Statistical-Financial Valuation Methods of the Investment Projects

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Abstract. *Investment projects are always connected with the risk and the criteria of selection of investment projects depend in the majority of cases on the level of risk. Therefore it is necessary to use the statistical and financial methods to evaluate the investment projects that imply the calculation and the analyses of some indicators that will allow to emphasize the size, structure, dynamics and the efficiency of using the investment resources. The specified methods should satisfy the informational needs of a wide range of users as well as supply relevant data to set a basis for polices and to take decisions at micro and macroeconomic level.*

Key words: the capital commitment; the investment pay-back; the net present value; the index of the investments profitability; the internal pay off.

The substantiation of the specific decisions concerning the investment activities is based, especially, on the valuation and comparison of the investment volume and of the future advantages offered by the investment project.

Because of the fact that the processes and the phenomena from the investment field are influenced by the implications of the time factor, it is necessary to valuate dynamically the parameters of the investment projects (the investment value, the project incomes and costs, the profit or the net cash flow etc.).

The dynamic valuation of the effort and effect indicators within the analysis of the economic efficiency provided by the investment projects has a significant relevance, when the value indicators defining the investment activity involve an unfolding, an evolution in time and consists in re-calculation of the investment parameters, their presentation depending on the reference chosen moment, an operation that requires the use of the up-dating procedures. So, the up-dating is a specific method for the dynamic valuation of the investments economic efficiency.

The use of the up-dating technique gives the possibility to calculate certain adequate dynamic indicators that allow to express and estimate the economic efficiency of the investments.

1. The capital commitment

This indicator expresses the initial total costs of the investments for building the projected production capacities and the ulterior costs for commissioning, for their operation minus the redemption expressed in the present value for a certain reference moment, usually, at the moment of beginning the investment works (t_0). In the

practical activity, this indicator is named also *engaged capital,* ant in the methodologies of valuating the investments efficiency used by certain financial-banking bodies it is named *up-dated total costs.* The time horizon for calculation of the engaged capital is (d+D), namely the duration of executing the investments works (d) and the duration of efficient operation for the investment objective (D). Therefore, the capital commitment is calculated according to the relationship (Stoian, Ene Nedea, 2002, p. 92):

$$K_t^{|} = I_t^{|} + C_t^{|} = \sum_{t=1}^{d+D} \frac{I_t + C_t}{(1+r)^t} \qquad (1)$$

where:

$K_t^{|}$ – the total capital commitment up-dated at the moment t_0;

$I_t^{|}$ – the total investments up-dated at the moment t_0;

$C_t^{|}$ – total operation costs up-dated at the moment t_0;

I_t – annual investments;

C_t – annual operation costs;

r – up-dating rate.

Generally, it is aimed to minimize the capital commitment at a given level of the production capacity, total incomes and total economic advantages. This indicators is recommended to be used as criterion for choosing the variants of the investment projects for fields of public interest financed by the State budget.

2. The Payback Period (PP)

The payback period of the investments is a segment of the useful life concerning the operation of the capacities provided through investments. The payback period of the investment represents the period of time that begins at the moment of commissioning the capacities, installations and production equipment, when the cumulated sum of the provided economic advantages equals the volume of the investments allocated in the project. In a dynamic approach one calculates the updated term of the investment payback, starting from the equality:

$$\sum_{t=1}^{d} \frac{I_t}{(1+r)^t} = \sum_{t=d+1}^{d+T} \frac{P_t}{(1+r)^t} \qquad (2)$$

This one is the variant when the calculations are done from the beginning of the investment works on the assumption that the annual profits P_t are generated only after commissioning the objective; therefore, during the execution period are partially put in exploitation certain production capacities that will generate certain advantages.

If the calculations are done at the moment of putting the objective into operation, then we have:

$$\sum_{t=1}^{d} I_t (1+r)^{d-t+1} = \sum_{t=1}^{T} \frac{P_t}{(1+r)^t} \qquad (3)$$

where T – term of payback the investments.

If we accept a simplifying assumption such as the volume of the economic advantages expressed by the annual profit (P_t) is a *constant quantity*, i.e. it will the same for all the years of project operation:

$$\sum_{t=1}^{d} \frac{I_t}{(1+r)^t} = P_t * \frac{(1+r)^T - 1}{r(1+r)^T (1+r)^d}$$

$$r(1+r)^d * I_t^{|} * (1+r)^T = P_t (1+r)^T - P_t$$

and then by applying the logarithm we get:

$$T = \frac{\log P_t - \log(P_t - I_t^{|}(1+r)^d r)}{\log(1+r)} \qquad (4)$$

If more variants of the investments projects are compared, then is preferrable the project providing a minimum payback period.

The use of the payback term analysis in the economic and financial valuation of the investment decision is considered as a way to take into account the risk of the projected investments. By giving the priority to the more advantageous projects, characterized by short payback periods, it is accepted the conclusion that the future incomes and economic advantages will not be affected by incertitude and risk at the same scale as in case of variants with larger payback periods.

Another argument in the favor of this method is represented by the fact that the companies confronted with a cash shortage will give more importance to the rapid recovering of the invested funds and, respectively, to the possibility to satisfy other necessities.

Although this method gives, really, an indication concerning the level of the project liquidity, it has also certain deficiencies. It is known that the expansion project and those related to innovations and modernizing as well are implying a planning

on long term. And this method does not take into account the cash flows ulterior to the payback term and, therefore, can lead to selecting investment projects less profitable. In spite of the fact that the method of investment payback period is easy for use, knowing its disadvantages, it is recommended that, during the taking the decision about the investment, certain valuation criteria have to be used.

3. The net present value (VAN)

This indicator, being a fundamental criterion for the economic and financial valuation of the investment projects, characterizes, as absolute value, the advantage gain of an investment project, the investor's gain for the invested capital expressed as cash-flow in present value.

Defined in comparison with the cash-flow, the VAN provided the scale of comparison between the total present cash-flow generated during the life of the project ($CF_t^|$) and the total investment effort provided by that project, expressed in present value ($I_t^|$) (Stancu, 1997, p. 291).

VAN is an integral indicator of investment efficiency and strikes off the register the total surplus of cach-flow in comparison with the investment cost. The reference moment for the NPV calculation is that of the works start (Cistelecan, 2002, p. 319):

$$VAN = CF_t^| - I_t^| = \sum_{t=1}^{d+D} \frac{CF_t}{(1+r)^t} - \sum_{t=1}^{d} \frac{I_t}{(1+r)^t} \quad (5)$$

Defined by means of the net value, NPV expresses the algebraic sum of the present net value upon the horizon of time (d+D). By annual net value VN it is understood the difference between the annual volume of incomes (receipts) generated during the all operating period of time V_t and the volume of the total annual costs (investments and operation in the year t (K_t=I_t+C_t).

$$VN = V_t - (I_t + C_t) = V_t - K_t$$

and respectively:

$$VAN = \sum_{t=1}^{d+D} \frac{VN_t}{(1+r)^t} \quad (6)$$

According to the criterion VAN, must be accepted the projects and the project variants for which VAN > 0. This fact means that the corresponding project has the capacity to reimburse during the economic life (D) the invested capital or, in other words, has the capacity to generate an income flow in excess, providing a certain volume of net value.

A project with VAN < 0 has to be rejected because its rentability will be smaller than the updating rate.

This indicator has, also, certain deficiencies:

- VAN allows us to see if the investment project is or is not profitable, but does not strike off the register the relative importance, that comparative one of the project advantage;
- VAN does not take into account the size of the payback term;
- VAN depends very much on the size of the updating rate (r) and in this case it is very important that this size must be fixed depending on its main components (the capital cost, the risk prime, the inflation prime).

Nevertheless, VAN remains one of the best criteria for selecting the investment projects. But, in order to exclude the risk of certain incorrect decisions it is recommended the analysis of this indicator together with other ones, namely the profitability index, the internal rate of return, the updated term of the investment collection.

4. The profitability index (PI)

Usually, the profitability index is used together with the VAN indicator. During the calculation and the analysis of the investment project one uses this index when the investment projects or the projects variants are differentiated between them through the necessary investment effort, because this index takes into account the size of the investments, i.e. the necessary investment costs, element that is not provided when we use the VAN indicator. The profitability index is calculated according to the relationship (Cistelecan, 2002, p. 333):

$$PI = \frac{CF^|}{I^|} = \frac{\sum_{t=d+1}^{d+D} \frac{CF_t}{(1+r)^t}}{\sum_{t=1}^{d} \frac{I_t}{(1+r)^t}} \quad (7)$$

An independent investment project must be accepted only if $PI > 1$ and has to be rejected if $PI < 1$. The project having $PI = 1$ (same as when $VAN = 0$) will provide the recovering of the investment expenditure only, without generating some profit. The more PI is the more profitable are the projects.

5. The internal rate of return (IRR)

This is defined as the updating rate that provided an equality between the updated value of the net cash-flow incomes and the updated value of the investment costs. It results that *RIR* represents that discounting rate for which the *VAN* value is equal with zero (Covalev, 2003, p. 59).

$RIR = r$, where $VAN = f(r) = 0$

The internal rate of return is one of the most significant indicators for the efficiency of the investments project, because it expresses the investment capacity to generate profit during the all operating period of the objective by fixing its economic power.

The *RIR* value can be calculated through the *interpolating method* (Stoian, 2002, p. 98). The application of this method implies to find such two updating rates that for a rate r_{min} results an updated positive net value (VAN+), and for r_{max} an updated negative net value (VAN-). The values of the VAN level for these two updating rates are placed within a rectangular system of coordinates, expressing on X-axis various updating rates, and on Y-axis the progress of the updated net value.

The difference between r_{max} and r_{min} must not exceed 5 percentage points. Otherwise, by using a larger distance an error will be generated, i.e. RIR will be larger than the real value. Given the fact that the differences between r_{max} and r_{min} are small enough, we can take into consideration the existence of a linear dependence between VAN and the updating rate (r). Therefore, for finding with exactness the RIR one uses the relationship:

$$RIR = r_{min} + (r_{max} - r_{min}) \frac{VAN(+)}{VAN(+) + VAN(-)} \quad (8)$$

When we compare alternatives of investment projects or project variants, characterized through *VAN* close values the priority is given to the project (variant) having a maxim RIR (Covalev, 2003, p. 60).

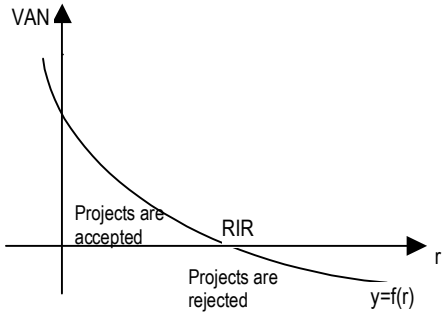

Figure 1. *The updated net value in case of a classic investment project*

The resulted *RIR* value is compared frequently with the interests rate of credits r'. Depending on the capital taken as an loan, *RIR* represents the maximum rate of the interest for which is possible the capital loan for financing the investment in conditions of profitability. For an interest rate $r' < RIR$, the project will have a $VAN > 0$ and, consequently, the project will be accepted. For an interest rate $>RIR$, the project will be unacceptable, because it will generate losses for a $VAN < 0$. In the case of = *RIR* the capital taken as a loan does not bring any gain. As a conclusion, there are accepted only the projects characterized by a *RIR* larger than the cost of the capital.

Conclusions

In the analysis of the economic efficiency concerning the investment projects, a significant importance has the number of the analyzed projects, either a sole project or a set of investment portfolio when there are independent projects and projects that exclude themselves reciprocally is in discussion. The analysis of a sole project is a particular case of a portfolio of investment projects when the criteria *VAN, RIR* and *PI* leads to the same conclusion concerning the acceptation or the rejection of the investment project. This happens because between these indicators there are relationships of interdependence:

if $VAN > 0$ it is obvious that *RIR* >and $PI > 1$

if $VAN < 0$ then also *RIR* <and $PI < 1$

if $VAN = 0$ then also *RIR* =and $PI = 1$

More frequently the manager has to make a selection between two or more competitive investment projects and in this case there are situations when the valuation methods used give contradictory results. Such cases happen when the distribution in time for the incomes flows and costs of the projects are different; the projects vary depending on the invested capitals; the life duration of the projects is different. In the analysis of identical project as size of the capital involved, it is recommended to take into account the rate of re-investing the annual flows of incomes and to use an identical rate of updating.

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