

THE USE OF PROFITABILITY INDEX IN ECONOMIC EVALUATION OF INDUSTRIAL INVESTMENT PROJECTS

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Abstract: *The economic and financial evaluation of industrial investment projects in developed countries with market economy is based on the combined use of traditional and modern, rational methods, characterized by the scientific and reliability, tested and validated by long practice. In this article is presented the indicator of economic evaluation of industrial projects, profitability index, the method of calculation, as well as the advantages and disadvantages of using it through a case study. The case study shows a clear problem solving investment in case of the existence of several variants of industrial projects and their related modeling in linear terms. The profitability index is a significant indicator in assessing the economic and financial performance of a project or a company both internally and in the diagnostic tests requested by external partners.*

Key words: *method of profitability index, economic evaluation, industrial investment projects.*

1. INTRODUCTION

In recent decades extensive studies have been undertaken to establish principles and research methods and techniques and improving economic and financial analysis of projects in phase of initial investment. Analysts currently operate with concepts and techniques generally accepted in all developed countries and are taken up by other countries, including Romania [1, 3].

Traditional methods for assessing the economic and financial efficiency of investment is characterized by: a static analysis approach to processes and phenomena; simplification of real situations in the economy during the economic life of the product investments, working with constant or average annual benefits / economic effects and expected operating costs [1].

For the modern, rational evaluation of projects is characteristic the dynamic approach of investment analysis process, on the time horizon identical for all variants and investment alternatives, structured of work time execution and economic life time of build capacities. It is taken into account the impact factor of time, working with the present value, as a rule, determined by the start of the work, by all costs (investment and operating), incomes and profit generated by this project investment. Combined use of traditional and modern methods is specifying to evaluate the investment projects of small and medium-scale. For evaluation of large scale projects is only used dynamic analysis methods based on rational, modern [1, 7 and 8].

Regardless of the method used, assessment of investment projects is accomplished by means of an indicators system. The system contains efficiency indicators designed in economic and technical specifics of the area

in which the project is realized, with economic significance and relevance for the characterization and expression of purpose and investor interests. In formulating the system of indicators for evaluating projects is taken into account also the relative importance that decision-maker is giving one or other of the indicators of efficiency, compared with other possible indicators to use, develop or use of economic theory in practice [2, 3, and 5].

Basically, a system of indicators of economic efficiency of investments, including between five and nine indicators (number of indicators = 7 ± 2) and its use of a draft choice ensure convenient, not much in terms of the exigencies of efficiency.

The decision to invest is born of necessity or interest to make an investment. Any decision to invest must be subordinated of the private finance objective, which of the maximization company value. The way in which an organization grow and develop, the ability to survive and even being competitive will depend on the ability to generate steady streams of ideas for new products, better products or lower costs, that is to get the best investment decisions [6]. Such a decision is based on several considerations: "value system" (time value of money n), the economic context of the project, the perspective of investors, funding opportunities, risks, the forecast of the input and output flows, accounting of performance, as well as on various alternative investment opportunities with comparisons depending on available resources, generic comparisons called opportunity cost of investment.

There are several development strategies, from the point of view of the enterprise, resulting in two types of investments: internal and foreign investment. Internal investments consist of capital allocation for the acquisition of material and non-material assets, with a view to enhancing the development and appliance manufacturing and distribution of goods and services which are the subject of enterprise activity. Foreign investments

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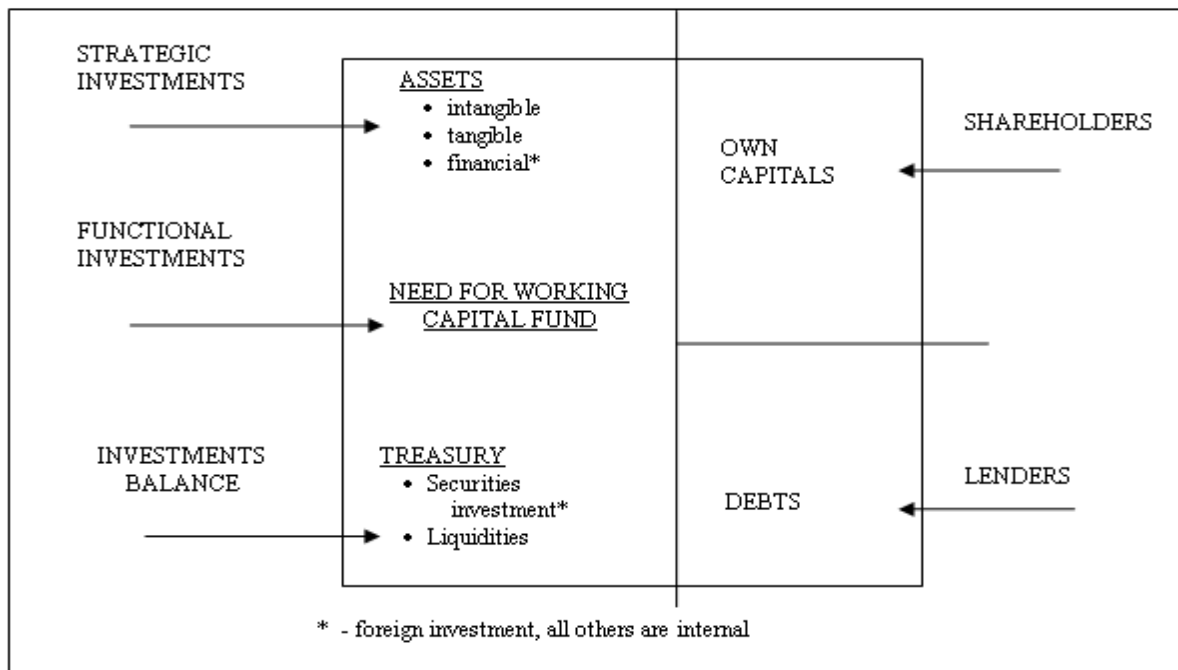


Fig. 1. Investment portfolio of an enterprise and its funding sources.

are investments in capital for raising financial participation in the formation of other commercial companies' capitals. The objective is to diversification of the base activity, in order to obtain savings and the optimal amount for enterprise. The last type of investments better reflect specific financial markets concept, the portfolio of titles, which in the case of an enterprise turns to portfolio investment, which characterizes the work investing firm. It is evident that a portfolio of investments is less flexible than a portfolio of financial securities, however, and in the framework of an enterprise may apply to successful diversification strategy of portfolio investment in order to increase its value (Fig.1).

As it emphasizes some specialists, represents the commitment of resources and investments with the hope of writing some benefits in the course of a long period of time.

These emphasize the concrete content, material investment (material, human and financial resources), and the ultimate goal, the benefit.

2. SOME CLASSIFICATION OF INVESTMENTS [1, 3, 9]

The investments can be disaggregated according to several criteria, so:

1. After the relation whom it has with the projected objective, we have:

- Direct investments are those that are made for the basic objective (acquisition of equipment, fitting them, etc.);
- Collateral investments which ensure the utilities of basic objective (water pipelines, gas, compressed air, telephone networks, etc.);
- Related investments are those completed in other economic objectives, in order to ensure the necessary raw materials for the production process of the future objective (land consolidations, etc.);

2. After the execution of the works, we have investments made in:

- Direct labor - by investor, the future owner of the investment objective;
- By specialized enterprises;
- Mixed system - through active owner collaboration with the entrepreneur.

3. After their technological structure, we have:

- Construction-assembly works, consisting of construction works and installations of technology equipment mounting on the construction sites;
- Acquisitions of machinery that require mounting, fixing foundations, on pillars or placements;
- Acquisitions of machinery which does not require installation, means of transport, tractors, etc.;
- Geological works for the discovery of new reserves of useful mineral substances;
- Other investment expenditures, which refers to the plant-growing trees, buying and breeding, etc.

4. After the character works, we have:

- The constructions of new units are those which are for things that have not previously existed, based on their building all elements which lead to getting the objective;
- Reconstruction of the existing objectives, which have suffered as a result of natural disasters, fires, etc.;
- For development – consist in expenses that are made in order to increase production capacity, storage;
- For the modernization of existing units - consisting in the introduction of new machinery in place of those that are worn out physically and morally.
- For redevelopment – to the existing objectives for determining the best conditions of work activity;

3. METHOD OF PROFITABILITY INDEX (PI or γ)

The profitability index (PI) refers to the ratio of discounted benefits over the discounted costs. It is an evalu-

ation of the profitability of an investment and can be compared with the profitability of other similar investments which are under consideration. It is also referred to as benefit-cost ratio, cost-benefit ratio, or even capital rationing. It is one of the numerous ways used to quantify and measure the efficiency of a proposed investment.

The profitability index expresses the net present value for an initial expense equal to a monetary unit. Profitability index characterizes the relationship between VAN and investment funds that generate VAN volume. It completes analysis of efficiency in relative terms, in the form of net benefit per unit of measurement relative to the cost of the investment.

The profitability index is greater than the projects are more efficient, in equivalent terms, comparable to other points of view [3, 9].

$$PI = \frac{\sum_{t=1}^n CFD_t \cdot (1+k)^{-t}}{I_0} \quad (1)$$

Profitability index can be rewrite in the form [3]:

$$PI = \frac{VAN + I_0}{I_0} = 1 + \frac{VAN}{I_0} \quad (2)$$

VAN – net present value;

I_0 – initial investment [monetary units];

CFD – available cash flow;

n – lifespan of the project investment [years];

t – the index of the period of time considered as increment for life duration;

k – minimum acceptable rate of profitability [%];

VRn – residual value at the end of the project life [monetary units];

Interpretation of profitability index: Equivalent decision of project invest, in case if $VAN > 0$, an investment project or proposal is considered to be profitable if it features a profitability index above 1. For example, a profitability index of 0.89 indicates that the project or investment will not make us any profits. On the contrary, a profitability index equal to 1 indicates a break even on the investments without making any profits [4, 9].

The advantages of profitability index for an enterprise are listed below:

- The profitability index tells about an investment increasing or decreasing the firm's value;
- The profitability index takes the time value of money into consideration;
- The profitability index is also helpful in ranking and picking projects while rationing of capital;
- The profitability index also considers the risk involved in future cash flows with the help of cost of capital;
- The profitability index takes into consideration all cash flows of the project.

In addition to the aforesaid advantages, there are also certain disadvantages featured by the profitability index:

- An estimate about the cost of capital is required so as to calculate the profitability index of an enterprise.
- The profitability index of an enterprise might not, sometimes, provide the correct decision while being

used to compare mutually exclusive projects under consideration.

Divesting refers to the decision of cancellation before the investment term of a process, with the aim of optimization of dynamic portfolio investment as a result of the emergence of opportunities which, at the time of the initial decision, no one knew. Although divesting has defensive connotations, it is, however, an important element of dynamic optimization of corporate value.

4. APPLICATION

An industrial enterprise which produces agricultural machinery wishes to carry out an investment project for the launch of a new production line. The available investment fund of the society is $I_0 = 5$ million lei. The leadership society has selected five projects which are been effective and timely, characterized by information (Table 1).

It is required to draw up the most advantage investment strategy, and how many and which projects should be carried out?

1. The profitability index is calculated (γ):

$$\gamma(P1) = 1 + \frac{VAN}{I_0} = 1 + \frac{1.4}{4} = 1.35; \quad (3)$$

$$\gamma(P2) = 1 + \frac{VAN}{I_0} = 1 + \frac{0.6}{1.5} = 1.4; \quad (4)$$

$$\gamma(P3) = 1 + \frac{VAN}{I_0} = 1 + \frac{0.45}{1} = 1.45; \quad (5)$$

$$\gamma(P4) = 1 + \frac{VAN}{I_0} = 1 + \frac{0.75}{2} = 1.38; \quad (6)$$

$$\gamma(P5) = 1 + \frac{VAN}{I_0} = 1 + \frac{0.5}{1.7} = 1.29; \quad (7)$$

2. It is establishes the order of the priority projects after the descending value of the γ index:

(P3, P2, P4, P1, P5).

3. There are fixed sets of investment projects within the limits of $I_0 = 5$ million lei, having regard to the order of priority projects and determine the necessary investments:

$$\text{It } (P3, P2, P4) = (1 + 1.5 + 2) = 4.5 \text{ million lei,} \quad (8)$$

$$\text{It } (P3, P1) = (1 + 4) = 5 \text{ million lei,} \quad (9)$$

$$\text{It } (P3, P4, P5) = (1 + 2 + 1.7) = 4.7 \text{ million lei.} \quad (10)$$

4. It is calculated the overall VAN get on the sets of projects:

$$VAN(P3, P2, P4) = (0.45 + 0.6 + 0.75) = 1.8 \text{ million lei,} \quad (11)$$

Table 1

Projects information

Project	P1	P2	P3	P4	P5
The investment volume required by general estimate [million lei]	4	1.5	1	2	1.7
VAN, calculated, [million lei]	1.4	0.6	0.45	0.75	0.5

$$VAN(P3,P1)=(0.45+1.4)= 1.85 \text{ million lei.} \quad (12)$$

$$VAN(P3,P4,P5)=(0.45+0.75+0.5)= 1.7 \text{ million lei.} \quad (13)$$

5. Because the enterprise does not have sufficient funds to carry out all five projects, it's chosen the most advantageous strategy by criterion: the cumulative maximum VAN for all projects set:

Cumulative VAN, on the projects sets = $\max\{1.8;1.85;1.7\}= 1.85$ million lei. So the most effective strategy must be based on complete set (P1,P3).

Selection of investment projects carried out within the limits of the financing possibilities can be modeled and resolved in terms of linear programming [1].

Each project P_i is assigned as parameters VAN_i and I_i , the total fund available to invest I_0 , number of eligible projects n . Introducing the Boolean variables x_i , $X_i = 1$ if the project is accepted, $X_i = 0$ if the project is rejected, the objective function it's writes:

$$MaxVAN_{global} = \sum_{i=1}^n VAN_i x_i. \quad (14)$$

and the restriction are:

$$\sum_{i=1}^n I_i x_i \leq I_0, \quad x_i = 0 \text{ or } 1 \text{ pentru } \forall i, \quad \sum_{i=1}^n x_i \leq 1.$$

To determine the maximum allowable price for the acquisition of assets put up for sale, may be carried out with the help of the profitability index given in the form: γ_1^{need} . In this case:

$$VAN^{need} = I_i \cdot \gamma_1^{need}, \text{ and} \quad (15)$$

$$I_i = \sum VA(CF_h) - I_i \cdot \gamma_1^{need}. \quad (16)$$

From the equality:

$$I_i (1 + \gamma_1^{need}) = \sum VA(CF_h), \quad (17)$$

We can write:

$$I_{i_{\text{maximum, permitted}}} = \frac{\sum VA(CF_h)}{(1 + \gamma_1^{need})}. \quad (18)$$

5. CONCLUSIONS

Investment projects have a great importance for the development of industrial enterprises. Because it prepares the capabilities and future production conditions, these projects influencing long-term competitiveness of enterprises and in consequence the results and fiscal balance. Because investments consume considerable long-term financial resources, these projects present a special risk, their launch has most often an irreversible character.

For definite of economic benefits or to formulate criteria for the project choices and their variants, the use of economic theory is indispensable. There are already fundamental results on the two problems (benefits and criteria of choice) and the mechanisms and techniques of economic assessment progresses.

The calculation and analysis of the profitability index should be called whenever the projects differentiate between them itself through the investment effort needed ($I_i \neq \text{constant}$), because it allows to take into account the extent of the projects, the investment costs involved, what the VAN don't realize, and when financial availabilities for investment are limited.

The profitability index, order independent efficient projects, allows us to develop the most advantage investment strategy, choosing n projects of the possible, having regard to the restrictions on capital budgets, and so within the limits of our available funds (I_0) to finance investments, using the optimization criteria of the global projects of VAN, all selected projects.

The results obtained by the author in the case study presented can be easily put into practice as applied method resulted to select the best investment project

This article can be useful for economists, directors, managers of enterprises who want to achieve an optimum choice for spending the funds investment.

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