Solving the Linear Programming Problem when Considering the Issue of Optimal Financing Modernization of the Company

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Abstract: The paper considers an analysis of the economic situation, taking into account the construction of dynamic models of the company's development, based on the methods of capital investments in modernization, payback periods, as well as the selection of the most adequate valuation coefficients. The paper formulates and substantiates an algorithm for evaluating and subsequent analysis of time options for the financing process for the modernization of the company. The chosen maxim in the formulated task is justified, as well as possible limitations built up in short-term time intervals. The possibility of using parametric calculus methods made it possible to simplify the course of calculations as much as possible and to choose the optimal cost plan of the company well enough with parallel optimization of its structure, as well as the structure and volume of available funds. It is concluded that the credit policy that has developed at a particular time has a significant impact on both the sources and distribution of funds.

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1 INTRODUCTION

In the conditions of the modern economic situation, when many must not only survive, but also choose the optimal strategic vector of the company's development, built taking into account the inflation process, determined by its component such as the ratio between the banking percentage and the dynamics of inflation rates (Ovsienko, 2024; Danilin, 1975).

2 FIRST SECTION

When building a dynamic development model for a company, one of the key provisions is monitoring the time intervals of investment funds. We will consider the feasibility of financing the modernization of the company at the present stage. The basis is the ongoing procedures for the modernization of the company based on different time intervals of investments and responses. An analysis of sources on investment issues in different historical periods has shown a qualitative excellent justification of economic methodologies in the Soviet period and in the context of modern dynamics and import substitution, as well as existing sanctions. All these features have left their mark on the structure of companies' funds.

Long time intervals made it possible to use highly integrated cost data and reactions to them over the years in calculations, information in short-term time intervals implies the use of a detailed report on accounting for investment volumes and cash flow, taking into account these short time periods. The methodology of maximum detail of investment projects works well in the modernization of projects implemented in commerce. In this situation, it is quite justified to assume equivalent amounts of funding and response to it within these short periods of time. This fully justifies the use of the same indicators of the economic assessment of upcoming payments used in the short-term assessment. With prolonged investments, single segments for the entire period of project execution do not justify themselves (Bellman, 1960; Von Neumann, Morgenstern, 1970). But the dynamic economic situation cannot help but focus on temporary effects in short time periods.

The conducted research allowed us to formulate an algorithm for analyzing and evaluating temporary options for financing the modernization of the company.

1. Let's use the normative indicator to indicate $E_{н}$ the time interval (month, year) and bring the total investments to the ratio of the amount of investments over long-term periods to the normative net profit for this billing period: $ЧП_{н}^{t}(K_t) = E_{н}K_t, \quad t = 1,...T, \quad E_{н} \to 1$. In this case, the time gap will be minimized to zero.

2. We will find the sums of net income from the investment project that we are interested in in a certain period of time: $ЧП_{р}^{t}(K_t)$.

3. We will find a net profit taking into account the current value in the form of the following ratio (ЧТС): $ЧП_{р}^{t} - ЧП_{н}^{t} = ЧТС_t$.

This value corresponds to an increase in assets over time, taking into account monetary investments.

4. Using the value of the parameters of the financial assessment of upcoming payments α_t, in the long term, the amount of net profit is reduced to a single point in time, while summing up: $\sum_{t=1}^{T} a_t ЧТС_t$.

5. The values obtained in this way correspond to the best options for injectable injections (Ovsienko, 2024; Hall, 2015).

3 SECOND SECTION

For example, consider a situation in which a company will consist of a single enterprise. The management is interested in the most optimal plan for the functioning of the company for a specific time period, including Several stages of production, for example, years. Let's consider the possibility of applying statistical methods to the analysis of the linear programming model (ЛП) (Tsvirkun, 1975). To do this, let's give the following example, let's assume that a company manufactures n types of goods and at the same time consumes m resources. The production of product I means the use of technology $A_j = (a_{1j},...,a_{mj},c_j)$ in the form of a set $\{a_{ij}\}$

The excess income of the company will be the basis for the maximum value of the optimized function of the dynamic model of the company's development. The criterion for choosing the best investment option, which is based on the economic indicator of upcoming payments, will be written as:

$$F^{*} = \max_{[I_t]} \left\{ \sum_{t=1}^{T} (DPP(I_t) - E_{н} DK_t(I_t)) a_t \right\} \quad (3)$$

here $DPP(I_t)$ is the net income received from investment funds; $DK_t(I_t)$ - an increase in basic finances in period *t;* a_t - an indicator of the financial assessment of future capital gains in period *t*.

The value τ in the ratio (3) determines the difference between the amount of funds invested in increasing the company's profit and the use of appropriate technological components presented implicitly, the value $E_н$ determines the corresponding time periods located within a specific time period formed by the time lag between the investment period and the effect of the funds received. If the resulting lag is constant for the entire interval [1, T], then it is written explicitly using the exponent α:

$$\max_{[I_t]} \left\{ \sum_{t=1}^{T} (DPP(I_t)a_{t+t} - DK_t(I_t)a_t) \right\}$$

After that, we write the optimality criterion as in the ratio (3). Note that $DPP(I_t)$ and $DK_t(I_t)$ are calculated by increments $F^*(I)$ and $K^*(I)$, which will be calculated taking into account formula (2).

The investment funds used to increase production capacities are formed by the company on the basis of borrowed finances *G* at the beginning of the time interval and its own funds received from net income $S_t = \gamma\Phi_t - \beta_t^k G,$, where β_t^k is the percentage for using borrowed money in the period *t, γ* is the coefficient corresponding to the share of deductions.

The balance of own and credit finances, depending both on the operating conditions of the company and on external influences, is fundamental in the vector of economic development of the company (Korolev, Lapshin, Khorev, Lapshina, Lukina, 2023; Sharakshane, Zheleznov, Ivanitsky, 2017). Functions (2) undergo changes in accordance with the speed of realization of the manufactured goods. These changes in the time interval for the annual period of the company's operation should be planned in the model. Note that the functions $F^*(I)$ and $K^*(I)$ were constructed as a result of solving the LP (1) problem for a one-year time period *t*.

Let's define the additional net profit of the company for the period *t* through $Y_t(I_t) = gF_t(I_t)$ the volume of capital investments $I_t = \sum_{s=1}^{t} DI_s$, where DI_s the net investments in the period *s*. Note that $VF_t(I_t) = F_t^*(I_t) - F_{t-1}^*(I_{t-1})$, and $DK_t(I_t) = K_t^*(I_t) - K_{t-1}^*(I_{t-1})$, note that $K_t(I_t) = I_t - I_{t,об}$ "t, where $I_{t,об}$ is the investment in increasing working capital by the time t. Considering (3), we formulate the criterion of optimality of the company's investment policy as:

$$F^* = \max_{[G,t]} \left\{ \sum_{t=1}^{T} (Y_t(I_t) - E_н DK_t(I_t))a_t \right\}. \quad (4)$$

Let's write down the funds accumulated by the company that can be spent on investments in period t in the form:

$Д_t = gF_{t-1}(I_{t-1}) - b_t G,$ где $b_t = b_t^K / 100 + b_t^Д;$

here $b_t^Д$ is a part of the loan repaid in period *t*. The model takes into account different conditions for obtaining a loan (Sheremet, Saifulin, 1999). Based on the above accumulated funds, by the period the amount of capital investments will meet the restrictions

$$I_{t-1} \le I_t \le I_{t-1} + Д_t. \quad (5)$$

Based on (4) and (5), we write down the dynamic optimization problem of capital investment in the development of the company in the form

$$F^* = \max_{[G,t]} \left\{ \sum_{t=1}^{T} (Y_t(I_t) - E_н DK_t(I_t))a_t \right\},$$
$$0 \le I_t \le G + F_0, \quad I_{t-1} \le I_t \le I_{t-1} + Д_t,$$
$$t = 2,3,...,T, \quad (6)$$

Here Φ_0 is the company's own available initial amounts of investment funds.

4 CONCLUSIONS

Dynamic programming methods are used as the basis for determining the maximum function (6), with specified constraints (Schroeder, 1994). The optimal solution to the problem (6) $\{G^*, I^*\}$ determines the movement of investment funds and sources. It is necessary to take into account the impact of such indicators as the economic assessment of the upcoming ones α_t, the tax rate and the terms of the loan γ on the final decisions made.

When the value has been obtained I_t^*, we again proceed to finding the initial task of the ЛП, then proceed to forming a plan taking into account the volume of cash injections for each time interval t, which determines the direction of financial flows,

taking into account the production characteristics of the company.

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