hp}} = -\sum_{h=1}^{d} \mathrm{I_h}(1+\mathrm{i})^{-h} + \sum_{h=1}^{D} \mathrm{CF_h}(1+\mathrm{i})^{-h}$$

in which:

I_h - value of investment in year h;

I_{hp} - present value of the investment in year h;

CFh - cash-flow in year h;

CF_{hp}- present value of cash-flow in year h;

d - the number of periods of execution of investment works on site;

D - the number of effective periods of operation of the target.

If NPV < 0, the investment is not profitable. Even if the company has the capital to carry it out, it is advisable to abandon the investment project and invest it in another project. If NPV > 0, the investment is profitable. A positive net present value means that the economic activity carried out will generate more value than the capital invested, ensuring the ability to repay loans and the related interest when they fall due.

However, net present value also has its limitations (Prelipcean, 2008): it does not show the relative, comparative importance of the contribution of the project in question; it does not allow decision problems to be resolved when projects have different economic lifetimes; it does not take into account the size of the payback period; it depends on the size of the discount rate used in the calculations, which means that particular attention must be paid to its choice.

Another indicator used in the analysis of investment projects is the *profitability index*, which expresses the ratio between the net present value and the funds allocated to the project. Initial investments (I_t) or their present value (I_{tp}). Expressed in percentages.

$$P_i = \frac{NPV}{I_t} x100 \qquad \text{or:} \qquad P_i = \frac{NPV}{I_{tp}} x100$$

The profitability index allows us to select the efficient project variants where $P_i > 0$ and to rank them by its decreasing value. Under equivalent, comparable conditions, the higher the profitability index, the more efficient the projects will be. The project for which the profitability index is higher will therefore be chosen.

4. Findings

To demonstrate the usefulness of using the two indicators, we carried out research on an economic entity that wants to make an investment (to purchase production equipment) worth 260.000 lei. The investment allows for 4 years of activity and can be used from the first year. After the four years, the residual value of the equipment is expected to be 80.000 lei. The income tax rate is 16% and the discount rate taken into account is 15%. The expected operating revenues and expenses for the four years are shown in Table 1.

Table no. 1 Estimated income and expenditure (lei)

Year	Income	Depreciation	Other expenses
1	390.000	65.000	260.000
2	520.000	65.000	325.000
3	585.000	65.000	390.000
4	260.000	65.000	156.000

Source: Information provided by the economic entity

As the purchase of the equipment allows it to be used from the very first year, the NPV is calculated according to the formula:

$$NPV_{tp} = -I_t + \sum_{h=1}^{4} CF(1+i)^{-h}$$

Indicators are calculated for each period:

Gross operating income GOI = Revenue - Expenditure

Tax = GOI x 16%

Net result = GOI - Tax

The calculation of the cash flow is shown in Table 2. It is considered that depreciation does not imply cash flows.

Cash-flow CF = Net result + Depreciation

Table no. 2 Cash-flow calculation (lei)

Period N	Income	Expenditure	GOI	Tax	Net result	Cash-flow
1	390.000	325.000	65.000	10.400	54.600	119.600
2	520.000	390.000	130.000	20.800	109.200	174.200
3	585.000	455.000	130.000	20.800	109.200	174.200
4	340.000	221.000	119.000	19.040	99.960	164.960

Source: processing based on information provided by the economic entity

Discounted cash flow is calculated in Table 3. The discount coefficient (c) is:
$c = (1+0,1^{)-h}$
Discounted cash flow = $\mathrm{CF}(1+\mathrm{i})^{-\mathrm{h}}$

Table no. 3 Discounted cash-flow calculation

Period N	Cash-flow (lei)	Discount coefficient	Discounted cash-flow (lei)
1	119.600	$(1+0,15)^{-1} = 0,869565$	104.000
2	174.200	$(1+0,15)^{-2} = 0,756144$	131.720
3	174.200	$(1+0,15)^{-3} = 0,657516$	114.539
4	164.960	$(1+0,15)^{-4} = 0,571753$	94.316

Source: processing based on information provided by the economic entity

NPV_{tp} = -260.000 + 104.000 + 131.720 + 114.539 + 9.4316 = 184.576 lei

$$P_i = \frac{NPV}{I_t} x100 = \frac{184.576}{260.000} x100 = 70,99\%$$

Since the net present value and the profitability index have positive values, the investment is considered profitable. The economic activity undertaken will yield a value that is greater than the value of the capital invested. This ensures that the loans and the related interest are repaid when due.

After discounting expenditure and revenue (table no.4), another efficiency indicator can be calculated, namely the ratio of discounted revenue to discounted expenditure (Gomoi, 2021):

$$R = \frac{\text{Discounted revenue}}{\text{Discounted expenditure}}$$

Table no. 4 Discounted income and expenditure (lei)

Period N	Income	Expenditure	Discounted income	Discounted expenditure
1	390.000	325.000	339.130	282.609
2	520.000	390.000	393.195	294.896
3	585.000	455.000	384.647	299.170
4	340.000	221.000	194.396	126.357
Total			1.311.368	1.003.032

Source: Author work

$$R = \frac{1.311.368}{1.003.032} = 1,3$$

In our case, the ratio of discounted revenue to discounted expenditure is overunity, which again shows that the project is cost-effective.

Based on the results obtained by calculating the three indicators, we can conclude that the investment project is characterised by a high degree of viability.

5. Conclusions

Investments are the means by which the medium and long-term development of the enterprise is fixed. The investment decision is a strategic decision and is an integral part of the firm's overall policy. An investment programme sets out the objectives, actions and means to achieve the objectives, performance and how the means are to be combined and used. The time lag between the time when the funds are advanced and the time when the benefits of the invested funds are obtained requires the use of discount indicators in the analysis of investment projects, thus validating the research hypothesis on which the study was based.

In the analysis of investment projects, it should be noted that no single indicator can be considered the most relevant in assessing the value of a project. In addition to economic criteria, other criteria are often used in economic practice to make decisions on investment projects.

Valuation using the discounted cash flow method also has some limitations which relate to: the actual estimate of expected cash flows; the estimate of the residual value; the estimate of the weighted average cost of capital or the discount rate. In spite of these limitations, through the advantages that discounted cash flows offer, the method remains the most widely used today in the analysis of investment projects.

6. References

- Berland, N., 2009. *Mesurer et piloter la performance [Performance measurement and piloting]*, ebook, [online]. Available at: http://tun-tirage.e-monsite.com/medias/files/mesurer-et-piloter-la-performance-de-l-entreprise.pdf [Accessed 05 October 2020].
- CECCAR, 2019. Momente de referință în actualizarea valorilor unei investiții. *Expertiza și auditul afacerilor* [Benchmark moments in discounting investment values. *Business expertise and audit], No.14,* [online]. Available at: https://www.ceccarbusinessmagazine.ro/momente-de-referinta-in-actualizarea-valorilor-unei-investitii-a4776/ [Accessed 27 October 2023].
- Davasse, H., Lannglois, G., 2001. *Comptabilité de gestion. Gestion Prévisionnelle*, 2e édition. *[Management accounting. Predictive management.* 2rd Edition]. Paris: Foucher.
- De Rongé, Y., Cerrada, K., 2009. *Contrôle de gestion,* 2rd edition *[Management control, 2rd edition]*. Paris: Pearson Education France.
- Gomoi B. C., 2021. Studiu privind elaborarea unui proiect de investiții [Study on the development of an investment project]. *CECCAR Business Review*, No.7, pp.25-34, [online]. Available at: https://www.ceccarbusinessreview.ro/study-regarding-the-development-of-an-investment-project-iii-project-evaluation-a142/ https://doi.org/10.37945/cbr.2021.07.03 [Accessed 27 October 2023].
- Jugrin, A., 2008. Valoarea actualizată netă şi valoarea actualizată ajustată [Net present value and adjusted present value]. *Oeconomica*, No.4, pp.127-158, [online]. Available at: http://oeconomica.org.ro/files/pdf/30.pdf [Accessed 25 October 2023].
- Leclere, D., Lesel, Ph., and Doubrulle, L., 2000. *Control de gestiune [Management control]*. Bucharest: Economica Publishing House.
- Mieilă, M., 2009. *Managementul investiţiilor [Investment Management]*, Bucharest: Cartea Studențească Publishing House.
- Mieilă, M., 2012. Selection of investment projects in situations of discordance between criteria of efficiency assessment, *Valahian Journal of Economic Studies*, 3 (17), pp.57-64.
- Năstase G., 2011. *Gestiunea financiară a întreprinderii [Financial management of the enterprise. Course notes]*, [online]. Available at: http://file.ucdc.ro/cursuri/F_3_N39_Gestiunea_Financiara_a_Intreprinderii_Nastase_Gabriel.pdf [Accessed 25 October 2023].
- Prelipcean, G., 2008. *Strategii investiţionale în afaceri [Investment strategies in business*, Distance learning course], Ștefan cel Mare University of Suceava, [online]. Available at: http://www.seap.usv.ro/~ro/cursuri/FB/FB_II_SIA.pdf [Accessed 20 September 2017].
- Shim, J. K., Siegel, J. G., 2008. *Financial Management*. New York: Barron's Business Library.
- Stoica, M., 2021. *Managementul investiţiilor [Investment Management]*. Bucharest: Pro Universitaria Publishing House.

- Vasilescu, L., 2011. Assessing the firm performance through the financial ratios. *Annals of Constantin Brâncuși University of Târgu Jiu, Economics Series*, No. 3, pp.159-166 [online]. Available at: http://www.utgjiu.ro/revista/ec/pdf/2011-03/20_LAURA_VASILESCU.pdf [Accessed 25 October 2023].
- Zamfir, M., 2017. *Controlul de gestiune prin sistemul de bugete [Management control through the budgeting system]*. Bucharest: ProUniversitaria Publishing House.