OPTIMIZATION TECHNOLOGY IN FINANCIAL PLANNING

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Introduction. Financial planning is the basis of the program of development of a modern company. There is a trend of increasing usage of methods of mathematical modeling and optimization for the development of the strategy of the company.

Aim. The use of the model of financial planning based on the model of Carleton W.

Materials and methods. The model is based on the model of the flow of dividends, taking into account the number of shares, amount of dividends and the amount of the share capital.

$$\frac{P_0}{N_0} = \sum_{t=0}^{T-1} \frac{D_t}{N_t \left(1+k\right)^t} + \frac{P_T}{N_T \left(1+k\right)^T},$$

where P_0, N_0 - the total value of the share capital and the total number of ordinary shares in the start-up period, T – the duration of the forecast period, t – current time, D_t – the amount of dividends paid by the company for the period from the start to the current point in time, N_t - the number of outstanding common shares at the current time. P_T - the aggregate market value of the share capital of the company at the end of the forecast period, N_T - the number of ordinary shares during the forecast period. K – a constant characterizing the cost of equity under conditions of constant risk.

To find the optimal solution uses the classical method of mathematical programming in which the goal function accepted a function

$$\sum_{t=0}^{T-1} \frac{D_t}{N_t \left(1+k\right)^t} + \frac{P_T}{N_T \left(1+k\right)^T} - \frac{P_0}{N_0} \to \max$$

This goal function maximizes the present value of the capital stock, which includes future dividends and opportunities for financial growth. The disadvantage of this objective function is its nonlinearity.

For linearization of the goal function, it is proposed to use the method of Lee C. F., which allows to replace the nonlinear function linear function of the form

$$\frac{D_1}{N_0 \left(1+k\right)} + \frac{D_2}{N_0 \left(1+k\right)^2} - \frac{\Delta E_1}{N_0 \left(1+k\right)\left(1-c\right)} - \frac{\Delta E_2}{N_0 \left(1+k\right)^2 \left(1-c\right)} -$$

$$- \frac{\Delta E_3}{N_0 \left(1+k\right)^3 \left(1-c\right)} + \frac{P_3}{N_0 \left(1+k\right)^3} + \frac{D_0}{N_0} - \frac{D_0}{P_0} \to \max,$$

where D_1, D_2 are the dividends for the first and second periods; ΔE_1, ΔE_2, ΔE_3 – new

issue of shares for each of the periods; c – assessment of the part of equity capital that can be lost due to transaction costs; P_3 – total market value of the share capital in the last period.

Results and discussions. This goal function was simplified on the base of two assumptions:

➢ the total market value of the share capital at the end of the forecast period P_3 is completely predefined by the value of dividends and issues of shares;

➢ the values of the parameters at the beginning of the forecast period, known and constant.

Thus, the goal function can be reduced to the form

$$\frac{D_1}{N_0(1+k)} + \frac{D_2}{N_0(1+k)^2} - \frac{\Delta E_1}{N_0(1+k)(1-c)} - \frac{\Delta E_2}{N_0(1+k)^2(1-c)} - \frac{\Delta E_3}{N_0(1+k)^3(1-c)} \to \max$$

As a system of constraints in the optimization problem used the following limitations:

➢ requirements for the amount of income that can be used for the payment of dividends;

➢ restrictions on the sources of funds and their use;

➢ limitations related to the selected financial policy of the company.

The formation of the constraints is taken into account that the restriction of the income on ordinary shares is determined by the limitations of net income and the shares of which may be divided between the shareholders. Thus, these restrictions may take the form $D_i \le \alpha_i \tilde{D}_i \quad i = 1,2$, where D_i is the net income of the company for the i-th current period and α_i – share of net income that can be spent on the payment of dividends. On the other hand, because the dividends unite all cash payments to the shareholders, they cannot be negative and the system constraints must be supplemented with conditions $D_i \ge 0$.

Sources of funds might include raising funds by issuing new shares and bonds. Quantitatively they are measured by the change in the amount of share ownership excluding retained earnings. Usually this value represents funds received from the sale of new ordinary shares. This is also a non-negative value. Therefore, the system constraints must be included conditions $E_i \ge 0 \quad i = 1,2,3$.

The initial information for forming the constraints and the objective function are the financial statements of the company and prognostic characteristics of the external economic environment.

Conclusions. This model is intended for long-term development planning of the company and forecasting of its operating results. The simulation results can be the basis for making fundamental financial decisions on the amount of dividends, working capital, internal and external financing.