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Calculation Methods of Investments Economic Efficiency in New Equipment

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***Abstract*—The article presents the technical and economic analysis of the investments in new equipment in general or design/ design-technological innovations that depends on an investment budget formation, which determines the net cash flow from the project implementation for the entire exploitation period. We identified quantitative indicators of economic efficiency of investments according to the well-known UNIDO methodology. The payback of the project can be determined in two ways: by net cash flow without taking into account the time factor (P - payback) and by discounted cash flow (CP - payback). Payback calculation is in the current case: the cash flow is summed up until the amount exceeds the amount of investment.**

***Keywords*—innovations; the total net profit; time factor; discounted cash flow; investment**

I. Introduction

In practice, there are various options for direct investment, and assessing approaches of their economic efficiency have unique features. For example, economic efficiency calculation of the new enterprise construction for the final products manufacturing and workshops, zone or technological equipment reconstruction in the case of the existing enterprise will have its own distinctive features, since the resulting benefit, which should cover one-time costs, is being calculated by various methods. In general case, there are two methods for calculating the economic efficiency of investments: the method of absolute values and the difference method.

II. Methods and Materials

The method of absolute values is used in the following investment cases: a new production is organized "in the open field"; within the existing enterprise, a new production is created, the products of which are sold "to the side"; a new object, which brings income on its own, is introduced, i.e. produces finished products (for example, a truck). In these cases the manager knows the amount of investments, revenue, total costs and taxes, which are used in calculation of the net cash flow for the entire period of operation of the object [1-6]. Discounted net cash flow is used to calculate such valuation criteria as the net present value, return on investment, internal rate of return, rate of return on investment, current rate of return without discounting, etc.

The difference method is used in cases of investment in existing enterprises and facilities. For example, a machine-building enterprise replaces a lathe machine with a CNC machine or installs a gearbox of a more advanced design on a mass-produced truck. The final result of the investment - net cash flow - in this case, it is impossible to calculate as it is generated not only by the new investments but also by the previous "old" investments [7-12]. To assess the effectiveness of investments, it is necessary to consider two forecast variants of the enterprise's activity during the operation of the proposed investments, the enterprise operates in a fixed mode without investments; the enterprise’s investments affect the assets and results of the enterprise's activity.

III. Results and Discussion

The difference method is resulted in determination of how much the new investments change the net cash flow, which should pay off the invested funds. In this case, the investment is determined by the formula:

$$I = I_{ntc} - V_L \quad (1)$$

where I_{ntc} - net new investments; V_L - value of funds liquidated as consequence of new investments.

Typically, when new equipment is introduced, some of the obsolete equipment is liquidated or sold at residual value [13-14].

With the implementation of investments in general case there is a change in revenue, prime cost, taxes of the enterprise. If net cash flow (NCF) i-number is calculated:

$$NCF_i = B_i - S_i - H_i \quad (2)$$

where *Bi* - i-year revenue; *Si* - i-year cost; H_i - i-year taxes; than he differential i-year cash flow is equal to:

$$\Delta NCF_i = (B_{2i} - B_{1i}) + (S_{1i} - S_{2i}) + (H_{1i} - H_{2i}). \quad (3)$$

Indices 1 and 2 are assigned to the direct values of enterprises operating without investments and with investments. The components included in formula (3) form the different net cash flow, which pay off new investments defined by formula (1).

Very often in practice there are small by the value investments aimed at improving equipment, technologies, reducing material and labor costs, which practically do not affect the volume of revenue. For example, the worn milling machine on the production line was replaced by a better machine, which reduces the cost of milling operations [15-18]. Then the different net cash flow is:

$$\Delta NCF_i = (S_{1i} - S_{2i}) + (H_{1i} - H_{2i}). \quad (4)$$

In this case it is clear that the investment's cost should be reduced, i.e. $S_{2i} < S_{1i}$, otherwise the investment will not pay off, their implementation is unprofitable. A typical example is the replacement of an outdated physical and moral machine with a new more productive one with lower current operating costs. Investments will be equal to the machines cost difference (taking into account the dismantling cost of the old and installation of a new one). If the old machine is sold at a residual value, then the net cash will be calculated according to the formula (4). At the same time, obviously, the costs will change only for those operations that are performed in this equipment. Therefore, when calculating the cost difference of products it is sufficient to calculate the cost difference for the operations performed on this machine. This approach simplifies the process of calculating ΔNCF_i. The additional profit in this case is the cost difference from which income tax is taken. Assuming that other taxes remain virtually unchanged, net cash flow will be determined by the formula:

$$\Delta NCF_i = (S_{1i} - S_{2i}) \times (1 - T_{pr} / 100) \quad (5)$$

where T_{pr} is the profit tax rate.

After the different net cash flow calculation, this flow is discounted, and it determines the well-known evaluation criteria - NPV, IP, TPC, CP and etc.

For the technical and economic analysis of investments, new equipment in general design or design-technological innovations, first of all it is necessary to form an investment budget, which determines the net cash flow from the implementation of the project for the entire period of its exploitation. Cash flow quantitative indicators of economic efficiency of investments are determined according to the well-known UNIDO methodology.

Let us consider the evaluation of investments by the method of absolute values on the example of investment in a truck enterprise, i.e. for the purchase of new equipment.

When calculating the net cash flow, an investment budget is arranged, which consists of three parts.

1. Investment.

2. Income and expenses on the investments implementation (including taxes).

3. Cash flow adjustments.

The first part of the budget takes into account the cost of buying a car and all capitalized costs associated with the purchase of a car. For example, for a car you will have to build a garage or a mini-gas station, buy special equipment for operation, etc. The budget also includes a tax on the purchase of a vehicle (20 % of the selling price of the car) and tax discounts provided by the law when introducing new fixed funds.

The second part of the budget describes the projected economic benefits of the investment. This part is similar to a condensed report that contains items of receipts, expenses, and tax deductions. Annual profit for transport logistics is the difference PR = TF * Wn - Texp, where TF – tariff for transportation RUB/t or RUB/(t-km); Wn - annual volume, traffic, t or t-km; Texp – total annual exploitation costs, RUB.

The annual profit calculation is carried out for the entire period of operation of the vehicle. Determination of budget revenues is reduced to the calculation of the annual performance of the car and costs to the calculation of operation costs.

The third part of the investment budget takes into account additional cash flows associated with the realization of investments. First of all, depreciation charges (A) are added to net profit, as they remain at the disposal of the enterprise. Moreover, into account are taken changes in working capital when introducing new tools for this project, as well as the sums received for selling equipment purchased under the project for the residual value.

The net cash flow calculation from the investment project realization (for example, the exploitation of a truck) is carried out in a tabular form.

Net cash flow itself is not informative, although it shows in current prices the net profit from the use of a new car and the possibility of the loan repayment. The disadvantage of estimating investments by net cash flow is that it does not take into account the time factor. Investments are made in the zero year, and the profit is obtained in the following years. As you know, it is incorrect to directly compare the money amounts of different periods because over time the money purchasing possibility changes significantly. In addition, money as capital can bring profit, for example, in the sum of Bank interest.

Taking into account this given factors, investments and net cash flow need to be brought to a single time frame, usually to the initial investment period, i.e. the zero year. Bringing the future amount to the present moment is called discounting. The discount rate is calculated by the formula:

$$KD = 1/(1+i+r\times i)^n \tag{6}$$

Where n is the serial number of the year, n = 1, 2, 3..., i is the annual rate of inflation; r is the discount rate equal to the "cost" of capital or the interest rate of the Bank, if the investment is made at the expense of the loan.

Also in the denominator of this formula can be taken into account the risk premium (the risk ratio) usually determined in an expert manner. In the case of the joint stock investments, the discount rate shall be equal to the dividends of the joint stock.

Capital gains from investments are the difference between the total discounted cash flow and the discounted investment amount. This value is called net present value (NPV) and shows the integral effect of vehicle operation, which must be greater than zero, otherwise there will be "erosion" of the consumer's capital. NPV is calculated by the formula:

$$NPV = \sum_{n=1}^{tres-1} \frac{T_f \times W_n - T_{\exp} - T_{pr}}{(1+r+r\times i)^n} + \frac{T_f \times W_n - T_{pr} - PR_{res}}{(1+r+r\times i)^n} - \\ -(I_1+I_2+I_3) \tag{7}$$

NPV – a criterion for assessing the economic efficiency of the new car. The comparative analysis of alternative cars models technical and economic efficiency is reduced to definition and NPV. The most effective model is the one with the highest NPV value and vice versa.

Evaluation of technical and economic efficiency is not limited to the definition of only, NPV, although it is the determining criterion, except it is calculated investments profitability (IP), time affected payback coefficient (TPC), payback (P), current payback (CP) and the coefficient of efficiency of investment (KEI). Consider these additional criteria.

Investment profitability is determined by the formula:

$$IP = \left(\sum_{n=1}^{tres-1} \frac{T_f \times W_n - T_{\exp} - T_{pr}}{(1+r+r\times i)^n} + \frac{T_f \times W_n - T_{pr} - PR_{res}}{(1+r+r\times i)^n} \right) / \\ /(I_1+I_2+I_3) \tag{8}$$

Investments are profitable if IP > 1. This condition is automatically met when the NPV > 0. Condition IP > 1 at the same time shows that the costs of this project are returned and the value of IP is equal to the multiplicity of payback. Naturally, in the comparative analysis, the most preferable option is the one with the highest profitability.

The payback of the project can be determined in two ways: by net cash flow without taking into account the time factor (P - payback) and by discounted cash flow (CP - payback). To calculate the payback, the cash flow is summed up until the amount exceeds the amount of investment. The year in which this excess occurs is the payback period. The consumer compares the value of the payback period with alternative investments and makes a decision (for example, to purchase a car). If the investments are made at the expense of the loan with the condition of its return only at the expense of profit from the car exploitation, the payback period should not exceed the loan repayment period.

The investment efficiency ratio is the division of the average annual net cash flow by the average investment value according to the formula:

$$IER = \frac{NCF}{I_{avg}} \tag{9}$$

where NCF is the average annual net cash flow.

IV. Conclusion

The value of IER is compared with the profitability coefficient of advanced capital, calculated by dividing the total net profit of the enterprise by the total amount of funds advanced in its activities. But this criterion does not take into account the time component of cash flows. In addition, when alternative investments are considered, it does not make the difference between projects which has same average annual i-year variable return and between projects with the same average annual return but generated over a sum of different years. Because of these shortcomings, this criterion is not recommended for investment evaluation.

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