Modelling of an impact of investment maintenance on the condition of economic protectability of industrial enterprises

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Abstract. There was substantiated the necessity of implementation of a modelling of an impact of investment maintenance on the condition of economic protectability of industrial enterprises with the participation of estimation of cost of investments and investment projects, the mechanism of purchase and sale of securities and conclusion of option contracts that allows to rationally manage the profitability of investment programs, fully ensuring the protectability of entrepreneurship of each subject of real sector of economics.

Key words: processes of investing, investment activities, industrial enterprises, economic protectability, valuation of investment projects, option contracts.

INTRODUCTION

Under the conditions of changing market, the environmental processes of investing are not subjected to sufficiently precise economic-mathematical prediction due to the fact that any investments by their nature of inflows are uneven both by time and by volume. This makes quantitative measurement-forecast of investments axiomatically subordinate to the law of probability distribution of the random value. However, the volume of investment inflow has always had a direct impact on the general level of investment maintenance of a number of business entities that needed them, since investment funds replenish working capital and are reflected on the condition of the economic protection of the given enterprise.

In this context there arises the necessity to conduct a modelling of an impact of investment maintenance on the quality of economic protectability of the business entity for implementation of effective management and control over investment processes and their profitability in the system of high-grade safety of entrepreneurship.

ANALYTICAL INSTRUMENTS

In most countries in recent years there has developed an uneasy economic situation in which the necessity to review the possibility of additional involvement of foreign direct investments in order to restore financial stability and to save sufficient level of economic protectability of industry that noticeably staggered in crisis conditions of world scale has become the urgent need for the real sector of the economics. In particular, in Ukraine the current situation as to inflow of investments is cardinally distorted - some outflow of foreign funds from the industry has been fixed [18]. The reason lies in both improper attention of the state to ensuring of the realization of statutory guarantees for foreign investors and in the deterioration of a number of economic parameters of strategically important domestic branches of industry that previously attracted investors by big dividends.

As is known, financial investments ensure investing of capital in various financial instruments of investment primarily in securities to receive income. They are independent kind of economic activities for enterprises and primary means of realization of external investing.

Analyzing the general financial-credit policy in the post-crisis period, we can conclude that some production and economic structures have stopped to prefer foreign investments due to the difficult financial condition and have started to cover all their needs from their own savings, reserve funds and domestic bank loans. However, these funds are not enough and under the rules of the market economy at this stage the preference should be given to namely external investments as to the main instrument of government maintenance of such financially unstable industrial enterprises that can become significant substitutes for insufficient domestic sources concerning profit earning and for efficient cost management.

Such domestic and foreign scientists as I.Blank [2], R.Castro, G.Clementi, G.MacDonald [4], B.Karpinskyi [5] etc. were engaged in the problems of the research of investments and investment maintenance of the market subjects. However, researches that would combine the analysis of efficiency and profitability of investments, investment projects at the enterprises with the measures to improve the condition of integrated economic protectability through effective quantitative modelling of the change of share price, effectiveness of optimal portfolio, mechanism of rational granting of premium for financial contracts, in particular, option ones, calculation of option prices have remained beyond their attention. As a matter of fact, the given article will be devoted to these issues.

SOURCE MATERIALS AND METHODS

It is necessary to understand that financial-credit and investment maintenance at crisis enterprises in full is impossible without primary activization at them of investment and innovation activities and increase of their investment attractiveness that requires the search of appropriate opportunities of acceleration of their economic growth on their own reproductive basis and improvement of the regulatory framework concerning regulation of economic activities. The problem of choice of sources of raising funds in a lack of own financial resources to ensure sufficient economic protection of enterprise is typical for crisis condition of economics, when production and economic structures are forced to turn to external resources, but do not get them by themselves, due to unstable financial condition, since the risk of not returning of investments and their ineffective use increases.

Rational combination of financing sources and strategic decisions relating to various projects of development of enterprises forms its financial-credit and investment strategy that has the direct impact on the economic security of the letter ones. According to [1], financial and credit and investment strategies can be based on a resource or targeted basis. Depending on the structure of the financing sources of the activities and development of enterprise as well as on the effectiveness of objectives and scopes of investment projects the following variants of selection of strategy are pointed out: using preferably own funds to invest limited number of small investment project; receiving state investments and loans; receiving financing from various sources on the basis of partnerships; use simultaneously all investment sources for the realization of one strategic project or only one kind of financial resources of all possible. In other words, economic development of industrial enterprises is always caused by the choice of a particular strategy of financing that is the basis of investment maintenance and is evaluated by the ultimate effectiveness of the process of functioning and profitability of investment program.

For most of industrial enterprises additional investments inflow is particularly necessary for renewal of the basic production assets, since production assets is a limitative factor for them that determines the production of finished products [10].

The experience of the developed countries of the world shows that the reproductive processes occur solely on the basis of investing. The more active it is, the faster paces of reproduction are and the more effective innovation transformations are. There is a wide range of methods to stimulate attraction of investments: accelerated depreciation, rational tax system, soft loans, the introduction of mechanisms of regulation of bank interest rates, encouragement of leasing [20]. Nowadays, as a rule, enterprises try to give preference to independent investing without intermediaries and to introduce rational policy of attraction of external resources, including favorable foreign investments [17, 21]. Preference is given to foreign direct investments among other external sources of financing, since they do not increase the indebtedness of the country that receives them but, quite on the contrary, stimulate export revenues and create conditions for further decrease of debt.

In this situation, real valuation of economic efficiency of investment projects where effectiveness of investment project should be considered as a transformed economic category that reflects its compliance with the goals and interests of the participants of the project and affect the quality of the general process of support of economic protectability at industrial enterprise becomes possible. Successful realization of investment project is always aimed at increase in profits of enterprise.

In general, investment projects are born only from the needs of individual production and economic structures, and the conditions of their viability always correspond to the investment policy and strategic goals of the state [15]. Timely quantitative valuation of investment projects is the guarantee of qualitative investment analysis that promotes correct selection of the most effective project, its improvement and risk minimization in the system ensuring of economic protectability of enterprise.

If there are made decisions on investing of funds that will be paying off during many years, the following is taken into account: change of demand for industrial products produced due to new investments, the size of interest rates and taxes that will affect expenses in investing, the future political and economic changes as well as inflationary depreciation of funds that affect the size of interest rates and price. In the case of inflation, there will be more future profits than the initial ones, so far as inflation affects price increases. At the same time the monetary cost of the investments will grow, therefore, to compare current investments with the investments of previous years it is necessary to use real investments, that is, taken in constant prices [17].

Financial and economic evaluation of investment projects occupies one of the central places in the process of modeling concerning substantiation and selection of possible variants of investing of funds in financial transactions with real assets [12]. Investment project at industrial enterprise should not be accepted for execution, if it does not provide return of invested funds at the ex-

pense of incomes from sales of industrial goods and profit earning that will ensure profitability of investments not lower than the desired level of production and economic structure and due to recoupment of investments within the period that will satisfy the given business entity. It means that it is suggested to evaluate investment projects at manufacturing enterprises comprehensively taking into account investment expenses that can be done either once or several times over quite a long period, and the initial investments in business entity must be considered both in terms of the possibility of obtaining profits and losses of enterprise, correcting its condition of economic protectability.

In general, estimation of cost of investments is affected by: valuation of their payback period; accounting rate of income on securities; net current value; internal rate of profitability and correlation coefficient of costs and incomes. In the period of significant inflation long-term capital investments will not be preferred because to provide loans and to invest money in securities for a long period of time is unprofitable because of the high risk of unstable economic situation, depreciation of money that will outstrip incomes, and because of the difficulties to predict interest rates in the future. Such capital investments usually have target character and may be preferential and connected with the financing of national programs. In such a case bank institutions should use the mechanism of allocation of loan not for the whole number of years and under mixed interests. In this situation, the payment amount or accreting amount will be calculated:

$$S = S_0 \times (1+i)^{t \times l} \times (1 + \Delta\, t \times i), \qquad (1)$$

where: $t = t \times l + \Delta t$, S – the payment amount or accreting amount, hrn; S_0 – initial loan amount received by the borrower, hrn; i – interest rate; $t \times l$ – the whole number of years; Δt – fractional residue; t – term of crediting of the enterprise, years.

If an increase of interest rate is expected, the following options are available [12]: 1) the rate under the agreement varies according to the growth of the average market rate, which, in its turn, changes depending on inflation; 2) the rate changes according to the terms of the loan agreement. Then the amount of repayment (S) will be calculated by the formula:

$$S = S_0 \times (1+i_1)^{t_1} \times (1+i_2)^{t_2} ... (1+i_k)^{t_k}, \qquad (2)$$

where: $i_1, i_2, ... i_k$ – successive values of interest rates; $t_1, t_2, ... t_k$ – periods during which the corresponding rates are valid.

A special place concerning correction of investment activities today belongs to the issues concerning the optimality of portfolio of securities, estimation of cost of bonds and shares and determination of factors that influence their price and yield, and can be implemented in daily financial and economic activities of an industrial

enterprise to ensure their necessary economic security now and for the future. The best option is such when the investor has an optimal portfolio of securities, that is, there is established an optimal correlation between risk and yield on dividends of securities. Although researches showed that the degree of risk of optimal portfolio will anyway be growing with increase of efficiency that is required and expected. If borrowed capital is present, it is possible to form a portfolio with any expected efficiency, but herewith the risk will be increasing indefinitely. If at some moment of time it is impossible to borrow money, then utmost expected efficiency of portfolio will match the efficiency at that moment of the most efficient security, all cash will be invested exactly in it. Most often portfolio of investor is diversified, which means that it represents a variety of securities: that is why both capital and risk will be allocated among all types of securities. Accordingly, the effectiveness of such optimal portfolio ($E_{opt}^{ЦП}$) can be expressed by the random value:

$$E_{opt}^{ЦП} = k_0 \times g_0 + \sum_{i=1}^{n} G_i \times k^*, \qquad (3)$$

where: k_0 – share of investments with guaranteed efficiency g_0; G_i – random efficiency of the i-th risky security; k^* – scalar multiplier.

Simultaneously, particular attention should be paid to estimation of cost of a wide range of securities that are in circulation in the market, since their cost has also a direct impact on the security of economic protectability of business entities that own them. For bonds, for example, it is a must to take into account: coefficient of long-term debt to own capital, coefficient of profitability, coefficient of interest income taking into account dividends on preferred shares, coefficient of relation of working capital to short-term obligations, conditions of ensuring of bonds by mortgage, conditions of guarantees, maturity date etc.

As for mechanism of valuation of shares, valuation is carried out separately both for preferred and ordinary shares. Evaluation of ordinary shares is much more difficult in comparison with the valuation of bonds or preferred shares because the investor cannot always be sure of the amount of income, time limits of his payments and rate of profit. For bonds and preferred shares the only unknown variable is the accepted rate of profit. This approach is also suitable to determine the investment value of ordinary shares. But it is possible to give preference also to profit for discounting or to discount incomes which will receive dividends.

The most appropriate method that is used to determine the cost of ordinary shares is:

$$V_0 = \frac{D_1}{(1+g)^1} + \frac{D_2}{(1+g)^2} + ... + \frac{V_n}{(1+g)^n}, \qquad (4)$$

where: V_0 – discounted value of shares; $D_1, D_2, ...$ – expected annual dividend payment to the n-th year; g – expected rate of profit; n – last year of holding period of investment; V_n – expected cost of the shares at the end of the year n.

An important criterion of estimation of the portfolio of securities is the general expected rate of profit on a portfolio. This indicator can be expressed as follows:

$$P^N = \sum_{i=1}^{n} a_i N_i^a + \sum_{j=1}^{k} o_j N_j^o, \qquad (5)$$

where: P^N – total expected rate of profit on a portfolio of securities; N_i^a, N_j^o – expected rates of profit on shares and bonds; a_p, o_j – percentage (or proportion) of shares (bonds) in the portfolio of securities; n – number of shares in portfolio; k – number of bonds in portfolio.

However, much attention now is paid to option contracts and the opportunity to use them at industrial enterprises to manage at them financial and economic protectability. In general, option on a security is characterized by a certain maturity and exercise price. Option to purchase gives its owner the right to purchase a security at an exercise price, option for sale - the right to sell a security at an exercise price. The problem of efficient granting of premiums for option is one of the most difficult in the theory of development of the securities market. As for the European option, it is based on some assumptions that are taken from the experience of developed countries and are applied in practice. Firstly, the effectiveness of risk-free investments is determined by permanent force of growth so that the price of the investment will change in time according to the equation:

$$\frac{dS_0(t)}{S_0(t)} = Z dt, \qquad (6)$$

where: $S_0(t)$ – price of investment; Z – force of growth of effective risk-free investments.

Secondly, the effectiveness of investment in any securities option issued will always be a random value and the price of security will change according to the stochastic equation:

$$\frac{dS(t)}{S(t)} = v dt + R^1, \qquad (7)$$

where: $S(t)$ – price of a security that is set at the moment of payment of premiums; v – growth rate of the expected value of the efficiency of investment; R^1 – standard process with unit intensity.

If we denote a premium for option for sale as P_p^0, a premium for option to purchase as P_κ^0, and an exercise price after time interval T after the release of option as P_κ^0, then according to the theorem of parity of options [3] the following dependency s established between the premium for option to purchase and sale:

$$P_p^0 = P_\kappa^0 + P \times e^{-ZT} - S(t). \qquad (8)$$

From this we can conclude: the higher the price of a security that the industrial enterprise owns, that is established at the time of payment of premiums, the lower the premium amount for option for sale is.

Option contracts allow you to limit the risk with a certain amount that is lost in the event of adverse development of events at business entity in the development of which funds are invested and their gaining herewith is potentially unlimited. Various assets are the basis of options contracts. In practice, option contracts can be concluded on shares, indices, interest securities, currencies, futures contracts, goods and more.

As is known, the contents of option lies in the fact that it provides one of the parties of the agreement a right of choice in the execution of contract or rejection of its execution, if it is disadvantageous [3, 11] and thus significantly destabilizes condition of economic security of the corresponding business entity if its actual costs significantly exceed the planned ones [6].

The problem of modelling of prices of options is the determination of the price that must be demanded for the purchase (or sale) of option. Resolution of this problem can greatly simplify the mechanism of management of the condition of economic protectiveness of the owner of this option or of that production and economic structure which wants to purchase it from an investor. Since it is impossible to predict accurately in advance the cost of the option at the moment of its expiry as P_κ^0, its use can be either beneficial or not.

Theoretically, to evaluate option is much easier than to simulate a situation that will be responsible for the condition of economic protectability of business entity that is interested in the contract. In practice it is difficult to assess the value of American option since American options, unlike the European ones, are characterized by the right of premature execution, that means that it is impossible to predict their ending date. Therefore, let us review a European option with pre-known ending date. Let us consider that shares are its basis and the dynamics of change of the share price during the validity of option is a random process. In order to more precisely evaluate the random event, in practice, we turn to the Bernoulli process [14]. With its help it is possible to evaluate the dynamics of the price of shares during the validity of option which either increases with the probability q or decreases with the probability $(1 - q)$. This mechanism is the basis of binominal process.

If to denote share price at the moment of conclusion of option as A_0, then after some period of time in case of increase of dynamics of price the new share price will be $A_1 = A_0 \times k_1 \uparrow k_0 \downarrow$ and in case of decrease – $A_1 = A_0 \times k_0 \uparrow k_1 \downarrow$, where A_0 – initial share price; A_1 – share price in one time interval; $k \uparrow$ – growth of share price; $k \downarrow$ – falling of share price. According to the binomial process period of validity of the option is divided into sub periods where each period is characterized by possible growth or falling of share price and can be considered as a classical Bernoulli process.

Having conducted modelling of binomial process of change of share price for the duration of the option contract that is owned by enterprise for the period t you can establish additional control over the process of management of its level of economic security [8]. Moreover,

if we assume that during the validity of European option on shares it is affected by a large number of factors: time of conclusion and end of option, dynamics of change of share price during this period, the presence of capital on the market except shares and other financial instruments, the presence of a continuous process of functioning of the capital market, the lack of opportunities of arbitrageur and taking into account the fact that the capital market is competitive, then, according to [14], the magnitude of the cash flows that are expected on option for sale at time t, will be equal to:

$$G_{k\uparrow} = \max(A_0 k \uparrow - P, 0) \text{ i } G_{k\downarrow} = \max(A_0 k \downarrow - P, 0), \quad (9)$$

where: P – option exercise fee.

Accordingly, for European option for sale the value of cash flows will be evaluated by the following equations:

$$P_{k\uparrow} = \max(P - A_0 k \uparrow, 0), \text{ якщо } A_1 = A_0 \text{i}$$

$$P_{k\downarrow} = \max(P - A_0 k \downarrow, 0), \text{ якщо } A_1 = A_0 k\downarrow. \quad (10)$$

For more precise valuation of options in practice it is suggested to calculate profitability of shares ($r_{k\uparrow}, r_{k\downarrow}$), which are the part of option and affect change of share price, so:

$$k \uparrow = 1 + r_{k\uparrow}; \; k \downarrow = 1 + r_{k\downarrow}. \quad (11)$$

For valuation model of European option for sale, also using the binomial model, we can calculate the magnitude of cash flows that would directly affect the characteristics of option for sale after m growth of share price:

$$P^m = \max\left(P - A_0 k \uparrow^m k \downarrow^{n-m}, 0\right). \quad (12)$$

By controlling this process, it is possible to more efficiently determine the impact of the investment maintenance on condition of economic protectability of industrial enterprises, modeling forecasted dynamics of the rate of individual securities within the option contract.

Apart from that, the more increased the number of shares in the portfolio, the more complex the problem of valuation of European options will be. This will lead to a variety of changes in the rate of securities and will affect the price of options to purchase and for sale, which will lead to either losses or extra profitability of an industrial enterprise.

Also, the building of generalization of criteria of evaluation of investment projects at production and economic entities in the sphere of general investment activities which affects the general level of their economic security has become crucial [7, 9, 11]. When it is necessary to choose an investment project, it is recommended first of all to answer the question: what is the required amount of financial resources for an enterprise; where to find additional sources in the necessary amount and what their price is; to determine whether the investment pays off.

The main approaches to the evaluation of investment projects at industrial enterprises are [13, 19]:

1) calculation of the time cost of money (V_n) and their accounting in the valuation of investment projects:

$$V_n = \frac{D}{(1+r)^t}, \quad (13)$$

where: V_n – current cost (valuation of magnitude D from the position of the current time moment); D – income, that is planned to be received in the t-th year; r – discount factor;

2) calculation of the weighted average price of capital of investment project that is implemented in to industrial structure (SP_k):

$$SP_k = \sum_{j=1}^{t} p_j v_j, \quad (14)$$

where: p_j – price of the j-th source of funds; v_j – unit weight of the j-th source of funds in their total amount.

However, in general to evaluate the general potential of the project from a position of profitability and liquidity it is enough to analyze the following characteristics [16]:

1) dynamics of cash flows (funds) ($C_k(t)$), where parameter t shows, that a certain value C_k corresponds to each point of time:

$$C_k(t) = P_0 + A - B_I(\Delta), \quad (15)$$

where: P_0 – net profit on the investment project; A – amortization; $B_I(\Delta)$ – investment (capital) cost sand changes in working capital;

2) income if the project is implemented for one year ($D(I_1)$) –magnitude that indicates what should be the annual income from financial rent, that is equivalent to this investment project by income level:

$$D(I_1) = \frac{E_0}{a_{t_i}}, \quad (16)$$

where: E_0 – net brought effect of investment project; a_{t_i} – coefficient of financial rent;

3) calculation of the break-even point of investment project (valuation of reliability of the project).

RESULTS AND DISCUSSION

Thus, management in the sphere of the investment activities of industrial enterprises and integration of rational investment policy with scientific-research, production and commercial activities must become an essential element to ensure their economic security. In other words, to successfully develop a mechanism to ensure economic security of an industrial enterprise, an objective and precise financial and economic evaluation of its investment projects is necessary. It has been found that an investment project that is owned by an industrial enterprise and which affects the investment maintenance of its activities is a complex mechanism that operates

according to a number of factors and parameters, which constantly and dynamically change and correct, through its effectiveness or ineffectiveness, the condition of its economic security, which directly complicates the process of modelling of this effect. There is a way-out from this situation if the final financial result of investment activities of an industrial enterprise is timely subjected to modeling through functional dependency on sufficient number of factors of micro- and macroeconomic character that govern investment calculations. This is recommended to be performed in a strict sequence, taking into account all the major valuation criteria of investment projects and, accordingly, the quality (quantitative) characteristics of the final results considering degree of uncertainty of recoupment of investments, that is, with the introduction of an additional factor of investment risk in order to more objectively diagnose the level of economic security of an enterprise in future.

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