USE OF MIRR AS TOOL FOR APRRAISING RELATIVE PROFITABILITY

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Abstract:

The efficiency of investment financing sources at the microeconomic level is an approach whose successful achievement also requires the most efficient use of financing sources.

The measurement of this efficiency is carried out with the help of specific indicators - among which MIRR stands out, namely for management interested in quantifying relative profitability, on one hand, and for long term use of corporate governance – inter alia, of capital budgeting, on the other hand.We must, however, observe MIRR assumes cash inflows are reinvested at WACC, which, again, is – or, at least, must be – a crucial component of corporate governance: the inverse proportional relationship between the calculated value of WACC and the value of the firm means the minimum value of WACC corresponds to the peak of the growth trend (maximum) of the firm's value.

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The internal rate of return is defined as rate of discount for which NPV value equals zero (0)[39]; in other words, internal rate of return *rule* states that a firm should accept an investment project if opportunity cost of capital is less than the internal rate of return[40].

However, this is not as straightforward as it may sound: namely, the use the internal rate of return as a criterion in preference to net present value can be, on one hand, deceiving – for, given that, as discount rate increases, NPV usually rises, to be followed by a no less usual decline – due to the double variation in cash-flow stream *sign*, there can be as many internal rates of return for a project as variations of cash flow stream *signs*[41].

A firm can, on the other hand, discount the cash flows from the end of an *investment* project's 'life' at capital cost until there remains only one change in the sign of the cash flows. Therefore, what is known as a modified internal rate of return (MIRR) can be quantified on basis of this revision.[42]

Formally, MIRR is solution to the following equation:

$$\sum_{t=0}^{n} \frac{COF_t}{(1+K)^n} = \frac{\sum_{t=0}^{n} CIF_t \cdot (1+K)^{n-t}}{(1+MIRR)^n}.$$

or

$$PV_{costs} = \frac{TV}{(1+MIRR)^n}.$$

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[39] Brealey, R.A., Myers, S.C., Allen, F. (2020), p. 115.

[40] Id., p. 116.

[41] Id., pp. 116-117.

[42] Ibid., p. 118.

To illustrate this, in the table below are data illustrating in a quantitative approach the relationship between two (in this example) projects – named PROJECT BETA and PROJECT GAMA – and MIRR and IRR indices.

Processing both projects' data yields following results (assuming discount rate i = 7%, i.e. an *average* interest rate in a typical developed market economy, and a period of 5 years):

PROJECT NAME	**BETA $000**	**GAMA $000**
CF_0	(22000)	(49000)
CF_1	9000	22000
CF_2	6400	18000
CF_3	7600	18400
CF_4	8400	19200
CF_5	11000	22400

$$\sum_{t=0}^{n} \frac{COF_t}{(1+k)^t} = \frac{\sum_{t=0}^{n} CIF_t(1+k)^{n-t}}{(1+MIRR)^n}$$

PROJECT BETA

MIRR is computed as follows:

$$22000=\frac{\sum_{t=0}^{5} 9000(1+7\%)^{5-1}+6400(1+7\%)^{5-2}+7600(1+7\%)^{5-3}+8400(1+7\%)^{5-4}+11000(1+7\%)^{5-5}}{(1+MIRR)^5}$$

MIRR=17,04%

IRR is computed as follows:

$$CF_0+\frac{CF_1}{(1+IRR)^1}+\frac{CF_2}{(1+IRR)^2}+\cdots\ldots\ldots..+\frac{CF_n}{(1+IRR)^n}=0$$

$$-22000+\frac{9000}{(1+IRR)^1}+\frac{6400}{(1+IRR)^2}+\frac{7600}{(1+IRR)^3}+\frac{8400}{(1+IRR)^4}+\frac{11000}{(1+IRR)^5}=0$$

IRR=25,5%

PROJECT GAMA

MIRR is computed as follows:

$$49000=\frac{\sum_{t=0}^{5} 22000(1+7\%)^{5-1}+18000(1+7\%)^{5-2}+18400(1+7\%)^{5-3}+19200(1+7\%)^{5-4}+22400(1+7\%)^{5-5}}{(1+MIRR)^5}$$

MIRR=18,58%

IRR is computed as follows:

$$-49000+\frac{9000}{(1+IRR)^1}+\frac{6400}{(1+IRR)^2}+\frac{7600}{(1+IRR)^3}+\frac{8400}{(1+IRR)^4}+\frac{11000}{(1+IRR)^5}=0$$

IRR= 29,68%

Due to the fact that MIRR is higher than the cost of capital (7%), both for project Beta and for project Gama, if the projects are independent, both projects would be accepted.

If the projects are mutually exclusive, and for both projects MIRR is higher than the cost of capital, *we will accept* the project with the highest MIRR, in our case *Project GAMA*, *whose MIRR is 18.58%*, unlike Project BETA, whose MIRR is 17.04%.

The MIRR outperforms the conventional IRR in a big advantage.

While the conventional IRR assumes that each project's cash flows are reinvested at its own IRR, the MIRR assumes that all cash flows are reinvested at the cost of capital.

The modified IRR is a better predictor of a project's relative profitability because reinvestment at the cost of capital is typically more accurate; also, the issue of multiple IRR is likewise solved with MIRR.

MIRR is distinguished from the other variants of internal rate of return indexes by following distinctive features[43]:

(1) The discount rate – including the one at which the benefits resulting from the functional investment project are **reinvested** – is equal to the weighted average cost of capital (WACC);

(2) The use of the MIRR model generates – from the calculation – a *single* value of the internal rate of return (MIRR, in this case), i.e., it *cannot* yield more than one value of it;

(3) MIRR can be compared with the cost of capital, so that the decision to finance an investment project is – as far as figures go – appropriately taken.

WACC is, in fact, the index used to quantify the cost of long-term financing sources contracted and used by the company – especially so, for a joint-stock company[44], and one based on following premises[45]:

(1) the different sources of long-term financing of the company are, in fact, different types of capital - which, together, make up the capital of the company -, which, on the whole *is* more or less *risky*

[43] Ehrhardt, M.C., Brigham, E.F. (2011), p. 393.
[44] Id., p. 115.
[45] Ehrhardt, M.C., Brigham, E.F. (2011), p. 337.

(there is a risk for acquiring it and another risk for using it – inclusively, in the form of *opportunity costs*);

(2) thus, for each type of capital there is a specific size of expected rate of return (capital yield);

(3) the expected profitability of respective types of capital must register a dynamic that contributes decisively to the ***maximization*** of the company's ***share price***, which implies design of a desired (or optimal) capital structure - for which, the typical[46] elements of of the company's capital are considered to be[47]:

i. debts (long-term) – in WACC formula, D

ii. ordinary shares (eng. common equity) – in WACC formula, AO

iii. the preferred shares (eng. preferred stock) – in WACC formula, AP, and, thus, WACC formula has the following form (w stands for planned weights of the types of capital, r the cost of holding and using the types of capital, and T the marginal rate of interest income tax applied to the firm):

iv. $WACC = w_D \cdot r_D \cdot (1 - T) + w_{AO} \cdot r_{AO} + w_{AP} \cdot r_{AP}$.

Based on these premises, the cost of financing sources contracted and used by the firm in the long term is the weighted average of the costs associated with holding, on one hand, and using, on the other hand, various components of the firm's capital.

The dynamics of financing sources cost contracted and used by firm in long term is normally, say, designed and carried out by company's management so as not to violate a fundamental financial principle, according to which the capital structure of the firm must simultaneously satisfy following needs:

1) On the one hand, avoiding the materialization of the risk of bankruptcy;

2) On the other hand, financing of necessary investments for company's development.

From this perspective, the financial technique necessary for the materialization of the desired (optimal) capital structure, which will ensure - by definition - the ***decrease in the cost*** of long-term financing sources contracted and used by the company is applied by taking the following measures[48]:

1. Contracting credits (long-term) to take advantage of fiscal advantage of this source of financing - as long as the company does not record financial distress costs[49];

2. Continuing to access long-term financial sources in the form of long-term loans until the WACC value is minimal - which corresponds to the maximum increase in the value of the company.

Finally, the company's management must stop using long-term loans as sources of financing, the purpose of this decision being

3. Decreasing cost of long-term financing sources, so that the company's financial situation does not decrease as a result of the reduction of the company's value by increasing the current value of the (future) costs produced by the materialization of the bankruptcy risk for the company[50] - costs that exceed fiscal advantage of long-term loans.

The profitability of short-term financing sources - more precisely, reinvested profit and short-term credits (banking and commercial) – manifests itself somewhat indirectly, in the sense liquidity is indispensable for the existence of profitability of company's long-term financing sources (especially long-term credits) in that it ensures their operation, and respectively, and first of all, the company itself, in the long term.

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[46] Ehrhardt, M.C., Brigham, E.F. (2011), pp. 368; 399.
[47] Ehrhardt, M.C., Brigham, E.F. (2011), pp. 358-359.
[48] Ross, S.A., Westerfield, R.W., Jordan, B.D. (2013), pp. 541-542.
[49] Op. cit., p. 543. Financial distress costs are bearable for a company if a sensible part of its assets is made up of *tangible assets*, that is assets which can be sold, without any significant value loss, *for settling the company's debts*.
[50] Ibid.

More precisely, short-term financing sources are profitable because they support the company's ability to pay its maturing debts[51], which ensures the company's ability to further contract other (long-term) debts.

For long-term financing sources, significantly different levels of profitability are registered, depending on (as before, our analysis focuses on joint-stock companies)[52]:

1. Size of the company

2. The quality of the system, in general, respectively of the information mechanism, in particular available to the company - quality responsible for

a. Obtaining (privately) quality information regarding the prospects of the evolution of the company's profitability (in the future)

b. Avoiding informational asymmetry (and adverse selection);

3. The company's ability to organize its activity of attracting financing sources according to workings of *economies of scale*.

On the one hand, long-term financing sources consisting of borrowed funds - especially long-term loans - are more profitable for companies (or, in any case, used in a larger proportion), or, simply, accessible to them in practice in the situation where companies:

A) Appeal to a market of financing sources in which private lenders (e.g. banks) are better informed than public lenders (i.e. potential shareholders, etc.) on the characteristics of potential borrowers, on the one hand, and, on the other on the other hand, they are "young" or small companies - with the common characteristic of being more exposed to the influence of *information asymmetry*[53];

B) At the same time, are sensitively exposed to information asymmetry and are in possession of certain information regarding the prospects of the evolution of their *earnings*[54].

Such firms are, in general, economic agents of relatively small size, or – which, from the perspective of *sales volume*, is about the same thing – (relatively) little known in the market. In addition, debt-based financing is also generally more disadvantageous, given that the sources of financing in this category increase the variability of the dynamics of earnings before taxes.

If this dynamic turns out to be unreliable, its immediate effect is that of discouraging shareholders and *potential* shareholders, through the consequent and implicit increase in the variability of earnings per share dynamics [55].

On the other hand, stocks, both listed and unlisted, are much more profitable - in the long run - than loans, generally for large and/or well-known firms, which have, in short, the ability to be profitable, since they can make good use of[56]:

(I) Information obtained through their own means and connections about evolution of their level of profitability;

(II) Exposure in a (more) reduced proportion to information asymmetry – for which perspective we must note, however, that possession of such information does not entail exposure in the same proportion to information asymmetry for all firms in this situation[57];

(III) The size of their economic activities, from which, further, they can *derive* the issuance of shares (listed or unlisted, respectively) in terms of an *economy of scale* - which, first of all, will determine the significant ***decrease in the costs*** of share issues.

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[51] Ehrhardt, M.C., Brigham, E.F. (2011), p. 110.
[52] Journal of Financial Economics 51 (1999), p. 407.
[53] Ibid., p. 409.
[54] Ibid.
[55] Ehrhardt, M.C., Brigham, E.F. (2011), p. 779.
[56] Journal of Financial Economics 51 (1999), p. 422; 432.
[57] Ibid., p. 429.

Quantification of weighted average cost of capital has a great value for the analyst, from several points of view.

First, there is an inverse proportional relationship between the calculated value of WACC and the value of the firm: the minimum value of WACC corresponds to the peak of the growth trend (maximum) of the firm's value. An economy as Romania's, in which companies financing - inclusively - is mostly ensured - as far as borrowed financial funds *sources* are concerned - by the banking system, thus offers companies a means of making financing sources more efficient at the microeconomic level, whose qualities are, however, not absolute: it is about the fiscal advantage of long-term loans, which is no more when the company goes bankrupt.

On the other hand, low costs may not be a problem for companies, in the long run, if some measures are taken to prevent careless spending.

A firm can bear, in the long term, high costs – i.e. generated by the financing of its *investments* - corresponding to high risks, provided that:

1) high risks correspond to (very) profitable projects;

2) high costs are not associated with small risks, which correspond, therefore, to less profitable projects.

As for high costs that incur as immediate effect of investment, they do not contradict the principles of economy, efficiency and effectiveness, respectively the profitability target; in connection with this, we emphasize the following:

A) high costs imply high expenses - paid for materialization of investments;

B) the high costs will be borne by the firm without adverse effects for it on the basis of (at least) maintaining the level of the firm's *savings*.

Secondly, in relation to the MIRR indicator, it must be said that it reflects, as a tool for calculating profitability of investment projects:

I. the links that exist – or, respectively, that *must* exist – between the firm's investment strategy and corporate governance, on the one hand, and

II. its relative efficiency – e.g. compared to that of NPV –, on the other hand.

Regarding connections established between the firm's investment strategy and the results projected by/obtained by using the methodology and perspectives of corporate governance within the firm, we note, first of all, that MIRR, as a tool specially designed for "energizing" investment policy of company, is an indicator intended for[58]:

1. quantification of the increase in value from which the company - in its entirety, therefore, at least in one sense, more than its "simple" financial structure - will benefit from the materialization of investment projects, through the processing of inputs included in the production process;

2. quantification of (relative) profitability (i.e., rate of return) necessary to maximize the quantitative characteristics of outputs of production *process*.

MIRR, in other words, at the same time measures and promotes the quantitative - and qualitative - development of the production cycle, therefore of the company, from which "must" result, even if indirectly, the efficiency of investment financing sources (on a microeconomic level), unlike the NPV, which, applied to the data characterizing the investment projects, registers values at (higher) levels presupposing, respectively determining, directly, the existence/increase of the efficiency of investment financing sources.

[58] Ehrhardt, M.C., Brigham, E.F. (2011), p. 395.

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