

**PLANNING AN INVESTMENT PROGRAM OF A COMPANY IN VIEW OF
REINVESTMENT OPPORTUNITIES**

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A company's investment program is drawn up with specific reference, using a joint analysis of marginal cost of capital (MCC) and investment opportunity schedule (IOS) curves. It is suggested to apply the modified internal rate of return (MIRR) indicator instead of the internal rate of return (IRR) indicator for plotting the IOS curve. The MIRR equation has been improved to deal with the problem of the circling in determining the discount rate and calculating the optimal investment budget.

In the context of a continuously changing economic environment, businesses and private investors have to make fairly complicated financial decisions that should allow for many factors affecting the target profit margin. Such factors include external economic conditions, such as change in the legal environment of economic activities in the country, influence of the economic environment of foreign counterparties and global crises as well as internal economic conditions, such as the amount of own financial sources, including profit at hand, and credit capabilities of businesses and private investors.

The above conditions compel investors to plan their investment opportunities in order to overcome crisis situations and expand business. The planning process involves both analyzing individual investment projects and development of major investment programs incorporating a certain number of projects. This enables companies to encompass various market segments. Furthermore, the above programs cannot be implemented unless a company has equity funds and credit capabilities sufficient to finance a few projects at a time. In this case the investor has to choose the most optimal project package to minimize expenditure and increase the company's profit. From here on we will use the term "maximum permissible amount of investment" to mean "the optimal investment budget".

When calculating the optimal investment budget, companies will normally construct marginal cost of capital (MCC) and investment opportunity schedule (IOS) curves. The optimal investment budget is where these two curves intersect.

The MCC curve is constructed based on the weighted average cost of capital (WACC), using the following formula [1]:

$$WACC = w_d k_d (1 - T) + w_p k_p + w_s k_s, \quad (1)$$

where w_d , w_p and w_s - specific weights of liabilities, preferred and ordinary shares, respectively, in the total capital value; $k_d(1 - T)$, k_p , k_s - component values of liabilities, preferred and ordinary shares, respectively; k_d - interest rate on liabilities; T - profit tax rate.

Each exhaustion of one of capital components gives rise to a discontinuity point. Discontinuity points (DP) on the MCC curve are found with the following formula [1]:

$$DP = \frac{C}{w_C}, \tag{2}$$

where C – amount of capital of a given type at a lower cost, a w_C - share of capital of a given type in the total capital amount.

Component capital values in the intervals between discontinuity points are defined with the following formulas [1].

Nondistributed profit value (%):

$$k_s = \frac{D_1}{P_0} + g = \frac{D_0(1+g)}{P_0} + g, \tag{3}$$

where D_0 and D_1 – size of a dividend per common share in the current and following years, respectively (in money units), P_0 – current market price per common share (in mu), g – rate of increment of yields and dividends on ordinary shares (%).

When nondistributed profit is exhausted, a company may increase its equity capital by issuing new ordinary shares. In this case in the WACC formula k_s will be substituted with k_e (value of newly issued ordinary shares) that is defined as follows:

$$k_e = \frac{D_1}{P_0(1-F_s)} + g, \tag{4}$$

where F_s – cost of flotation of new ordinary shares on the market (in mu).

Preferred share value (%):

$$k_p = \frac{D_p}{P_0(1-F_p)}, \tag{5}$$

where D_p – size of an annual dividend per preferred share (in mu), F_p - cost of flotation of new preferred shares on the market (in mu).

Cost of liabilities (B %):

$$k_d(1-T). \tag{6}$$

The IOS is constructed using IRR values and the following formula [1]:

$$\sum_{t=0}^n \frac{CIF_t - COF_t}{(1+IRR)^t} = 0, \tag{7}$$

where CIF_t and COF_t - cash inflow and outflow in year t , and n – project period (years).

When cash receipts from all the investment projects under review represent annual annuities, there is an easier way to define IRR by using the present annual annuity value [2, 3]:

$$PV = R \cdot a_{n;IRR}, \tag{8}$$

where R – annual payment amount and $a_{n;IRR}$ – discount multiplier for annual annuity, which is defined as follows:

$$a_{n;IRR} = \sum_{t=1}^n \frac{1}{(1+IRR)^t} = \frac{1-(1+IRR)^{-n}}{IRR}. \tag{9}$$

Knowing the implementation period of each project in years and the discount multiplier value, IRR for each project may be found using the financial tables. MCC and IOS curves are then constructed as shown in Fig. 1. The optimal investment budget value corresponds to the crossing point of the curves. Such is the classical viewpoint on calculation of a company’s optimal investment budget, its drawback being that it disregards any possible reinvestment of receipts from the current projects in other projects or, as a minimum, in the ongoing business. We therefore suggest a new approach that allows for such possibilities.

As will be shown further, the suggested method will help plan a budget for greater investments.

If reinvestment possibilities are taken into account, MIRR should be defined instead of each project’s IRR, using the following formula [1]:

$$\sum_{t=0}^n \frac{COF_t}{(1+k)^t} = \frac{\sum_{t=0}^n CIF_t (1+k)^{n-t}}{(1+MIRR)^n}, \tag{10}$$

where k – price of capital at which funds are reinvested in the second member of the equation, i.e. k_s or k_e .

If cash proceeds from each investment project are annuities, there is an easier way to define MIRR with the following formula:

$$PV = \frac{R \cdot s_{n;k}}{(1+MIRR)^n}, \tag{11}$$

where $s_{n;k}$ - annual annuity multiplier [2, 3] defined as follows:

$$s_{n;k} = \sum_{t=1}^n (1+k)^{n-t} = \frac{(1+k)^n - 1}{k}. \tag{12}$$

Then MIRR will be equal to:

$$MIRR = \sqrt[n]{\frac{R \cdot s_{n;k}}{PV}} - 1. \tag{13}$$

MCC and IOS curves constructed by MIRR are depicted in Fig. 2. Shown in the same figure in dotted line is the previous IOS curve constructed by IRR.

Let us now consider the following standard situation as an example of calculating the company’s optimal investment budget using the method described above [1, 5].

Assume that a company has the capital structure it believes is optimal:

1. Ordinary shares (OS): 60%.
2. Preferred shares (PS): 15%.
3. Liabilities: 25%.

In the current year the company expects to derive net income (NI) of 34,285.72 mu; the established sized of dividends is 30%; profit tax rate $T = 40\%$; forecast rate of increment of yields and dividends $g = 9\%$ per year. While in the previous year the company paid the dividends $D_0 = 3.6$ mu per common share, now these shares sell at the price $P_0 = 60$ mu per share.

The company may obtain new capital as follows:

1. *Issue of ordinary shares.* The cost of their flotation on the market (F_s) will be 10% of the market price if the amount of issued shares is up to 12,000 mu and 20% if the amount exceeds 12,000 mu.
2. *Issue of new preferred shares.* New preferred shares with annual dividend $D_p = 11$ mu per share may sell at the price $P_0 = 100$ mu per share. The cost of their flotation (F_p), however, will be 5% if the amount of issued shares is up to 7,500 mu and 10% if the amount exceeds 7,500 mu.
3. *Issue of new liabilities (bonds).* Liabilities of up to 5,000 mu may sell at an annual rate of 12%, those from 5,001 mu to 10,000 mu at a rate of 14% and those in excess of 10,000 mu at a rate of 16%.

The company’s investment capabilities are shown in Table 1.

Table 1. Company’s Investment Capabilities

Project	Cost at $t = 0$ (PV) (mu)	Annual Net Cash Receipts (R) (mu)	Project Period (n) (years)
A	10,000	2,191.2	7
B	10,000	3,154.42	5
C	10,000	2,170.18	8
D	20,000	3,789.48	10
E	20,000	5,427.84	6

Let us find discontinuity points on the marginal cost of capital (MCC) curve.

Discontinuity points are determined as follows. We first note that the company has nondistributed profit (NP) in the following amount:

$$NP = NI(1 - w_D) = 34,285.72(1 - 0.3) = 24,000 \text{ (mu)},$$

where w_D – payment of dividends in percentage to net income NI.

Table 2. Calculation of Discontinuity Points

Depleted Capital	Calculation of Discontinuity Points	DP Order
Nondistributed profit	$DP_s = \frac{24,000}{0.6} = 40,000 \text{ (mu)}$	2
OS allowing for $F_s = 10\%$	$DP_{e(10\%)} = \frac{24,000 + 12,000}{0.6} = 60,000 \text{ (mu)}$	4
PS allowing for $F_p = 5\%$	$DP_{p(5\%)} = \frac{7,500}{0.15} = 50,000 \text{ (mu)}$	3
12% liabilities	$DP_{d(12\%)} = \frac{5,000}{0.25} = 20,000 \text{ (mu)}$	1
14% liabilities	$DP_{d(14\%)} = \frac{10,000}{0.25} = 40,000 \text{ (mu)}$	2

Let us now determine capital component values in the intervals between DP.

Nondistributed profit (exhausted in the interval from 0 to 40,000 mu):

$$k_s = \frac{3.6 \cdot 1.09}{60} 100\% + 9\% = 15.54\% .$$

Ordinary shares with $F_s = 10\%$ (40,001 to 60,000 mu):

$$k_e = \frac{3.924}{60 \cdot 0.9} 100\% + 9\% = 16.27\% .$$

Ordinary shares with $F_s = 20\%$ (over 60,000 mu): $k_e = 17.18\% .$

Preferred shares with $F_p = 5\%$ (0 to 50,000 mu):

$$k_p = \frac{11}{100 \cdot 0.95} 100\% = 11.58\% .$$

Preferred shares with $F_p = 10\%$ (over 50,000 mu): $k_p = 12.22\% .$

Liabilities at $k_d = 12\%$ (0 to 20,000 mu):

$$k_d(1 - T) = 12\% \cdot 0.6 = 7.2\% .$$

Liabilities at $k_d = 14\%$ (20,001 to 40,000 mu): $k_d(1-T) = 8.4\%$.

Liabilities at $k_d = 16\%$ (over 40,000 mu): $k_d(1-T) = 9.6\%$.

Let us define WACC in the intervals between each discontinuity in the MCC curve.

In the interval from 0 to 20,000 mu, where $k_d(1-T) = 7.2\%$, $k_p = 11.58\%$, $k_s = 15.54\%$:

$$WACC_1 = 0.25 \cdot 7.2\% + 0.15 \cdot 11.58\% + 0.6 \cdot 15.54\% = 12.86\% .$$

WACC values for the other intervals of Table 2 are defined in a similar way:

$$WACC_2 = 13.16\% , \quad WACC_3 = 13.9\% , \quad WACC_4 = 14\% , \quad WACC_5 = 14.54\% .$$

MCC and IOS curves are shown in Fig. 1. By subtracting the MCC curve from the IOS curve, we obtain an area corresponding to the company's net income value. The projects' IRR values are laid off on the IOS curve in decreasing order to maximize the area, i.e. in practice projects should be implemented in the order B, E, C etc.

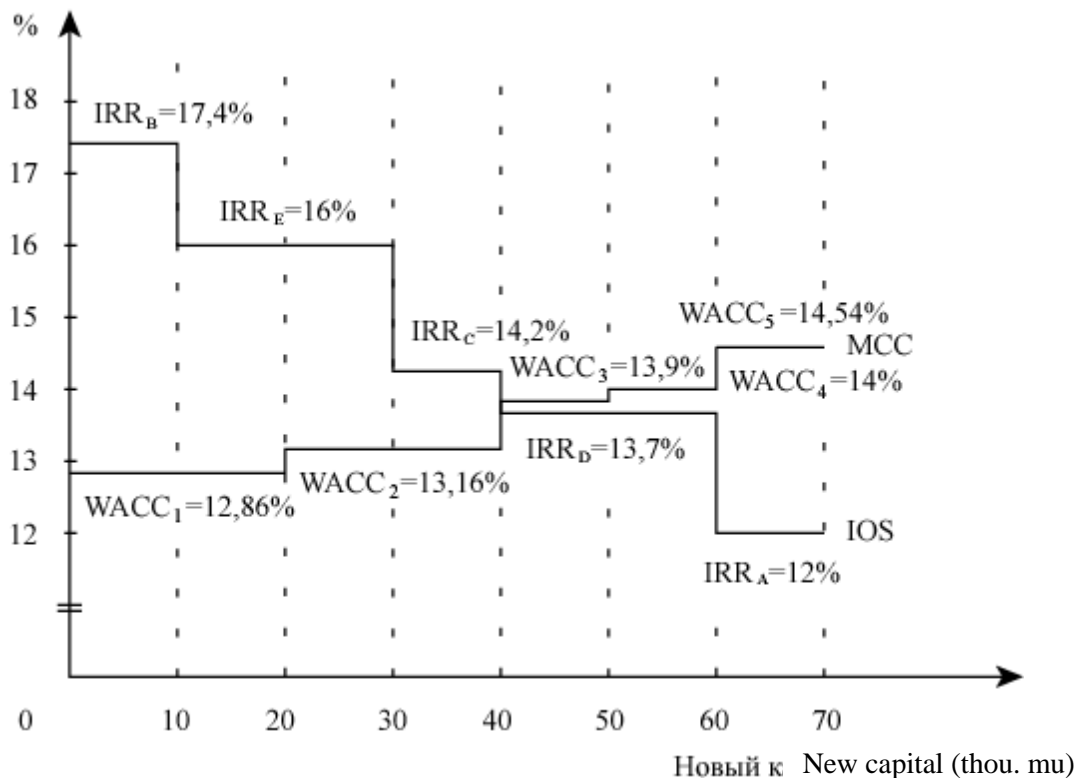


Fig. 1. Calculation of the Optimal Investment Budget

Allowing for Reinvestment

The company should accept the projects B, E and C and discard the projects D and A, since their IRR do not exceed the marginal value of funds required to finance those projects. The investment budget totals 40,000 mu.

Furthermore, the following considerations regarding investment risks should be taken into account:

1. If the company tries first to implement the project D and then the others, it will derive income from all the projects, except for the project A. In this case, however, the area obtained by subtracting the MCC curve from the IOS curve will be less than that shown in Fig. 1, i.e. the Company's income will be inferior to the maximum possible.
2. If, for example, the project E and then the project B are implemented the above area will still be maximal. But this increases the risk, as while the company is implementing the less profitable project E, a change in laws may occur, for example, that will prevent the more profitable project B from being subsequently implemented. Another example: assume that the project B is to be carried out jointly with another company and by the time our company completes the project E that other company may be facing serious financial hardships making it impossible to implement the project B or, for example, may have gone bust. In this case, again, the best investment opportunity will be lost for us.

3. In Fig. 1 the crossing point of MCC and IOS curves is easily obtained. Let us assume another situation when $IRR_D = 13.96\%$. If the project may be accepted partially the problem is coped with. If, however, it may only be accepted in whole we need to calculate the weighted average value of funds based on $WACC_3$ and $WACC_4$ and compare it with IRR_D .

4. What will happen if we take into account the project risk? Then the capital value used to assess more risky projects should be adjusted upward, whereas it should be lower for projects with lower than medium risks. In this case the intersection of the new MCC curve with IOS curve is used to define the net income value of new projects that are almost as risky as the company's existing assets.

Modifying the classical approach to calculation of the optimal investment budget, we will calculate MIRR for each project in the intervals between the discontinuities in the IOS curve, arranging the projects in the order as shown in Fig. 1. k_s or k_e is taken as a reinvestment rate for calculations, depending on whether or not a company has exhausted its nondistributed profit.

Project B (0 to 10,000 mu):

$$s_{5;15,54\%} = \frac{(1 + 0.1554)^5 - 1}{0.1554} = 6.814839,$$

$$MIRR_B = \sqrt[5]{\frac{3154.42 \cdot 6.814839}{10,000}} - 1 = 0.1654 \quad (16.54\%).$$

MIRR values in the other intervals between discontinuities are obtained in a similar way:

Project E (10,000 to 30,000 mu): $MIRR_E = 15.78\%$.

Project C (30,000 to 40,000 mu): $MIRR_C = 14.9\%$.

Project D (40,000 to 60,000 mu): $MIRR_D = 15.14\%$.

Project A (over 70,000): $MIRR_A = 14.59\%$.

MCC and IOS curves constructed by MIRR are depicted in Fig. 2. Shown in the same figure in dotted line is the previous IOS curve constructed by IRR.

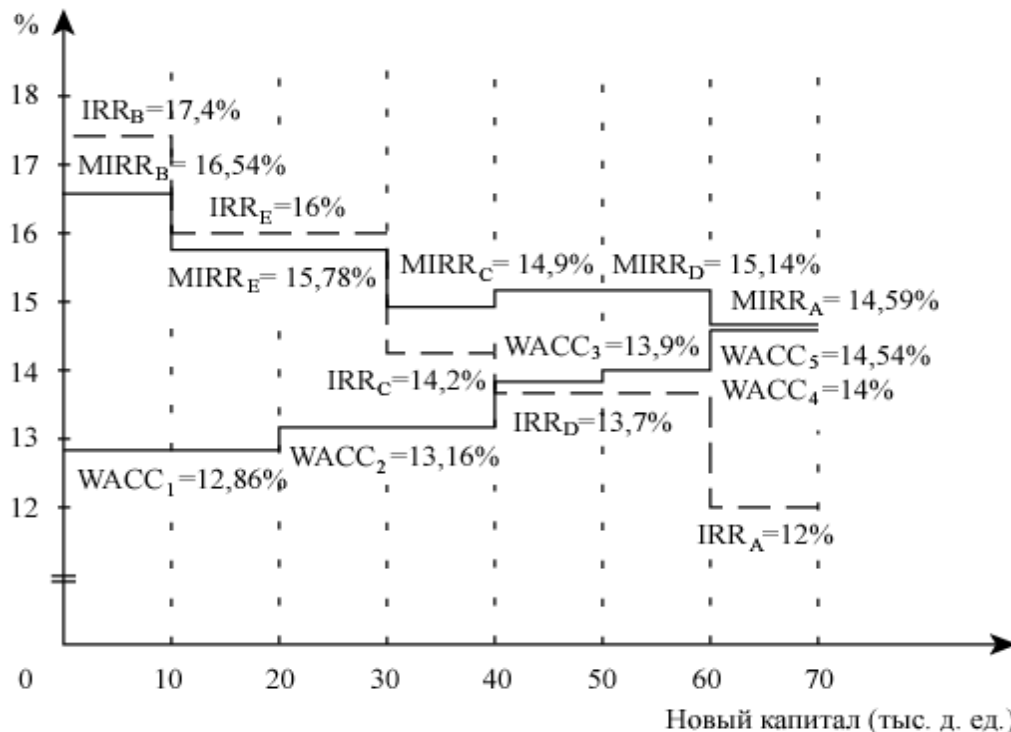


Fig. 2. Calculation of the Optimal Investment Budget Allowing/Not Allowing for Reinvestment

As evident from Fig. 2, $MIRR_D > MIRR_C$. Hence, it would seem more logical at first sight to lay off first $MIRR_D$ and then $MIRR_C$ in IOS curve. In this case, both modified internal rates of return have to be recalculated since in the interval from 30,000 to 60,000 mu reinvestment is made at different rates.

It should be noted that the reinvestment rate $k = 15.905\%$ for the project D is the average of two values, i.e. in the interval from 30,000 to 40,000 mu $k_s = 15.54\%$ and at that from 40,000 to 50,000 mu $k_e = 16.27\%$.

Project D (30,000 to 50,000 mu): $MIRR_D = 14.93\%$.

Project C (50,000 to 60,000 mu): $MIRR_C = 15.29\%$.

Then if we interchange new $MIRR_D$ and $MIRR_C$ values we will obtain the new IOS curve shown in Fig. 3. It means the project D should be implemented before the project C .

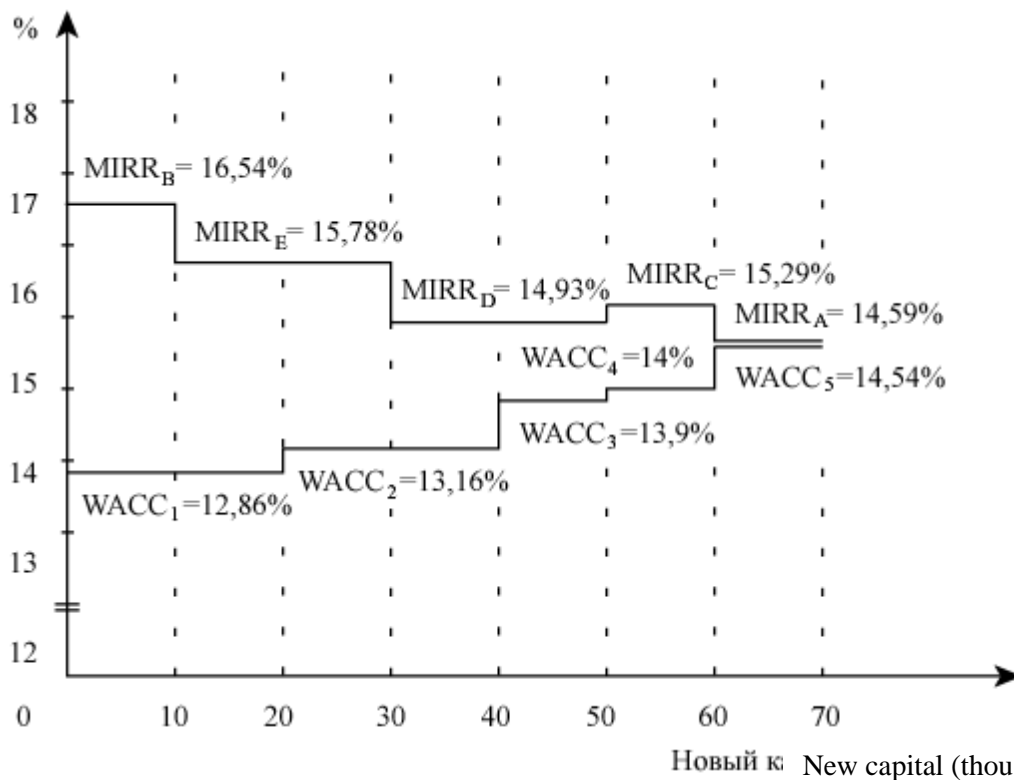


Fig. 3. Calculation of the Optimal Investment Budget with Reinvestment taken into Account and Projects Implemented in the New Order

In this case, the area between MCC and IOS curves in the interval from 30,000 to 60,000 mu will be 0.409 in fractions, whereas with the previous project implementation order it was 0.412 in the same interval. It means that having the projects implemented in the previous order, i.e. as shown in Fig. 2, is more advantageous to the investor.

As also seen from Fig. 2, if calculations take account of reinvestment opportunities, i.e. MIRR calculations, all the five investment projects are profitable since their MIRR is more than WACC needed for the projects to be carried out. If reinvestment is not taken into account, i.e. IRR calculations, only the projects B , E and C should be implemented because their IRR is more than WACC. If calculated by MIRR, the optimal investment budget will be 70,000 mu. It is much more than 40,000 mu in case of IRR calculation. The area between IRR and WACC curves, where $IRR > WACC$, is 1.156 in fractions and that between MIRR and WACC, where $MIRR > WACC$ is 1.339, which suggests that allowance for reinvestment is more economically beneficial. In the above example the task of calculating the optimal investment budget has been solved easily enough because we did not have to discount cash outflows COF_t in the left side of the MIRR equation. In general, the following equation should be used for MIRR instead of the previous one (10):

$$\sum_{t=0}^n \frac{COF_t}{(1+WACC)^t} = \frac{\sum_{t=0}^n CIF_t(1+k)^{n-t}}{(1+MIRR)^n}. \quad (14)$$

Such modification of MIRR calculation is explained as follows.

Since reinvestment is only economically sound if shareholders (ordinary shareholders) obtain the return equal to that they now have on ordinary shares or higher return, k_s or k_e should be used in the equation as a reinvestment rate (if the company is currently issuing ordinary shares).

In the left side of the last equation, the weighted average cost of capital (WACC) should be taken as a discount rate, because in practice, when the optimal investment budget is calculated, a package of investment projects is considered, for each of which its k_s or k_e is assumed as a discount rate. Yet for comparability of MIRR of different projects discounting is performed at a single rate. Following the traditions of the American financial school [1], the marginal cost of capital (MCC) value may be taken as such a universal rate, which on the joint curve of investment opportunity schedule (IOS) and marginal cost of capital (MCC) is the weighted average cost of capital (WACC) at the crossing point of the above curves.

If we follow the recommendations [1] and substitute the rate k in the left and right sides of the previous MIRR equation with the rate WACC common for all the projects at issue, it will give rise to the circling problem described by these authors. This problem consists in a change in the investment opportunity curve (i.e. MIRR curve), resulting in a new crossing point of MIRR and WACC curves, that will correspond to a new discount rate for all the projects under review. Thus, by applying the new modified equation instead of the previous one to define MIRR, we will resolve the above circling problem that leads, among other problems, to infinite updating of the optimal investment budget. This may seriously affect the correct decision making as to the amount of money an investor should allocate to implement an investment project package.

If the MIRR rate is applied the investment risk is assessed by the same four positions referred to in the optimal investment budget calculation using IRR.

What follows are the basic conclusions we have arrived at:

- 1) When calculating the optimal investment budget, allowance should be made for potential reinvestment of receipts from the current investment projects. This problem may be coped with if modified internal rates of return (MIRR) allowing for investment opportunities are laid off on the investment opportunity schedule (IOS) curve instead of internal rates of return (IRR) of the projects. Then a greater optimal investment budget may be planned.
- 2) We suggest that the MIRR defining equation offered in financial literature be modified as follows: cash outflows by year should be discounted at the weighted average cost of capital (WACC) rate rather than by the price of capital (rate of return on ordinary shares). This allows the necessary financial calculations to be done for the entire investment project package. The price of capital (rate of return on ordinary shares) should be used as a reinvestment rate in the right side of the MIRR equation. This helps deal with the problem of circling in updating the optimal investment budget/program calculations.

The obtained results may find fairly wide use in various industries both by companies and private investors.

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