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THE PECULIARITIES OF ECONOMIC AND FINANCIAL ANALYSIS OF AN ENTERPRISE WHEN MAKING OPTIMAL DECISIONS

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ОСОБЕННОСТИ ЭКОНОМИЧЕСКОГО И ФИНАНСОВОГО АНАЛИЗА ПРИ ПРИНЯТИИ ОПТИМАЛЬНЫХ РЕШЕНИЙ НА ПРЕДПРИЯТИИ

In article analysis methods for interpretation of optimum economic decisions for the enterprise, concerning efficiency of investment activity and production improvement of quality, are considered.
QUALITY STRATEGY. OPTIMIZATION METHODS. ECONOMIC BALANCE.

Рассматриваются методы анализа для интерпретации оптимальных экономических решений на предприятии, относительно эффективности инвестиционной деятельности и повышения качества продукции.
СТРАТЕГИЯ КАЧЕСТВА. МЕТОДЫ ОПТИМИЗАЦИИ. ЭКОНОМИЧЕСКОЕ РАВНОВЕСИЕ.

The wide range of problems of optimum economic decision making in market conditions can be reduced to maximizing of the level of individual's and society's satisfaction received from products and resources. Thus there are some economic, financial and other opportunities that can hinder the process of identifying of the way or plan of actions that make it possible to receive the maximum or minimum result of consumption and consequently it can be called the optimization of the level of satisfaction of the requirements at available financial and, in broad sense, resource restrictions. When using the mathematical and other models providing achievement of optimum economic or financial decisions, the correct economic interpretation of received results of the solution of an optimizing task play a very important role.

Let's present an economic rendering of a problem of drawing up the optimum financial plan providing investments into expansion of production of the company known and described in scientific economic literature as Myers and Poga model [1]. Let's consider the enterprise planning investments into implementation of a certain investment projects. The amount of investments (I) and amount of loans (Y) are the variables of this task. The last amount also indirectly characterizes the financial risk caused by investments into enterprise expansion if they are financed by the loan capital.

The optimum financial plan has to provide an increase or gain of the market value of a company or an enterprise value (MVC) as a result of implementation of the project. As restrictions the most admissible size (limit) of attracted investments into the project of expansion and the most admissible share of loan sources of financing of new investments serve. This task at the stated preconditions can be presented as a problem of linear programming and is formulated in the following look:

$$kI + tY \to \max$$

under the following conditions:

$$I \le I_0, \quad Y \le aI,$$

or

$$I \le I_0 \quad (Z_1),$$

$$-aI + Y \le 0 \quad (Z_2),$$

where k – stands for internal / demanded profitability of unit of the investments which are carried out at the expense of own sources of financing of a company; t – a profit tax rate, is equivalent expresses tax effect from unit of the loans, the second composed expresses to criterion function the full size of the tax effect gained by the enterprise from use of external/loan sources of financing; I_0 – limit of investments; a – the most admissible share of external financing.

The solution of the task defines the optimum plan of investment activity of the enterprise in the planned period. It is the direct task (DT). Here Z_1 are shown, to Z_2 – dual problem (DP) variables.

MVC gain as a result of investments consists of two components – the income from investments (the first composed criterion function) and so-called «tax effect» from use of borrowed funds (the second composed criterion function) which consists in receiving by the economy enterprise on the taxation when using the loan capital. As the enterprise receives this economy during the whole planned period, the capitalized size of tax effect makes a certain part of a gain of MVC. The main peculiarity of this task is that the restrictions cover not only absolute values also ratios of variables. Similar restrictions are often used by optimization of economic decisions, for example in problems of economy of quality. When using linear models what the most part of practical economic models of optimization, for the correct interpretation of received results is the analysis of dual models matters. Let's provide the analysis and interpretation of the dual problem (DP) of the optimum financial plan which isn't considered in [1]:

$$Z_1 I_0 \to \min$$

under the following conditions:

$$Z_2 \geq t,$$

$$Z_1 - Z_2 a \geq k.$$

So next, our interpretation of DT and DP will be given. As the solution of DT allows defining the optimum plan of action, and the solution of DP – the price (assessment) of the optimum plan, the Z1 variable on sense is the price of attraction of all volume of the capital invested in expansion the enterprise. As for expansion it is used both the shareholder's equity (E) and the loan capital (LC), it will be so-so weighed price of attraction of all capital (Z_1 = WACC). The Z_2 variable on sense is the price of attraction of LC. Proceeding from it, by determination of the average price of the capital:

$$Z_1 - Z_2 a = \text{price of shareholder's equity.}$$

Thus, the economic sense of restrictions of DP becomes clear. Concerning WACC and its components we will formulate the clear rule – we will call it «the fundamental economic rule»:

The price of attraction of unit of the capital has to be no more (less or it is equal) to the size of return (profitability) of unit of the invested capital (differently investments are inexpedient, net income from them will be negative). Return from the invested capital is in a broad sense its usefulness, and in concrete expression takes the form of profitability, returns, profitability etc. If the requirement that return from the capital enclosed in production of a product, exceeded limit usefulness of this product follows from conditions of optimization, it means that concerning this product the rule has to work: it is more favorable to make a product, than to consume. Otherwise – on the contrary, a product it is more favorable to consume, than to make.

Being guided by this rule, and also proceeding from DT and DP conditions, the minimum return from unit of E has to exceed demanded profitability of E, and the minimum return from unit of LC has to exceed tax effect from LC unit.

From the stated positions we will consider related according to the economic contents a problem of optimization of quality of production. Similarity of these tasks is explained by the fact that quality optimization belongs to the class of problems of optimum planning of production, also it contains restrictions on a ratio between variables.

Let's present a quality optimization problem in a general view:

$$\begin{pmatrix} \text{utility of certain} \\ \text{consumption set} \quad (CCS) \end{pmatrix} \to \max$$

$$\text{constraints:}$$

$$\begin{pmatrix} \text{resources required} \\ \text{for the production of } CCS \end{pmatrix} \leq \begin{pmatrix} \text{available resources} \\ \text{for the production of } CCS \end{pmatrix}$$

$$\begin{pmatrix} \text{minimum demand} \\ \text{for products} \\ \text{of certain quality} \\ (CQ) \end{pmatrix} \leq \begin{pmatrix} \text{quantity} \\ \text{of each product} \\ \text{from } CCS \end{pmatrix} \leq \begin{pmatrix} \text{maximum allowable} \\ \text{product consumption} \\ \text{of } CQ \end{pmatrix}.$$

Resource constraints can belong both to product consumption and to their production, to CCS as a whole and to separate products from CCS, can be as in cost, and in the natural form.

Consumer restriction for all set of products is the most admissible size of sales of all types of the products entering into CCS which, at the fixed prices of products, shouldn't exceed available financial resources, i. e. the maximum permissible market capacity of products from CCS, set in a cost look, or the budget of sales can't be exceeded.

Consumption optimization on quality of production provides use of the utility function (UF) as criterion function. Concerning UF it is necessary to accept some basic preconditions, allowing using it in linear problems of optimization. Besides known neoclassical assumptions concerning character and UF properties, we will consider that UF is defined by consumption of a certain quantity of each type of a product from CCS:

$$U(X_1 \dots X_n) = U(X_1) + \dots + U(X_n)$$
$$U(X_i) = u_i X_i, \quad i = 1 \dots n.$$

Proceeding from these provisions,

$$U(X_1 \dots X_n) = u_1 X_1 + \dots + u_n X_n = \sum_{i=1}^{n} u_i X_i,$$

where u_i – limit usefulness of i product consumption from CCS in number of X_i of units.

The classical optimum consumption plan of CCS including products of various quality, is defined from the following condition (DT):

$$\sum_{i=1}^{n} u_i X_i \to \max$$

under conidition

$$\sum_{i=1}^{n} p_i X_i = M(Z),$$

where P_i – price of product i; Z – dual variable; M – available budget of financial resources.

DP formulation:

$$MZ \to \min$$
$$p_i Z \geq u_i \vdots i = 1 \dots n.$$

Here the dual Z variable is «the price of money», or an interest rate. Thus, profitability of investments in acquisition of products has to be not less, than limit usefulness of consumption of a product. This condition can give the following interpretation according to fundamental economic rule: it is more expedient to invest, than to consume until a condition it is satisfied.

Let's consider a simple task for determination of features of optimization of quality of production. Let there is an economy in which only two types of products are made and consumed: «the improved quality» (with an index 1) and «usual quality» (with an index 2). In reality, certainly, the considerable number of categories of quality of products that will find expression in dimension of an optimizing task can be considered. But the problem definition and treatment of results will be any dimension of bigger unit identical to a problem. The task with dimension «two» is chosen for possibility of use of graphic interpretation of results.

DT formulation:

$$u_1 X_1 + u_2 X_2 \to \max,$$
$$p_1 X_1 + p_2 X_2 \leq M,$$
$$B_1 \leq \frac{X_1}{X_1 + X_2} \leq A_1.$$

Sense of the top restriction that production of the improved quality can't be consumed and made only. It is necessary as well production of «usual» quality as more quality production possesses also higher usefulness, the price of it is higher and it can be inaccessible to socially vulnerable groups of the population. The bottom restriction generally speaking has no value for a problem of maximizing. Here A_1 and B_1 respectively the upper and lower bound of consumption and production of the improved quality. Similar restrictions can be defined and for production of usual quality

The transformed problem definition:

$$u_1 X_1 + u_2 X_2 \to \max,$$
$$p_1 X_1 + p_2 X_2 \leq M \quad (Y_2),$$
$$(1 - A_1) X_1 - A_1 X_2 \leq 0 \vdots (Y_1).$$

Here Y_1, Y_2 – dual variables. DP formulation.

$$Y_2 M \to \min,$$
$$Y_1 (1 - A_1) + Y_2 P_1 \geq u_1,$$
$$-Y_1 (A_1) + Y_2 P_2 \geq u_2.$$

Sense of dual variables – limit usefulness of one monetary unit (Y2) and limit usefulness of one structural unit (Y1). According to fundamental economic rule, the price of attraction of monetary unit is equivalent to return from it or its limit usefulness. Therefore criterion function of DP is the requirement of minimization of expenses of attraction of monetary resources, and restrictions define a condition of efficiency of these expenses. The solution of DP allows defining value of these variables for the optimum consumption plan of products.

According to provisions of the economic theory (ET), the interrelation of quantity of a made or consumed product of a certain look «*X*» and the prices of the product «*P*» is defined by the demand function (DF) which represents generally speaking curvilinear, but at simplifying preconditions – the linear interrelation «*P*» and «*X*» as it is represented in drawing. In a case when products differ on a usefulness or quality factor (at an invariance of other operating factors), or on any other factor under the same conditions, DF represent family of parallel lines (see drawing).

At the fixed number of production or consumption of products dependence between quality and quantity of products, as quality – the quantified parameter, as shown in the left part of drawing can be received. Dependence characterizes objective communication of quality and the product price – the quality is higher, the price is higher. It means that the aspiration of the enterprises increase sales can be reached at the expense of modernization of strategy and policy of quality.

At a linear problem definition of optimization of quality of production the problem is represented in the simplified look. For achievement of optimum quality it is necessary to execute all restrictions on separate products, within restrictions the preference has to be given to products with the greatest usefulness (the greatest quality).

More realistic is quality optimization taking into account the integrality of variables – the quantity of products is expressed by an integer.

$$\sum_{i=1}^{n} p_i X_i \to \max,$$

$$X_i \le \bar{X}_i,$$

$$\sum_{j=1}^{m} \sum_{i=1}^{n} r_{ij} X_i \le R_j,$$

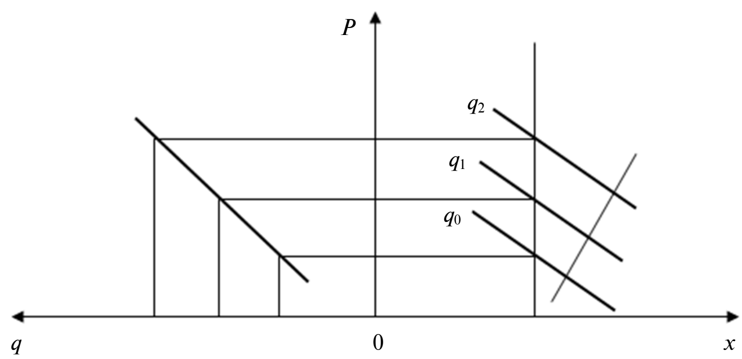
where X_i – whole numbers.

Here restrictions reflect production capabilities, – demand for the production *i* or the available capacity, a consumption rate of «*j*» type of a resource on «i» type of a product, m – quantity of types of the resources, an available limit by each type of resources. In our opinion it is expedient to solve this integer problem a method of dynamic programming (Bellman's method).

The problem of optimization of quality is reduced to optimum distribution of a limited limit of resources between various products from available CCS. This task can be traditionally solved by a method of dynamic programming. Steps of the decision are separate types of products. On the first step the case of allocation of all limited limit of resources for the first product is considered. On the second step expenses on resources for the second product, on «n-volume» – expenses on «n-volume» to a product etc. join. In a general view process of the decision is represented in the following look.

Step 1.

$$\varphi_1(X) = \min З_1(X), \quad 0 \le X \le A,$$



Step 2.

$$\varphi_2(X) = \min[3_2(y) + \varphi_1(x - y)],$$
$$0 \le y \le x,\ \ 0 \le x \le A$$

. . . .

Step *n*.

$$\varphi_n(X) = \min[3_n(y) + \varphi_{n-1}(x - y)],$$
$$0 \le y \le x, \quad 0 \le x \le A,$$

where 3_i – sales of each step; φ_{i-1} – optimum sales of the previous step.

It is expedient to consider search of the optimum decision on an example.

There are three levels of quality of a certain product, in essence it is equivalent to existence of three products of the various quality, to everyone there corresponds demand function. Limited resource is capacity for considered products and is expressed by the greatest possible quantity of let-out products, in an example equal to four units. In the conditions of the set restrictions it is necessary to define the maximum sales volume which under considered conditions corresponds to optimum quality of CCS.

The decision is presented in calculation tables. Search of the strategy leading to the optimum decision on each step, is carried out as it should be, the return to search of the optimum decision by means of the same calculation tables. To each diagonal of the table there corresponds a certain sales volume for each step of the decision. The maximum size of sales it is allocated on each diagonal (it is noted *). In the first calculation table capacity distribution between 0 and 1 product is considered, in the second table to optimum distribution of capacity between 0 and 1 product the second product is added.

The family of functions of the demand reflecting various levels of quality/usefulness of a product is presented in the following table.

The optimum decision can be not the only thing. So, for example, from the last calculation table follows that there are two decisions, providing the maximum sales volume equal to 40 e. It agrees to one of decisions, having made 2 units of the product 2, the remained resource of capacity should be distributed between products 0 and 1. Thus the maximum sales on the corresponding diagonal of the last table are equal 22 e. In the

X (ед.)	1	2	3	4
P_0	8	7	6	5
P_1	10	9	8	7
P_2	12	11	10	9

Search of the optimum decision

X 0/1	0	1	2	3	4
0	0	10*	18*	24	28
1	8	18*	26*	32*	
2	14	24	32*		
3	18	28			
4	20				
φ_1	0	10	18	26	32

X (0 + 1)/2	0	1	2	3	4
0	0	12*	22*	30	36
1	10	22*	32*	40*	
2	18	30	40*		
3	26	38			
4	32				
φ_2	0	12	22	32	40

previous table on a diagonal corresponding to production of two products, the maximum value of sales equally 18 that corresponds to production on 1 unit of a zero and first product. Thus the general maximum sales volume is equal 18 + 22 = 40 e. that coincides with earlier defined value.

Thus, accepted by production of the solution of rather economic justification of investment projects and programs of expansion of production, increase of MVC, quality of production can often be quasi optimum or advantages of optimum decisions aren't always obvious to practice because of insufficiency of their substantial economic interpretation. For bigger validity it is necessary to use more widely additional receptions of the economic and financial analysis, such the formulation of dual task in linear optimizing models, wider use of nonlinear methods of optimization.

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