Scinetific Problems of Modern Approach of Net Present Value

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SUMMARY

There are some scientific questions of NPV analysis, which has not been worked up. Would be useful for practice to explore the special inherence of the NPV method for making financial and management decisions, as well as for the different cash flow projects (typical that is "orthodox" and non typical that is "unorthodox" cash flow series). There is not cleared up scientific background of the question, why is not equal the total cost of capital for equity and for debt.

Net present value is a well-known category of economics and everyday management practice. Practical experiences show when companies use net present value calculation several problems emerge, wrong applications are general as well as misinterpreting. A large part of these can be due to the characteristics of the literature background. This paper intends to reveal besides these characteristics the directions of further economic research works on this topic.

Net present value calculation has also become part of the economic school-material in the Hungarian higher education since the second half of the 60's. In this period we could have met several interpretational and applicational mistakes, which was typical not only in the Hungarian but also in the international literature.

THE SUITABLE YIELD-CONTEXT

According to the original version of net present value calculation from the discounted value of total sales revenues the discounted value of total expenditures are subtracted. In case of investment projects the method can be simplified. From the sum of discounted value of a special income stream calculated as a difference of sales revenues and operating costs the discounted value of investment-related expenditures are subtracted.

Even two decades ago a false methodological description could be found in Hungary, which says that the way of net present value calculation is that from the discounted value of pretax profit arising from the investment the sum of investments is subtracted.[1]

Fault of this description is that the nominal value of the investment was refunded from the revenues twice. (On one hand to determine the accounting profit depreciation must be subtracted from the sales revenues, on the other hand the nominal value of investment is subtracted from the discounted value of profits.)

The right solution concerning investment projects has become general step by step. The income stream arising from the difference of sales revenues and operating costs is named a sort of "net yield" in the original Hungarian terminology. This is Hungarian counterpart of the well-known English acronym EBIDTA.[2] The discounted sum of this net yield should be decreased by the nominal sum of the initial investment, or by the discounted sum of the project investments (as the investment expenses are arising). Only this yield index can lead to the right value of the original method, i.e. to the sum as the difference of the discounted total sales revenues and discounted expenditures emerging during the investment. (In the literature we can see other variants of the NPV contents as well.)

METHOD-INTERPRETATION POSSIBILITIES

From the view of practical usability, the biggest problem of the existent, modern net present value concept is that *the issue is treated only on the high level of general interpretation* with the demand that the settings and statements may be applicable for all of the net present value calculation possibilities. Of course such a methodological assumption is necessary, but the *main characteristics of net present value analysis of different kinds of issues and projects, the special interpretation possibilities of the calculation results also should be revealed*. This way it would be possible to get closer to the exploration of the internal content richness of the method as well to a deeper knowledge of the characteristics of the practical application. The most important steps leading to the processing of the practical interdependences of the method are:

➢ distinguishing between projects connecting to the real sphere and the clearly financial projects
➢ a different interpretation of net present value of typical and non-typical cash flow pattern projects.

Projects Connecting to the Real Sphere and Clearly Financial Projects

It might be practical to make a distinction between projects connecting to the real sphere and projects being confined to financial activities during introducing model exercises and treating methodological questions of net present value calculations (and usually profitability calculations), since the economic content behind income and expenditure lines are basically different. Furthermore the way of thinking and the required professional knowledge which is needed for profitability calculations are also different. *The understanding of interdependences of the two project types and the management of their accomplishment also requires very different professional knowledge.*
For companies, methodological knowledge of profitability analysis of projects connecting to the real sphere is mainly needed. In the further parts of this paper the analysis of net present value interdependences are restricted to projects connecting to the real sphere.

Projects with Typical and Non-typical Cash Flow Patterns

The main characteristic of projects with typical cash flow patterns is that the time series of the difference of sales revenues and expenditures starts with a sum with a negative sign. *Ever since that the difference of yearly revenues and expenditures firstly becomes positive, the sign does not change any more, that is no such year will*

³ *Arnold – Hope (1990) pages 258-259.*

exist, when the sum of expenditures would exceed revenues.
Literature basically deals with the topic of projects with typical and non-typical cash flow patterns in connection with the method of internal rate of return searches, since in case of projects with non-typical cash flow patterns the chance of *more than one internal rate of return* may occur. *Projects with typical cash flow patterns can have only one internal rate of return.*
Because of the possibility of more than one internal rates of return, the literature suggests *net present value calculation* for the profitability analysis unequivocally and without qualification. (The name of typical cash flow line itself is not uniform. Arnold and Hope, for example, - also in connection with the method of internal rate of return search- talks about orthodox and non-orthodox cash flow line. Furthermore, they emphasize that in case of non-orthodox cash flow lines net present value calculation should be preferred.³ To make a distinction between the two different lines of cash flow, conventional and unconventional naming is also used.)
As we will see further, net present value calculation can lead to unequivocal results – differently from the general approach - only in case of typical cash flow lines.
As a consequence, in order to have a clear view it would be reasonable *to make a general and emphatic distinction between projects with typical and non-typical cash flow lines*. In case of projects with *typical cash flow lines* (in particular typical investments) *the project itself generates, exploits all the yield-elements figured in the analysis*. Therefore profitability calculation may follow the logical question, whether investments related to the project interpreting in interest relation how much profit proportion generates, and how much surplus yield is resulted compared to an interest-wise requested profit.
A main characteristic of non-typical cash flow lines investments is that the project is not independent financially, that is the cumulated cash flow of the project is not independent from the profitability of other projects. As it follows from this, the profitabilty of non-typical investments can be analyzed together with the profitability of other connecting project or projects.
As it follows from the above mentioned, typical and non-typical cash flow lines investments require different analysis background even methodologically during the efficiency analysis of investments.

NET PRESENT VALUE OF TYPICAL CASH FLOW LINES PROJECTS

Definition of Economic Content

In the recent days the majority of authors are decidedly aware of even to make mention of the economic content of net present value.

According to the general description, net present value is the difference of the discounted value of expected EBITDA and the expected investment cost of the project.[4] Instead of concrete economic content, it represents the result of a calculation, in which for a given point of time (usually for the starting point of time of the project) the discounted value of expenditures is subtracted from the discounted value of revenues. A given investment, and the project can be considered profitable, if the net present value is not less then zero, or according to the more popular (although not accurate) definition if it shows positive value, ergo greater than zero.

Nowadays the real economic content of net present value is not defined.[5] This obviously has a strong connection with a high level of generalization. *Besides a high abstraction level of method interpretation no unequivocal economic content arises.* Obviously, this also has a connection with the different content of net present value of typical and non-typical cash flow lines projects.

After distinguishing between typical and non-typical cash flow line projects, *the economic content of net present value of typical projects can be defined. The positive net present value of typical investment projects quantifies the discounted value of surplus-yields arising beyond the yield requirement based on the discount rate. Net present value with a negative sign indicates the present value of further yields needed for the requirement on returns.* (In case of positive net present value the real profitability of the project is higher than the requirement according to the discount rate.)

Example for the Interpretation of Net Present Value as Discounted Surplus-yield

The sum of investment of a project (correspondent with the conditions of typical investment) is 380 million HUF, one year after the investment the positive data line of EBITDA starts with the following yearly sums: 170 million HUF, 190 million HUF and 140 million HUF. The discount rate is 12 per cent.

To demonstrate the doctrinal interdependences through an example the net present value of the investment project is determined in the first step, then we show that the net present value of the project can be interpreted as a discounted value of surplus-yield arising beyond the yield requirement based on the discount rate.

Knowing the economic content of net present value, the net present value calculation of typical cash flow line investments and their different versions becomes logically controllable, the effects of changes in basic data becomes unequivocally traceable, the value-side of changes needed to reach the level of profitability can be easily mapped.

Table 1. Determination of net present value of the given project

Year	Revenue – Expenditures (million HUF)	D^t i = 12 %	Discounted values (million HUF)
0.	– 380	1	– 380,00
1.	+ 170	0,89286	+ 151,79
2.	+ 190	0,79719	+ 151,47
3.	+ 140	0,71178	+ 99,65
NPV			+ 22,90

Table 2. Calculation of fulfillment of yield requirements concerning the given project

Year	Set of returns compared to the requirements on returns (million HUF)
1.	– 380· 1,12 + 170 = – 255,6
2.	– 255,6· 1,12 +190 = – 96,27
3.	– 96,27· 1,12 +140 = + 32,18
A surplus-yield of 32,18 million HUF arises at the end of the 3. year. Its discounted value for the present gives exactly the sum of net present value. NPV= 32,18 · 0,71178=22,91	

The Comparability of Net Present Value of Typical Investments

The comparability of net present value *can be considered as a relevant question only in the case of projects with typical cash flow lines.* However comparability is definitely *problematic* even in this field, *which results from the characteristics of the method.*

A main characteristic of net present value calculation is that *it treats the size and duration of the investment in a correct way only when charging yield-expectations according to the discount rate. The surplus yields arising above this are simply discounted by discount rate.* Two important and from the point of view of comparability displeasant characteristics of the method result from this:

➢ It does not take into consideration the size of average investment laying behind the net present value of surplus yields (It is much easier to reach a net present value of 10 million through a 1-billion-project, then by a 10-million forint-project)

➢ It does not take into consideration the *duration of investment* resulting surplus yields (Through investing 1 billion HUF for 5 years a much bigger surplus yield can be reached, then by investing the same amount of money for 1 year). *From today's modern literature the conclusion can be drawn that this important characteristic of the method is not generally known among the experts.*

Although the two, above mentioned characteristics make it unequivocal that projects are usually not comparable based on their net present value, the literature is divided on this question.

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[4] *For example: Pappas – Hirschey (1987) p. 549., or Schmalen (2002) p. 593.*

[5] *About a one and a half or two decades ago we could meet the real economic content of net present value, but these were inaccurate or false even for typical yield investments. An example for the false version: „ ...net present value indicates the wealth increase resulting from the investment. This is equal to the increase in capital, which has not been realized yet." Clifton – Fyffe (1981) p. 179.*

In order to make the results of investments comparable, the net present value per unit of invested amount is often used. This partially eliminates the distortions deriving from the differences of average sum of investments, but it is not able to handle the differences of *durations*.[6]

In case of negative net present value, a need for comparison usually does not emerge. If it should emerge, a good starting point could be that a typical investment's net present value with negative sign quantifies the discounted value of yield-lack, which would be needed for the investment to reach the term of profitability.

NET PRESENT VALUE OF NON-TYPICAL INVESTMENTS

Non-typical cash flow line investment is meant when in the data line containing the difference of revenues and expenditures a data with negative sign occurs again after the line has once turned into positive. In economic sphere it means that *some part of or the whole amount of the once already withdrawn yields must be returned to the same project later*. This could be also imagined as if the non-typical investment project would *lend a given amount of money for a given period of time for arbitrary use to the entrepreneur*. Therefore the successfulness of the project also depends on that the withdrawn, but later returned amounts how much yield generates in another project. As a consequence, the possible outcomes of external use of the temporarily excess amounts must be also taken into consideration when determining economic profitability.

The automatism of net present value calculation treats investment as an independent project in each cases, it does not analyze the *yield-possibilities* acquirable in other fields of temporarily excess amounts.

It treats for the project temporarily redundant amount (and amounts) in a schematic way. *According to the implicit automatism of the calculation the later returnable amount yields in the period of transfer based on the discount rate.* This automatism is such a characteristic of the method, which the adaptors' attention should be definitely drawn to. It would be also practical to indicate that the analysis of real utilization possibilities of the given amounts of money may improve the clairvoyance regarding profitability.

It admits of no doubt, that contrary to the hardly treatable information content of the more than one internal rate of interest, net present value calculation also gives only one kind of results for these projects. However, the unequivocalness of the calculation's result is only apparent. Whereas nothing guarantees, that the temporarily utilizable money is invested in a project with the same risk as the examined investment, and a yield according to the discount rate will arise in this project.

It may occur as a false effect that *the method automatically assumes of the bigger yield-expectation rate connected to the bigger risk, that the temporarily excess amounts also accomplish this.* The contradiction depending on the characteristics of each project concretizes in a different way. Net present values of versions with different risk may even prefer less good decisions

Example for the Analysis of Net Present Value of a Non-typical Cash Flow Line Project

The following example intends to introduce the interpretational problem of net present value in case of non-typical cash flow line projects from the practical point of view.

An entrepreneur, B. G. is considering whether to buy the mining right of a smaller, during 1 year exploitable opencast coal-depot for 100 million HUF. A responsibility of returning the land in recultivated condition after two years is also part of the business. B.G. could sell the right of exploitation (and sales) to a mining entrepreneur for 625 million HUF. Next, the entrepreneur specialized also in recultivation would carry out the recultivation activity for 625 million HUF in one year. The 100 million HUF for the mining right is immediately due.

The mining entrepreneur would pay the agreed price in one year, after finishing his activity. The exchange-value of the recultivation activity would become due after the work will be done.

Table 3. Revenues and expenditures of the project in the example

Year	Expenditure/revenue
0.	− 100 million
1.	+ 625 million
2.	− 625 million

According to the data line, the project itself is showing deficit from the view of accounting. The sum of expenditures is greater than the sum of the revenues. The *possibility for yield in the project for B.G is that against the 100 million HUF given out in the start time he will earn 625 million HUF in one year for one-year arbitrary use*, and after one year the nominal value has to be paid back into the project.

Accordingly, B.G. would invest 100 million HUF for two years. The profitability of the 100-million-HUF investment depends on whether at what profitability he is able to transfer the 625 million HUF used arbitrarily all the year round in another project or another activity.

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[6] *In order to treat together the differences in the size of invested amounts and the length of the duration future value model has been worked out. Its description: Schmalen (2002) p. 602-605.*

If he locked his money in the safe-deposit, the invested 100 million HUF would be lost and its potential yield as well.

Let's suppose that B.G. used the method of net present value calculation to support his decision regarding the project. He gained such information in quick time that the mining entrepreneur accomplishes his payment liability always late and it is not rare that an occurrent penalty claim can be proved only after long years of pleading. Because of the bigger risk related to the accomplishment of financial liabilities he has found it reasonable to apply a 27 % discount rate. The calculation carried out under these conditions showed the project profitable, with a net present value of 4,63 million HUF.

$$NPV = -100 + 625 \cdot 0,78740 - 625 \cdot 0,62000 = -100 + 492,13 - 387,5 = 4,63$$

Later it has turned out, that the information concerning the annoying paying habits of the mining entrepreneur is false, this behavior is regarding for another entrepreneur. According to the corrected information the entrepreneur involved in the project has been working in this business for several decades, and he has accomplished his payment liabilities exemplarily so far. Therefore the risk of the project is considerably less than the original conception. B.G. recalculated the net present value with a 15 % discount rate according to the new information. In this case though a negative net present value arisen, i.e. with a smaller risk the project would have not been profitable:

$$NPV = -100 + 625 \cdot 0,86957 - 625 \cdot 0,75614 = -100 + 543,48 - 472,59 = -29,42$$

According to the example a paradox situation has occurred, that is net present value shows profitability calculating with a higher risk, whereas it is obvious that in other cases under the same conditions a less risky situation would be more advantageous for the entrepreneur. Though net present value is negative in that case.[7]

The root of the problem is meant by the characteristic mentioned above, that *the method interprets the external yield-effect of the temporarily excess money on a rate according to the discount rate. The conditions of profitability would be accomplished by the investment yielding according to 27% discount rate increased because of the high risk or even extra-yield would arise. If in case of one-year out-placement of 625 million HUF only 15% yield could be realized, then the 15% capital yield expectation of the project also not accomplishes.*

It is generally true, that in case of higher discount rate the method ab ovo assumes higher yield possibilities regarding the temporarily out-placed amounts, but from the increase of the given project's risk does not result a more profitable utilization of the temporarily disengaged monetary assets.

In case of the given example a cardinal question of profitability is that the 625 million HUF used arbitrary for one year at what percentage of profitability could be invested. In the favor of a more accurate orientation a critical yield rate can be determined, which would insure clearly and entirely that the mining project would accomplish the capital yield expected according to the calculative.

Assumption for accomplishment of the 15 % profitability expectation in case of the given mining project. $(1,15^2 = 1,3225)$:
$$100 \cdot 1,3225 + 625 = 625 (1+r)$$
$$\frac{757,25}{625} = 1 + r = 1,2116$$

Assumption for accomplishment of the 27 % profitability expectation of the project. $(1,27^2 = 1,6129)$:
$$100 \cdot 1,6129 + 625 = 625 (1+r)$$
$$\frac{786,29}{625} = 1 + r = 1,258$$

Based on the above mentioned, it can be stated that if the entrepreneur would like to realize a profitableness of 15% considering the given project, the 625 million HUF utilizable arbitrary for one year must be invest with a 21% profitableness. On the other hand though, in favor of the 27% profitability expectation of the project, an investment possibility with at least 26% must be found for the 625 million HUF.

In case of the 15% yield expectation net present value turned out to be negative because a money out-placement with such a yield rate does not bring an income, which would be required for a 15% profitableness of the given project.

A positive net present value arisen because a money out-placement with a 27% profitability would assure automatically a greater average profitability than it would be required for the expected profitability of the project.

(Nominal value return requirement of the entrepreneur's 100 million HUF investment: 725:625=1,16.

Consequently, to ensure a return at least on nominal value of the 100 million HUF, the 625 million HUF should be placed out at a profitability of 16%.)

In case on non-typical investments, concrete questions flashing on the questions of profitability can be conceived based on the content of the project.

[7] *It is interesting, that two internal rates of return (two internal financial rate of return) arise in the project, 25% and 400%. It means at the same time, that in case of each discount rate greater than 25% and less than 400%, the sign of net present value will be positive. Net present values will be negative in case of discount rates fallen outside the given interval.*

$$-100 \text{ million} + 625 \text{ million} \cdot \frac{1}{1,25} - 625 \text{ million} \cdot \frac{1}{1,5625} = 0, \text{ that is } [-100 + 500 - 400 = 0], \text{ further}$$

$$-100 \text{ million} + 625 \text{ million} \cdot \frac{1}{5} - 625 \text{ million} \cdot \frac{1}{25} = 0, \text{ that is } [-100 + 125 - 25 = 0]$$

PROBLEM OF AMALGAMATION OF PROJECT-PROFITABILTY AND FINANCING-PROFITABILITY

Profitability means the examination of whether the requirement on returns gets fulfilled, and the level of over-fulfillment is also determined. Financing reveals whether the required financial assets are available to fulfill the accrued expenses and from which sources they can be ensured.

Nowadays the application of net present value formulas, in which the profitability of the project and the profitability of financing runs into one another, are getting more and more typical. It is not rare that the financing terms based on the corporate average capital structure and their financial conditions are taken further for the given projects. Relations of investment-profitability, financing-profitability and financing-expedience are amalgamated. In order to get a clear picture *it would be practical to examine separately the profitability of the project and the profitability of the different versions of financing*. After revealing these the conjointed examination of the profitability of the two sides cannot be criticized.

APPLICATION OF RETURN NORMS DISCREPANT FROM THE PRINCIPLE OF OPPORTUNITY COST

Two or three decades ago the discount rate was very often interpreted as that it comprises of the return according to the bank rate of interest or the company's own average rate of capital profitability.[8]

Later it became unequivocal, that here *the use of capital-yield expectation based on the opportunity cost interpreted for the capital* and defined by the microeconomics is *reasonable*. Collaterally with this, the use of capital-yield expectations with *differential* rate based on equity capital and debt appeared in the net present value calculation.

The basis of this is that regarding equity capital competitive market risk-premium expectation also must return besides the risk free rate, but for the debt it is satisfactory if the interest returns. Recommendation of this differentiated rate capital-yield expectation of equity capital and debt in literature gets more and more emphasis, but the underlying principles of the method are not enucleated scientifically.

➢ No scientific explanation exists, why capital-yield norm determined on the basis of microeconomics is not suitable to fulfill the role of yield-requirements. Literature does not concern the scientific explanation of two different kinds of yield-norms of equity and debt.

➢ No explanation exist for that either, why - though primarily equity capital bears also the risk of debt as primary risk-taker - the return requirement of risk-premium norm regarding debt must be put aside during examination of profitability. (Otherwise under the same circumstances equity capital bears the more risk, the bigger the rate of the debt.)

➢ The development of commodity market processes is not affected by whether the capital behind the production is equity or it derives from debt. Accordingly, the change of corporate capital structure does not cause alone changes in the commodity market processes, on the other hand though the average of differentiated capital-yield expectation is a category depending on the capital structure. No explanation can be found how the norm not correspondent with the commodity market correlations is able to convey the commodity market requirements.

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[8] *For example authors Clifton − Fyffe (1981) also places this two yield-requirements in their collective work: „…in the method of net present value discount rate is the interest rate, which is analogous with the interest payable" , can be found on page 164.. Later it changes a little bit: „Discount rate applied in the discounting of future current incomes or the interest rate (cost of capital) being in operation on the money market, or the current profit rate of the equity invested capital of the company." (page 329.)*

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