Investment Evaluation Difficulties

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Abstract
The financial criteria used for evaluation of the enterprise are not numerous; however, they are causing heated discussion on whether using a criterion at the expense of another.

The most utilized financial criteria used in the ranking of investment alternatives are: the net present value criterion, the internal rate of return criterion, the payback period limit criterion and last, but not least, the profitability index criterion. These criteria have in mind, in the first place:

➤ *investments impact on enterprise profitableness and results,* by recording the future positive cash-flow

➤ *investments influence on the balance of an enterprise*, traced through the evolution, on one side of the working capital[1], on the other hand, the size of necessary working capital[2]

➤ *incidence of the investment project on enterprise risk level[3]*

Therefore, to ensure the best possible decision making, investors must choose of using, and why not, even construction of relevant indicators regarding the opportunity of an investment decision in one alternative or another. It is advisable to take into account a number of

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[1] an investment requires an initial allocation of capital which affects the size of working capital

[2] through investment, working capital necessary variation is positive and permanent, the expected conditions of growth divided over the entire period of the project

[3] payments related to investments affects enterprise treasury in real, in the context of a series of future uncertain cash-flows operations

principles, which are nothing more than to highlight various aspects of technical analysis of investment projects.

As a result, it is preferable not to neglect *the value of money in time* problem, solved by using dynamic indicators of investment; investment project analysis with reference the binomial *risk - profitableness*, ensuring that profitableness of an investment is directly proportional to the risk category in which is framed; the basis for the investment decision to materialize with the help of *marginal cash flow analysis* and, certainly not with the help of paper profits; taking into consideration *the fiscal policy* of the company; elimination of *the inflationary phenomenon* in the decision process; targeting of low risk investment projects, because this risk adds to the whole risk of the enterprise etc.

Keywords: investment, evaluation, difficulty, financial criteria, IRR

Internal Rate of Return

Internal rate of return on an investment is the capitalization rate of the analyzed investment project's cash-flow, which equals the net present value of the initial investment value. Under a more practical expression form, internal rate of return can be defined as the capitalization rate that equals the value totaling the cash-in-flows investments with the initial value of the investment.

To calculate the internal rate of return (IRR) on an investment, whether we are talking about an IRR of financing[4], or about an IRR of investing, assuming a single sum of initial capital invested, we use the relationship:

$$I_0 = \sum_{t=1}^{n} \frac{CFD_t}{(1+IRR)^t} + \frac{RV_n}{(1+IRR)^n}$$

where CFD is the size of future investment's cash-flow, RV_n is the residual value of investment at the end of its period, and I_0 is the initial investment. Further we neglect size residual value.

From the definition we see that the internal rate of return uses upgrade technique to bring future cash flows to present, as their value significance.

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[4] cash-in-flows are positive and cash-out-flows are negative

For example, an investment that last 10 years, releasing a table of cash flow, summarized in the table below, according to an initial investment of 3,500 lei:

CFD_1	CFD_2	CFD_3	CFD_4	CFD_5	CFD_6	CFD_7	CFD_8	CFD_9	CFD_{10}
800 lei	700 lei	800 lei	900 lei	900 lei	850 lei	750 lei	700 lei	700 lei	700 lei

Under these conditions, internal rate of return is unique; at the rate of 18.43%, due to variations of a single sign of investment flows, considering that the initial investment was introduced into the calculation with the sign - .

By this discount rate, net present value is expressed in terms of percentage return, indicated value[5] being greater than the percentage of 15%. The impact of one investment's internal rate of return over its policy in maximizing enterprise value is also emphasized by the *net present value profile,* which, practically, represents graphic of NPV variation to percentual change of cash flow discount rate.

Determination of IRR solution is difficult enough, especially under the conditions where we refer to a long period of investment project, its calculation being reduced to solution of a polynomial equation of degree n. Therefore, either we calculate by repeated attempts either we use the interpolation method. According to this method, internal rate of return of an investment is being estimated under the relation

$$IRR = k_{min} + (k_{max} - k_{min}) \cdot \frac{NPV_+}{NPV_+ + |NPV_-|}$$

Where NPV_+ positive net present value of is minimum, NPV_- is negative net present value of minimum, k_{min} is discount rate proper to the minimum NPV_+, k_{max} is discount rate proper to the maximum NPV_-. For this we must calculate a net present value set according to several discount rates. However, the calculations do nothing more than to set approximate levels on internal rate of return of the investment analysis. Salvation comes from information technology, which provides various programs for calculating the indicators of this nature. A solution would

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[5] according to BIRD, methodology of analyzing investment projects

be the utilization of *IRR (Values; Guess)* function, offered by Excel spreadsheet program.

Rationality IRR

Investors and the enterprise concept of internal rate of return vary. *Investors* perceive the IRR as the *minimum level of achievable profitability* on an investment, while the enterprise translates internal profitability indicator as the *minimum cost of invested capital.* Also, the investor wants to recover his initial investment in a short period, but the enterprise aims to minimize the cost of initial investment by rescheduling on a longer period with a smaller net present value. Because the asymmetry of information is present in the market economy, investors adopt a pessimistic attitude, but they trace maximizing the most unfavorable options in future enterprise value. In contrast, the company stands at the opposite end, approaching an optimistic attitude, to determine the investor to place his equities in projects of the enterprise. All this shapes a truly strategic game, each player watching the moves of the others. The two divergent optical, translated into the language of decision theory are expressed for the investor the form $IRR_{optimum}^{investor} = \max\left[\min\left(cash\ flow_{investment} = I_0\right)\right]$ and for enterprise

$IRR_{optimum}^{enterprise} = \min\left[\max\left(cash\ flow_{investment} = I_0\right)\right].$ Therefore, only the managers of the enterprise are responsible with identification of equilibrium IRR.

As a result of what was said, the internal rate of return is a relevant criterion for the selection of investments, considering the average *interest rate r,* as the reference yield. Conformable to this criterion, a rational investor will choose the investment whose rate of return is more than the average reference interest rate *IRR > r,* choosing to maximize the value of this indicator. In other words, internal rate of return can be analyzed from several angles:

➢ as the cost of capital employed in the investment;
➢ as an opportunity cost in relation to competing investment alternatives;
➢ as a form of minimum accepted profitability.

Reason of IRR criterion starts from the marginal analysis of future benefits corresponding to two or more investments belonging to different risk classes. An investor will choose for a risky investment as

long as the risk taken will be paid in his subjective limits of aversion against the risk. I pointed this reasoning, since a revelation of desire to obtain a maximized IRR by the investor is practically limited by investor's aversion to risk, without questioning an expected IRR rates virtually infinite anticipated.

The problem of applying the IRR criterion for assessing the investment is raising serious questions on relevant information revealed by this indicator, given that we refer to the informational value of the NPV criterion.

Contradictory results

Determination of the importance of IRR criterion among other criteria used in evaluating investments is an extremely difficult step, the discussion starting on assumptions which started conceptualization of internal rate of return indicator and also from a series of mathematical properties of the present value function.

Need for such an approach is useful because a simultaneous use of two assessment criteria cause decision-making situations conflict. In the case of independent investment projects, application of the IRR and NPV criterion generates the same result decision. Difficulties arise when investment projects are excluded in which case the size and different time cycle are giving birth to incompatibility of results of the two investment criteria evaluation.

Although, in practice most managers use IRR criterion in financial investment decision, conceptually speaking, the NPV criterion is much better built, especially in terms of finality, and namely the reflection and measure of enterprise value maximization.

The best solution to clarify the conflicting moods aroused by the incompatibility with the IRR or NPV elections is the combined use of these criteria noting that the relevance of the IRR is deeply affected by multiple methodological flaws and interpretation. Therefore, as the prime criterion in evaluating must be used the net present value criterion, and as a criterion for choosing between investments with the same NPV we use IRR criterion.

Also, it is essential to mention that a comparative analysis of the results of the two evaluation criteria is not meant for validation of any of the alternatives investment.

If an investment project has a NPV> 0 and an IRR> k, the project is validated. But in the case of investments that exclude each

other, decisional conflict will occur in case NPV criterion nominates as one of the appropriate investment, and through the IRR criterion is decided on other investments. Equally, the need of hierarchy investments, in terms of budget restriction[6], is solving in-depth analysis of all investments, by choosing investments with net present value or internal rate of return in maximum.

Next we discuss the case of investments I-IX, whose cash flows are presented in the table below:

I	II	III	IV	V	VI	VII	VIII	IX	X
-3500 lei	-3500 lei	-1000 lei	-350 lei	-3500 lei	-3500 lei	-1000 lei	-1000 lei	-1000 lei	-750 lei
1000 lei	500 lei	3900 lei	50 lei	500 lei	2000 lei	100 lei	50 lei	1000 lei	500 lei
1000 lei	500 lei	-5030 lei	100 lei	1200 lei	1000 lei	300 lei	300 lei	600 lei	250 lei
950 lei	500 lei	2145 lei	150 lei	1400 lei	-5000 lei	500 lei	600 lei	200 lei	150 lei
900 lei	600 lei		500 lei	1500 lei	1000 lei	800 lei	1000 lei	250 lei	200 lei
800 lei	800 lei		400 lei	1000 lei	-2000 lei	300 lei	1200 lei	250 lei	150 lei
700 lei	900 lei		250 lei	2500 lei	-3000 lei	400 lei		300 lei	200 lei
700 lei	1100 lei		300 lei	2700 lei	0 lei	400 lei		400 lei	250 lei
500 lei	1200 lei		500 lei	1500 lei	0 lei	450 lei		550 lei	200 lei
400 lei	1300 lei		150 lei	1800 lei	-1000 lei	900 lei		100 lei	200 lei
400 lei	1500 lei		100 lei	1200 lei	0 lei	400 lei		100 lei	250 lei

Relativism of IRR criterion

According to the basic objective of company's finances, enterprise value maximization can be achieved only by optimally-useful allocation of available funds in investment that provide maximum benefits. It is true that the minimum rate of return on an investment reveals the possibility of obtaining an added value in the future, compared with the initial investment, but net differentiation in favor of NPV criterion is the absolute impact on enterprise value, and not an impact on relative sizes.

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[6] where investments are indivisible

For instance, an investor chooses, rather, the investment V, with a net present value of 3.054 lei and an internal rate of return of 33.43%, than the investment IV with a net present value of 699 lei, but a rate of 48.76% IRR. Priority desideratum is to increase the wealth of enterprise shareholders; therefore the NPV criterion is the most indicated.

Conflict Zone

In the figure below the NPV curves of two investments I and II are graphically represented. Through updated cash flow technique, it achieves a more severe reduction of their future value. Therefore, we see that the IRR rate lower than the corresponding rate curves intersection of the two investment NPV, conflicting situations arise between IRR and NPV criteria.

Net present value profile
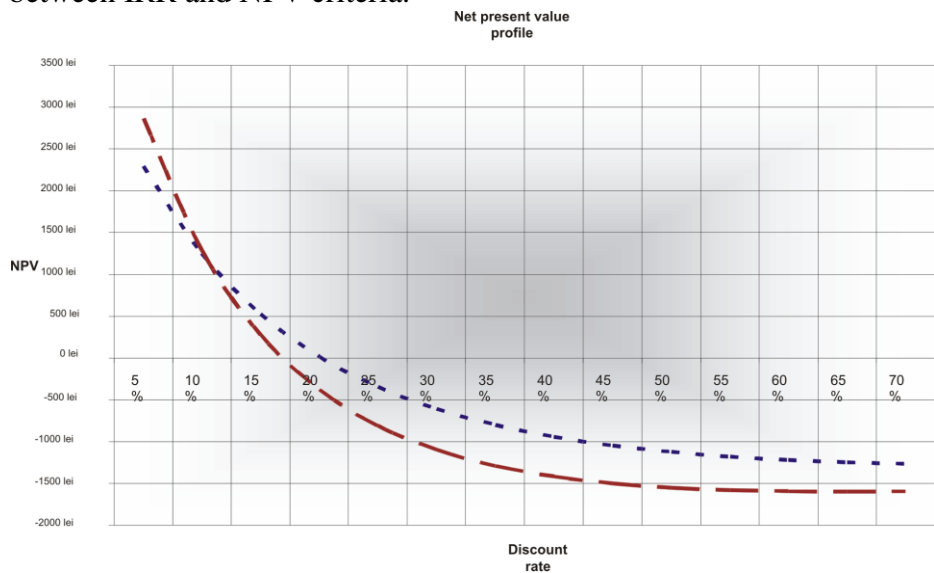
Thus, at a discount rate of future cash flows of the two investments, lower than level of 13.55%, we will have a net present value of investment I smaller than of investment II, although the IRR for the investment rate I (20.21%) is higher than the rate of investment II (16.86%). However, if future cash flows investments are updated at a higher discount rate meeting point of two curves will be able to proceed with analysis of individual investment projects using the two criteria, and the results will converge to the same conclusion.

Investment Size

Let's analyze the present value of the investment profile graphic XI and X. The investment IX is characterized by an IRR of 61.60% and a NPV of 1074 lei, while investment in X is defined by a net present value of 457 lei and a 36.35% IRR rate.

The magnitude of one investment affects alternatives investment evaluation from internal rate of return criterion perspective, once again due to the relative character of rates of return. Through an analysis of marginal cash flows, under the assumption that investment IX is an additional investment relative to investment X, we get the marginal cash flows:

CFDm$_1$	CFDm$_2$	CFDm$_3$	CFDm$_4$	CFDm$_5$	CFDm$_6$	CFDm$_7$	CFDm$_8$	CFDm$_9$	CFDm$_{10}$
500 lei	350 lei	50 lei	50 lei	100 lei	100 lei	150 lei	350 lei	-100 lei	-150 lei

Given that initial marginal investment is 750 lei, we obtain a net present value of marginal investment IX-X of 182 lei, reflected under the return of return's values of 28.02%. Because the marginal rate of return is higher than average interest rate by reference assumed of 15%, we can sustain that the investment project X is preferred to the detriment of investments X.

NPV										
	I	*II*	*III*	*IV*	*V*	*VI*	*VII*	*VIII*	*IX*	*X*
0%	3850 lei	5400 lei	15 lei	2150 lei	11800 lei	-10500 lei	3550 lei	2150 lei	2750 lei	1600 lei
5%	2294 lei	2863 lei	5 lei	1466 lei	7608 lei	-8224 lei	2291 lei	1525 lei	1978 lei	1056 lei
10%	1247 lei	1284 lei	0 lei	1010 lei	4878 lei	-6626 lei	1476 lei	1066 lei	1449 lei	699 lei
15%	526 lei	276 lei	-2 lei	699 lei	3054 lei	-5475 lei	934 lei	725 lei	1074 lei	457 lei
20%	18 lei	-379 lei	-1 lei	482 lei	1806 lei	-4627 lei	564 lei	468 lei	802 lei	289 lei
25%	-346 lei	-810 lei	-1 lei	328 lei	936 lei	-3989 lei	306 lei	274 lei	600 lei	168 lei
30%	-609 lei	-1097 lei	0 lei	216 lei	319 lei	-3500 lei	122 lei	125 lei	446 lei	80 lei
35%	-801 lei	-1288 lei	1 lei	134 lei	-124 lei	-3118 lei	-11 lei	11 lei	328 lei	15 lei
40%	-943 lei	-1415 lei	1 lei	73 lei	-447 lei	-2816 lei	-107 lei	-78 lei	234 lei	-35 lei
45%	-1047 lei	-1497 lei	1 lei	27 lei	-683 lei	-2572 lei	-179 lei	-147 lei	160 lei	-72 lei
50%	-1123 lei	-1548 lei	0 lei	-8 lei	-858 lei	-2373 lei	-232 lei	-200 lei	100 lei	-102 lei

	Conflict zone		Multiple IRR	Size of investment		Absence of IRR	Duration of investment		Investment Period	
55%	-1179 lei	-1578 lei	-1 lei	-34 lei	-987 lei	-2208 lei	-272 lei	-242 lei	51 lei	-124 lei
60%	-1219 lei	-1592 lei	-2 lei	-55 lei	-1082 lei	-2070 lei	-301 lei	-274 lei	11 lei	-142 lei
65%	-1246 lei	-1595 lei	-4 lei	-71 lei	-1152 lei	-1953 lei	-323 lei	-299 lei	-22 lei	-156 lei
70%	-1265 lei	-1590 lei	-6 lei	-83 lei	-1202 lei	-1852 lei	-339 lei	-318 lei	-50 lei	-167 lei
75%	-1275 lei	-1580 lei	-8 lei	-92 lei	-1238 lei	-1766 lei	-351 lei	-332 lei	-73 lei	-176 lei
80%	-1281 lei	-1565 lei	-10 lei	-99 lei	-1262 lei	-1690 lei	-359 lei	-343 lei	-93 lei	-183 lei
85%	-1281 lei	-1547 lei	-12 lei	-105 lei	-1278 lei	-1623 lei	-364 lei	-351 lei	-109 lei	-188 lei
90%	-1279 lei	-1527 lei	-15 lei	-109 lei	-1287 lei	-1563 lei	-368 lei	-357 lei	-123 lei	-192 lei
95%	-1273 lei	-1506 lei	-17 lei	-112 lei	-1290 lei	-1510 lei	-370 lei	-360 lei	-135 lei	-195 lei
100%	-1265 lei	-1484 lei	-20 lei	-114 lei	-1290 lei	-1462 lei	-370 lei	-363 lei	-146 lei	-198 lei
	Conflict zone		Multiple IRR	Size of investment		Absence of IRR	Duration of investment		Investment Period	

Investment time cycle

Also, *the time cycle* is a factor generating conflict situations, whereas in the case of cash flows investments from the first period, they are higher than those of other investments, enterprise will have a surplus of funds available that could place in other future investments, obtaining a higher net income than gains from other investments, because by update, with the passage of time, *money today is worth less than tomorrow*.

IRR criterion sets a trap to analysts under the analysis of profitable projects with different life times. For instance, investment VII, achieved on a period of 10 years, has an internal rate of return of 34.54%, inferior to internal rate of return of investment VIII that is of 35.53%. But investment VIII is planned to be achieved over a period of only 5 years. It would be wrong to consider investment VIII more feasible than investment IX, only on account of the internal rate of return. Therefore, if we calculate the net present value for only the first five years of investment under the case of investment VII, we will obtain a project VII internal rate of return of 23.17% and a net present value of only 217 lei, compared with net present value of investment VIII.

Therefore whole the net present value criterion is the most relevant indicator of discrimination against investments, investments more or less feasible.

Reinvestment to constant rate

Internal rate of return was defined as being the discount rate of cash flow investment analysis, to cover the full amount of initial investment. But it went wrong at least realistic assumption of constant reinvestment under the same company and at the same IRR of future cash flow.

To solve this it proceeded to accept the assumption of reinvestment of future benefits at a rate of return of the enterprise, and not of investment project, by the size of enterprise capital cost. Modified internal rate of return, abbreviated MIRR is being calculated by the relationship: $MIRR = \sqrt[n]{\dfrac{\sum\limits_{t=1}^{n} CFD_t \cdot (1+d)^{n-t} + RV_n}{I_0}} - 1$, where d is enterprise specific rate of return that can be reinvested future cash flows.

Clearly as the size of internal rate of return depends directly of positioning of the IRR from benchmark rate stock market d[7], representing the average interest rate on risk-free securities, as shown from the values below:

d	10.00%	15.00%	20.00%	25.00%	30.00%
$MIRR_I$	13.70%	16.85%	20.07%	23.36%	26.71%
$MIRR_{II}$	13.79%	16.00%	18.34%	20.80%	23.37%

It can be noticed that as long as the enterprise reinvestment rate is higher IRR rate, we will achieve modified growth rates of return. But rates of reinvestment lower than IRR generate increasing diminution of the modified internal rate of return.

Multiple solutions

Another problem utilizing IRR in investment selection is the multiple solutions problem. This problem occurs only if the investment

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[7] considered as the minimum rate of return required of shareholders

projects whose cash flow varies in the future, as an algebraic sign, from one period to another. The situation can be met if there is need for additional investment in the future, whether it's legal obligations, or extensions of the life of the investment.

As we can see in the graphic, the NPV curve that characterizes investment III, cuts the x-axis in three points, meaning the investment has three internal rates of return. They are determined by solving the mathematical equation of degree 10 polynomial.

In the case of the investment III we get three internal rates of return because we have three shifts of signs concerning the evolution in time of cash-flows. For the first internal rate of return is being used the function IRR of the Excel spreadsheet program, but the problem arises when determining the other two unknown rates of return. For this we will use the method of calculating the IRR through interpolation with the relation

$$IRR = 25\% + \left(30\% - 25\%\right) \cdot \frac{1}{1 + \left|-1\right|} = 27.5\% \quad . \quad \text{Analog will}$$

obtain the last value multiple of 52.5% IRR.

Net present value profile
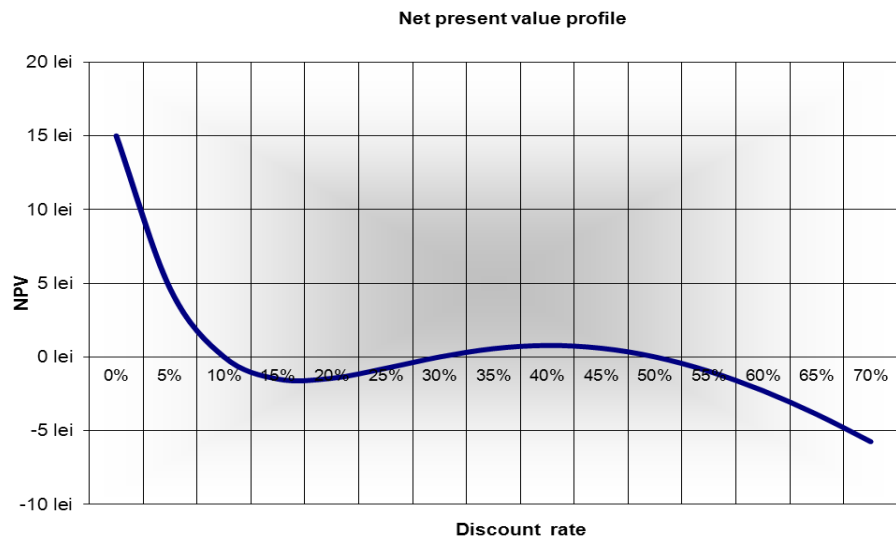
In these cases, abandon the use of the IRR criterion of investment evaluation considering it viable for the net present value criterion.

IRR absence

Due to mathematical construction from which we started determining the internal rate of return, we've come to the situation where determining this kind of rate is difficult, at the expense of solving polynomial equation resulting from equating the net investment with present cash flow sum and with unknown IRR.

There are situations in which the equation that was just mentioned doesn't accept real solutions; therefore, we're assisting at an evaluation project of investment characterized through the absence of internal rate of return.

In this case, investment *VI* is characterized by strictly negative net present values, in case we go through the interval of discount rates [5%-100%].

Net present value profile
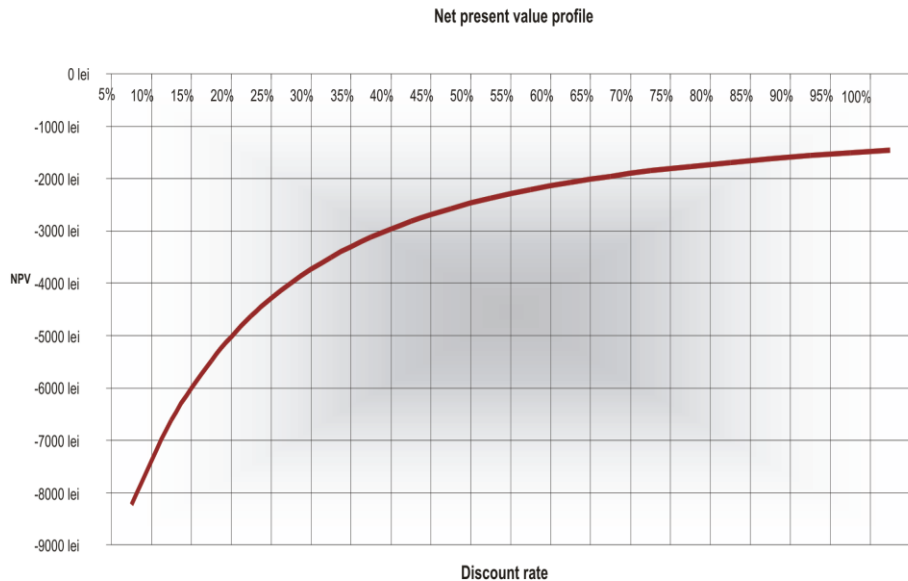
If the discount rate tends to a very high value, present coefficient tends to the initial value of investment, which causes the gradual cancellation of the importance value discounted cash-flow. This behaviour can be described more than a perpetual investment in the scheme,[8] in which case the present value of cash-flows is given by

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[8] project length tends to have high values, and cash-flow average describes and parallel to the x-axis

$NPV = \dfrac{CFD}{IRR} - I_0$. In addition to this asymptotic behaviour arises the financial practice problem, which doesn't look at situations of very high profitableness, since such situations are impossible at the level of analysis in absolute values.

Conclusions

An investments internal rate of return has won an important place in decision making in the analysis of financial practices of the largest enterprises. But scientific research has shown that such a criterion is relevant only in terms of comparative analysis of independent investment projects, those you can use assessing the feasibility of investment into the truth of the relationship IRR> *d*. Also, a depth analysis of investment projects can be used as a useful tool in their classification, given that the economic situation imposes restrictions on enterprise financing. Therefore, indivisible priority projects[9] that are intended to be done are those projects with the highest values of the internal rates of return.

A use for the IRR criterion raises numerous conflicting situations, starting from incompatibility of the results obtained through evaluation using the IRR criterion and, also, NPV criterion. Conflicting statements are limited to investment projects whose related net present values curves intersect. Also, methodological insufficiencies make their way in the valuing of information offered by the application of the IRR criterion for investment evaluation: multiple IRR solutions, IRR absence, or the unrealistic assumption of reinvestment of future benefits at a constant rate of non-specific general business risk and profitability enterprise etc.

All these remarks don't have as purpose minimising the informational value of the internal rate of return, but only to draw a fine attention to the weaknesses and traps set by utilising this indicator.

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[9] if we analyse dividable investment projects, we will be able to make a portfolio of investments, in which the problem is to determine the structure vector of the portfolio's components, that have to assure a maximisation of enterprise value either through by designing an objective function of maximum internal profitability, or utilising a function of net present value hope

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