POTENTIALITIES OF DEAN'S STATIC MODEL IN THE PROCESS OF SYNCHRONOUS INVESTMENT AND FINANCIAL PLANNING IN THE FIELD OF TRANSPORT

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Problems of the complex approach to acceptance of investment and financial decisions are considered in the given article.

The theoretical substantiation of opportunities of the Dean's static model use is resulted during synchronous investment and financial planning on transport, and technique of an estimation of efficiency accepted business decisions is discussed as well.

Keywords: investment object, financial object, synchronous investment and financial planning, optimal investment program

1. INTRODUCTION

The purpose of the given article is the theoretical substantiation of opportunities of the Dean's static model use in transport firms activity at acceptance of investment and financial decisions.

In the theory of finance of the most known the concept of limiting cost of the capital, supposing is at definition of the optimum budget of capital investments comparison of a parameter of limiting profitableness of the capital and a parameter of limiting cost of the capital. The given concept has abstract enough character that complicates opportunities of its practical application. Models synchronous investment and the financial planning, having more formalized character is little known.

Problems of the complex approach to acceptance of investment and financial decisions play an important role in the activity of any enterprise using for realization of capital investments external sources of financing.

2. THEORETICAL ASPECTS OF DEAN`S MODEL

In decision making process regarding the capital investment, it is important to consider the interrelation existing between the financial and investment spheres. Thereby profitability of raising funds depends on investment resources. On the other hand, advantages of the investment alternatives are determined by financial potentialities and related costs. The interrelation mentioned above may be considered in the models of synchronous investment planning and the source of investment funds.

In the theory of investment analyses there are known such models of synchronous investment and financial planning as the multistage model by Hax and Waingartner, the one-stage model by Albach and the static model by Dean. The models listed above differ in their diverse purpose functions and their approach to the factor of time.

Exploitation of the listed models provides the following assumptions:

1) the final number of investment and financial alternatives is known;
2) the situation is defined;
3) only the monetary effect of investment and financial alternatives is essential;
4) each particular investment object is assigned a processing program;
5) the term of exploitation and duration of the investment object financing is stated;
6) the investment object and the source of funds do not exclude each other, and they may be realized independently.

Besides the assumptions mentioned above, Dean's static model of synchronous investment and financial planning provides also the following statements:

- there is only a relevant period, at the beginning and at the end on which all the payments characterizing the investment and financial objects, are settled down;
- the investment and financial objects are realized and divided up to a definite and defined amount.

Certainly, if there are many assumptions, the potentialities of Dean's model exploitation are limited for any investment objects; in particular it is difficult to use this model in the process of planning investments in industrial objects. Therefore in such cases there are models of synchronous investment and industrial planning, for example, a model with several industrial stages by Ferstner-Henn, as well as Jacob's model with the choice of facilities and disinvestments.

However, regarding most of the transport objects (in particular, the objects of motor transport and railway transport), the assumptions listed above are commonly observed.

Namely:

* the final number of investment and financial alternatives are rather certainly known;
* the investment objects and the financial objects – they may be realized independently;
* the objects are rather liquid;
* the term of exploitation is rather clearly determined;
* the investment objects may be divided up to the defined size and then realized.

It means that generally Dean's static model of synchronous investment and financial planning may be applied to the sphere of transport.

Let's consider the main component parts of Dean's model. The model is purposed to the maximization of the final property value of the common investment and funding program. The final value of the property is determined at the end of the considered period as a balance of investment receipts and expenditures. It is considered that at this particular time in the investment objects there are receipts exceeding expenditures. In the beginning of the particular period it is important to provide the financial resources required for investment realization by means of proper measures and efforts in the field of funding.

The mathematical model is formulated in the following way:

The variables:

Xj = the volume of investment object j (j = 1,...,J) realization,

Yi = the volume of funding object i (i = 1,…,I) exploitation.

Parameters:

Ajt = net, income (receipts) from investment object unit j exploitation at the definite time t (t = 0,...1),

Dit = net payment for the funding object unit I at the definite time t (t = 0,...1).

The purpose function (for t = 1)

$$\sum_{j=1}^{J} Aj1 \cdot Xj + \sum_{i=1}^{I} Di1 \cdot Yi \Rightarrow \max, \text{ where}$$

$\sum_{j=1}^{J} Aj1 \cdot Xj$ – Net income of the investment objects;

$\sum_{i=1}^{I} Di1 \cdot Yi$ – Net payments of the financing objects.

The purpose function of the net payment sum, which is the final result of the income from the realized investments and payments regarding the object financing, strive for a maximally positive result.

The provisions of financing in the model of this particular type for t = 0 are as follows:

$$\sum_{j=1}^{J} Aj0 \cdot Xj + \sum_{i=1}^{I} Di0 \cdot Yi = 0, \text{ where}$$

$\sum_{j=1}^{J} Aj0 \cdot Xj$ – Net income of the investment objects;

$\sum_{i=1}^{I} Di0 \cdot Yi$ – Net payments of the financing objects.

The investment objects require financial payments (negative net payments) which are realized by means of income gained from the exploited financial objects. Terms of the project are the following:

$0 \le Xj \le 1, \quad \text{for } j = 1,...J$;

$0 \le Yi \le 1, \quad \text{for } i = 1,...I$.

Investment objects and financial objects may be realized in any shares of the maximal total volume ($Xj = 1$ and $Yi = 1$).

3. PRACTICAL APPLICATION OPPORTUNITIES OF SYNCHRONOUS INVESTMENT AND FINANCIAL PLANNING IN TRANSPORTATION

The method of choosing the optimal solution may be illustrated by means of the following example.

Let's assume that some transport company *X*, engaged in freight traffic, are making the decision regarding the purchase of five trucks with various load-carrying capacities and different aim significance (let's call them "investment objects"). Since the trucks are of different aim significance, they will differ also in price. The profitability of their exploitation is also essentially different. The expenses on trucks will be covered by inner funds, besides the terms of funding from different sources will differ as well.

The demand on capital funds is characterized by the total amount of all the investment objects; however the total supply of the capital funds depends on the price (an interest rate) of different funding sources.

Table 1. The demand on capital funds for different investment objects and the supply of capital funds for different financial objects

Investment objects	***Aj*0 Euro (thsd.)**	***Aj*1 Euro (thsd.)**	**Object Profitability (%)**	**Priority**	**Cumulative significance of the demand on capital funds**
Object 1	-70,0	77,0	10,0	5	250,0
Object 2	-60,0	69,0	15,0	1	60,0
Object 3	-50,0	56,5	13,0	3	140,0
Object 4	-40,0	44,8	12,0	4	180,0
Object 5	-30,0	34,2	14.0	2	90,0
Financial objects	***Di*0 Euro (thsd.)**	***Di*1 Euro (thsd.)**	**Calculated percents (%)**	**Priority**	**Cumulative significance of the supply of capital funds**
Object 1	20,0	-21,2	6,0	1	20,0
Object 2	40,0	-42,8	7,0	2	60,0
Object 3	50,0	-54,0	8,0	3	110,0
Object 4	70,0	-76,3	9,0	4	180,0
Object 5	70,0	-77,7	11,0	5	250,0

The problem of optimisation looks like as follows:
The purpose function:

$$77X1+69X2+56,5X3+44,8X4+34,2X5-21,2Y1-42,8Y2-54,0Y3-76,3Y4-77,7Y5 \Rightarrow \max$$

Additional terms of financing

$$-70X1-60X2-50X3-40X4-30X5+20Y1+40Y2+50Y3+70Y4+70Y5 = 0$$

On the basis of the data regarding the profitability of investment objects and the cost of their financing mentioned in the Table1, it is possible to realize the advantages both of the investment objects and of the financial objects. The data on the presented Table 1 also contain information regarding the total demand on capital funds and the supply of the capital funds, depending on the interest rate. Ranging investment objects with the indicators of maximal expenses on the purchase, may be used for determination depending on the rate of common demand on the capital funds.

To reach an optimal program, it is required that the demand on the capital funds is equal to the supply of the capital funds, since, on the one hand the program has to be furnished with finances, however on the other hand, credit in big amounts economically would not be the best solution. Having considered the advantages of investment objects and financial objects, starting with the investment object with the greatest priority, investment objects are gradually included in the investment program up to the time their profitability is higher than the rates of object financing.

The optimal solution of the model may be defined also by graphical means. To do it, one has to depict the function of demand and supply of capital funds on the diagram. The function of capital demand, on the basis of the investment objects offered for choice, shows how much of capital funds are spent at particular rates of profitability; the function of capital fund supply represents the total capital supply depending on the interest rate. At the point of intersection of the curves of capital demand and supply the optimal investment and financial program is developed. Besides, it is possible to determine the value of the interest rate, at the same time representing profitability of investment objects and financial objects (endogenous or marginal interest rate). The curve made according to the conditions of the set example can be seen in the following Figure 1:

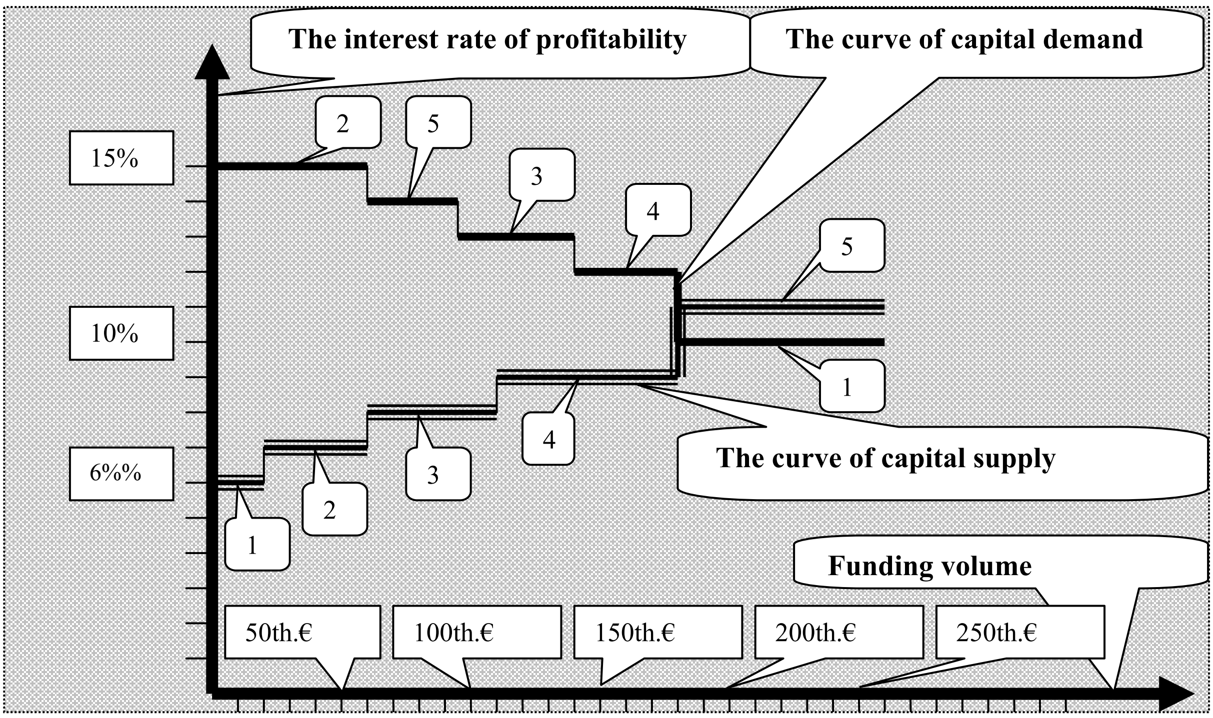

Figure 1. *A graphic ratio of a supply and demand of the capital by optimisation investment and financial programs*

In the graphic we can see the curve of capital demand and the curve of capital supply. The curve of capital demand is the descending one, since the realization of investment projects usually starts with the most profitable and finishes with the least profitable ones. Regarding the level of priority, the first position is held by the second investment object with the profitability of 15%, the second position is held by the fifth object with the profitability of 14%, etc. The total amount of capital demand is 250 thousand Euro. Unlike, the curve of capital supply on the upwards going, since the companies are more eager to use the cheapest sources of funding, and only afterwards they turn to more expensive sources of funding. The optimal investment and financial program corresponds to the point of intersection of the curves of capital demand and capital supply, which is equal to 180 thousand Euro. The first investment object with the amount of 70 thousand Euro cannot be realized, since the resources required to finance it, exceed the level of profitability of the investment object. (When the level of profitability of the investment object is 10%, the price of financing is 11%).

The effect arising from the investment and financial program is determined as the difference between receipts and expenditures at time $t = 1$. In the offered example the effect arising from the investment and financial program is 10, 2 thousand Euro (seen as the difference between the income and investment, composing 24.5 thousand Euro; the interest payment makes up 14.3 thousand Euro.)

In the present example the investment and financing amounts of four objects are the same; therefore it is possible to reproduce graphically the synchronism of investment and financial planning. However in case the investment objects can be divided; sometimes it is not possible to develop an optimal program out of graphical concepts. For example, it is impossible in case the optimal program is defined graphically; however the investment object is included in the program only partly (like in the example with the investment object 5). In this case the optimal program offers exploitation of the method of partial and full intersection. This method provides enumeration of all the possible investment programs. Then for each such program, by means of a previously set sequence, there is attributed a financial program, in such a way its volume is equal to the volume of investment. Then, each of the investment and financial programs mentioned above, may be calculated, the effect is the difference between receipts and expenditures. The program with the maximal total effect, is the most successful and optimal one. This approach may be illustrated by means of the example offered above; the only difference – the first investment object, which is obviously unprofitable, shall be excluded. All the required calculations can be found in the following Table 2:

Table 2. Optimisation of investment and financial programs' volumes

Investment program	Demand on Capital (thsd.)	Financial program	The total effect of investment and financial program Euro (thsd.)
Investment objects 2	50	Financial objects 1,2	5
Investment objects 2,5	90	Financial objects 1,2 and 0,6 Financial object 3	6,8
Investment objects 2,5,3	140	Financial objects 1,2,3 and 0,43 Financial objects 4	9
Investment objects 2,5,3,4	180	Financial objects 1,2,3,4	10,2

In the presented example, the results received by graphical means and the results offered by the method of listing objects, coincide. The amount of an optimal investment and financial program is 180 thousand Euro. In the program there are fully involved four investment objects and four financial objects. However, in case the investment object is involved in the program just partly, it is possible to employ only the method of intersection. This is the feature distinguishing Dean's model among the traditional graphical methods employed to determine the marginal capital value.

Dean's model is a rather simple model of synchronous investment and financial planning, which for sure may be employed by transport companies. Obviously, Dean's model, like any other simplified model, provides several limitations which are already mentioned at the very beginning of the article. However, from the theoretical point of view, such aspects as assumptions regarding the independence of investment objects and the objects of inter-financing, as well as limitations of the statistical model and disregarding investment and financial potentialities in future, may be subjected to criticism. Still the faults that can be found with this model are less powerful than the potentialities, which can be aimed at synchronous investment and financial planning.

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