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RISK EVALUATION AT ENTERPRISE INNOVATION AND INVESTMENT ACTIVITY FINANCING

The article reviews and makes an attempt to improve scientific and methodological approaches to risk evaluation in financing the enterprise innovation and investment activity. The essence of riskiness is determined and peculiarities of its estimation are described.

Keywords: *risk; riskiness; risk evaluation; financing; innovation and investment activity.*

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ОЦІНЮВАННЯ РИЗИКОВАНОСТІ ФІНАНСУВАННЯ ІННОВАЦІЙНО-ІНВЕСТИЦІЙНОЇ ДІЯЛЬНОСТІ ПІДПРИЄМСТВА

У статті досліджено та вдосконалено науково-методологічні підходи до оцінювання ризикованості фінансування інноваційно-інвестиційної діяльності підприємства. Визначено сутність ризикованості та описано особливості її оцінювання.

Ключові слова: *ризик; ризикованість; оцінка ризиків; фінансування; інноваційно-інвестиційна діяльність.*

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ОЦЕНКА РИСКОВАННОСТИ ФИНАНСИРОВАНИЯ ИННОВАЦИОННО-ИНВЕСТИЦИОННОЙ ДЕЯТЕЛЬНОСТИ ПРЕДПРИЯТИЯ

В статье исследованы и усовершенствованы научно-методологические подходы к оценке рискованности финансирования инновационно-инвестиционной деятельности предприятия. Определена сущность рискованности и описаны особенности ее оценивания.

Ключевые слова: *риск; рискованность; оценка рисков; финансирование; инновационно-инвестиционная деятельность.*

Introduction. Today's financial and political instability in Ukraine, current global tendencies in the world economy and limited, self-financing have caused the necessity to find alternative financial recourses for enterprise's innovation and investment activity. Furthermore, the attraction possibilities of budgetary resources, internal and external investments, banking credits, venture capital etc. are limited too, however, every competitive enterprise wants to receive maximum profit with minimum costs. Thus, it is obvious, that this process is problematic, expensive, risky and demanding highly experienced personnel. Managers and investors wish to receive all information necessary for better solutions and improved decision-making. Therefore, the question of risk evaluation and chosen direction of scientific research are topical because of crucial need to optimize the financial provision structure of enterprise's innovation and investment activity.

Recent research and publications analysis. The nature of financial and other kinds of risk, peculiarities of risk management and methods of qualitative and quantitative evaluation were explored by G. Cornuejols and R. Tuluncu (2005). V. Granaturov et al. (2003), J. Lintner (1965), H. Markowitz (1952), M. Melnikoff (1998), R. Merton (2013), L. Modigliani and F. Modigliani (1997), W. Sharpe

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(1964), V. Le Sourd (2007), V. Vitlinskiy (2004) and other domestic and foreign scientists. However, scientific and methodological approaches to riskiness quantification of financing enterprises' innovations and investments are investigated fragmentary, thus requiring further development and improvement.

The research objective is to investigate and improve scientific and methodological approaches to risk evaluation at enterprise innovation and investment activity financing.

Key research findings. Risk is inherent to most economic activities depending on the attempt to predict the unknown. This is especially true of financial activities where results of decisions made today may have many possible different outcomes depending on future events. In turn, innovative projects are considered to be the most high-risk ones for investment, so looking for investment and other commercial financial resources innovators need to assess their chances realistically. To make the right investment decision it is necessary not only to determine the value of the expected income, the degree of risk, but also to assess whether the expected return compensates the perceived risk. However, the difficulty here is related to the fact that risk evaluation in enterprise's innovation and investment activity is less formalized than other assessment methods (Grzebyk, 2012).

So, it is important to determine the essence of riskiness in enterprise's innovation and investment activity. In general sense, risk is a possibility of occurrence of certain adverse event entailing the emergence of various kinds of loss or in other words possible danger of loss arising from specifics of certain natural phenomena and human activities (Valinurova et al., 2012). Risk is an event that may happen or may not happen. In case of occurrence of such event there are 3 economic outcomes: negative (loss, damage), zero and positive (gain, profit) (Balabanov, 1996). Risk of innovative project is the risk of successful implementation of a project, characterized by the uncertainty and associated with the possibility of implementation of the project during adverse situations and consequences which point out cases of objective and subjective probabilities (the project may fail, be ineffective or less effective than expected) (Agarkov et al., 2011).

Summing up, we propose to determine riskiness of financing enterprise's innovation and investment activity as a complex concept covering the two aspects: 1) risk as a result of occurrence of certain event expressed in a possibility of receiving financial benefits, loss or zero result; 2) risk as a certain event or process which may happen (or may not happen), included adverse situations and consequences which point out cases of objective and subjective probabilities in the field of enterprise's innovation and investment activity.

We find important to emphisize some peculiarities of risk evaluation of enterprise's innovation and investment activity financing: 1) it should be taken into account a lot of risk factors, identified as many types of risks to trying minimize the overall risk of the innovation and investment activity (economic and political instability in the country, imperfect legislative base and government regulation, inflation, budget deficit, currency fluctuations, the rising cost of resources at the capital market, increase production costs, information asymmetry, ineffectiveness of personnel policy and management etc.); 2) income (or loss) from the innovative project is random and not determined quantitatively at the time of investment decision making;

3) riskiness is reflected first of all in the interest rate; 4) for investment and innovation projects losses are inevitable, but you can limit their value and make it comparable with a win that project will bring; 5) risk assessment is subjective and depends on the decisions managers make, furthermore it follows that the more informed and conscious their solutions are, the lower the level of riskiness will be; 7) risk evaluation suggests alternative choices to managers etc.

Generally, we share the idea of R. Merton that managers think through consequences of an innovation – how it will change the trade-offs people make and their behavior – they must be mindful of limitations of the models on which people base their decisions on how to use an innovation. The author says that some models turn out to be fundamentally flawed and should be jettisoned, while others can be improved upon. Some models are suited only to certain applications; some require sophisticated users to produce good results. And even when people use appropriate models to make choices on how to use an innovation – striking the right balance between risk and performance – experience shows us that it is almost impossible to predict how their changed behavior will influence the riskiness of other choices and behaviors they or others make, often in apparently unrelated domains. Indeed, many risks associated with innovations stem not from the innovation itself but from the infrastructure into which it is introduced. It is also interesting to note 5 rules to managing innovation risks as proposed by R. Merton: 1) recognize that a model exists and needs to be developed for judging risk and return; 2) every innovation model has its own set of limitations; 3) expect the unknowns; 3) obtain intimate knowledge and understanding of the user; 4) consider the infrastructure the innovation will be placed in (Merton, 2013).

Since companies cannot usually insure themselves completely against risk, they have to manage it. Obviously, it is a hard task even with the support of advanced mathematical tools. Different methods of risk analysis of investment and innovation projects are commonly used in the world practice of financial management: range, standard deviation, sensitivity analysis, breakeven analysis, simulation analysis, decision tree analysis, value at risk analysis, cash flow at risk analysis, method of adjusting the discount rate, method of reliable equivalents, sensitive analysis of performance criteria, scenario method, Monte Carlo method (statistical tests), methods of analogy, scoring, expert methods etc. A contemporary approach to risk management requires quantitative risk measures that adequately reflect the vulnerabilities of a company. Examples of risk measures include portfolio variance as in the H. Markowitz MVO model (Markowitz, 1952), the Value-at-Risk and the expected shortfall (also known as conditional Value-at-Risk), the capital asset pricing model developed by W. Sharpe (Sharpe ratio, information ratio, differential returns compared to benchmarks (alphas)) (Sharpe, 1964) and others.

Capital asset pricing model (CAPM) developed by W. Sharpe refers to absolute risk-adjusted performance measures, which evaluate enterprises' risk-adjusted returns without any reference to a benchmark (Sharpe, 1964):

$$k_T = k_{rf} + (k_m - k_{rf}) \times \beta, \quad (1)$$

where k_T denotes a return may be required depending on its risk level; k_{rf} denotes the return on risk-free asset; k_m denotes the market return (average market return);

($k_m - k_{rf}$) denotes risk premium; β denotes the coefficient of sensitivity of return changes to in market factor:

$$\beta_i = \frac{\sum_{t=1}^{n}(k_{mt} - \overline{k_m}) \times (k_{it} - \overline{k_i})}{\sum_{t=1}^{n}(k_{mt} - \overline{k_m})^2}, \quad (2)$$

where n denotes a number of observation periods; k_{it} denotes the return of i security in the period t; $\overline{k_i}$ denotes the average return of i security; k_{mt} denotes the average market return in the period t; $\overline{k_m}$ denotes the average market return for all time period.

In turn, Sharpe ratio initially called the reward-to-variability ratio is defined as:

$$S_p = \frac{E(R_p) - R_f}{\sigma(R_p)}, \quad (3)$$

where $E(R_p)$ denotes the expected return; R_f denotes the return on the risk-free asset; $\sigma(R_p)$ denotes the standard deviation of returns.

This ratio measures the return in excess of the risk-free rate compared to the total risk measured by standard deviation and is based on the total risk made up of market risk and unsystematic risk. One of the most common variations on this measure involves replacing the risk-free asset with a benchmark portfolio – the. information ratio. It should be noted that the Sharpe's model, which explains portfolio returns with the market index as the only risk factor, has quickly become restrictive. It now appears that one factor is not enough and other factors have to be considered. Factor models were developed as an alternative to CAPM, allowing a better description of portfolio risks and an accurate evaluation of managers' performance, in particular, a better evaluation of portfolio alpha.

The next indicator is the J. Treynor ratio which is defined as (Treynor, 1965):

$$T_p = \frac{E(R_p) - R_f}{\beta}, \quad (4)$$

where $E(R_p)$ denotes the expected return; R_f denotes the return on the risk-free asset; β denotes the beta of portfolio.

As we can see this ratio is drawn directly from CAPM. It is also interesting to note the method based on a conditional version of CAPM, which is consistent with the semi-strong form of market efficiency, where the beta is a conditional beta, i.e., it depends on the information vector.

The next risk indicator is Jensen's alpha defined as the differential between the return on the portfolio in excess of the risk-free rate and the return explained by the market model (Jensen, 1968). The statistical significance of alpha can be evaluated by calculating the t-statistics of the regression, which is equal to the estimated value of the alpha divided by its standard deviation. Unlike the Sharpe and Treynor measures the Jensen measure contains the benchmark. Besides, its value of alpha is actually proportional to the level of risk taken, measured by the beta.

Absolute risk-adjusted performance measures include a measure based on the Value-at-Risk (VaR) developed by financial engineers at "J.P. Morgan". It is an indicator that enables summing up the set of risks associated with a portfolio that is diver-

sified over several asset classes in a single value. VaR measures the risk as the maximum amount of loss that a portfolio can sustain for a given level of confidence (Le Sourd, 2007). It is a measure related to percentiles of loss distributions and represents the predicted maximum loss with a specified probability level (e.g., 95%) over a certain period of time (e.g., one day). For example, if a 99% one-day VaR of a security is 7%, this means that it estimates for the next one-day period, there is a 99% chance that the security does no lose more than 7% of its value. However, an additional difficulty with VaR is its computation and optimization. When VaR is computed by generating scenarios, it turns out to be a non-smooth and non-convex function of the positions in the investment port-folio. Another criticism on VaR is that it pays no attention to the magnitude of losses beyond the VaR value (Cornuejols and Tutuncu, 2005).

However, the above approaches to risk evaluation are backward looking and don't capture the current risk characteristics, that may differ today or in the future from what they were in the past. Such situation can lead to errors in valuation. Therefore, summarizing and improving the investigated scientific and methodological approaches to risk evaluation we propose to determine the coefficient of riskiness of financing enterprise's innovation and investment activity ($C_{risk_{IIA}}$):

$$C_{risk_{IIA}} = \frac{\sum_{t=1}^{n}(r_{m_{IIA}t} - \overline{r_{m_{IIA}}}) \times (r_{i_{IIA}t} - \overline{r_{i_{IIA}}})}{\sum_{t=1}^{n}(r_{m_{IIA}t} - \overline{r_{m_{IIA}}})^2} \times ER_{risk_{IIA}}, \quad (5)$$

where n denotes a number of observation periods; $r_{i_{IIA}t}$ denotes the return of innovation and investment activity of certain enterprise in the period t, % or decimal; $\overline{r_{i_{IIA}}}$ denotes the average return of innovation and investment activity (return on equity) of certain enterprise, % or decimal; $r_{m_{IIA}t}$ denotes the average market return based on the return from innovation and investment activity of chosen domestic enterprises in the period t, % or decimal; $\overline{r_{m_{IIA}}}$ denotes the average market return based on the return from innovation and investment activity of chosen domestic enterprises for all time period (return on equity), % or decimal; $ER_{risk_{IIA}}$ denotes the expert rating of riskiness of financing the enterprise's innovation and investment activity based on accounting probability of future technological an commercial success of enterprise's innovation and investment activity (or certain planned project), financial stability and chosen micro- and macroindicators of enterprise's development in the research area and in general (or in other words, the probability of repetition similar past results of innovation and enterprises' investment activity in future), decimal.

The proposed coefficient of riskiness of financing enterprise's innovation and investment activity displays sensitivity changes of certain enterprise's return from innovation and investment activities (return on equity) to change in the average market return based on the return from innovation and investment activity of chosen domestic enterprises with orientation both for retrospective and prospective analysis of micro- and macroindicators of enterprise's development and functioning with the help of expert rating. A $C_{risk_{IIA}}$ of 1 indicates that the level of security, stability and return from financing of enterprise's innovation and investment activity move with the market (chosen domestic enterprises which realize innovation and investment activity). A $C_{risk_{IIA}}$ of less than 1 means that the level of security, stability and return

from financing the enterprise's innovation and investment activity will be less volatile than the market level. A $C_{risk_{IIA}}$ of more than 1 indicates that the enterprise's level will be more volatile than the market one.

Conclusions. Investment and innovation activity of competitive enterprises is characterized by high levels of uncertainty dynamics of the main factors determining the results. Thus, contemporary finance has become increasingly technical, requiring the use of sophisticated mathematical tools in both research and practice. But risk control techniques also need to be implemented to adapt to rapid changes in the values of risk measures. In this context the proposed coefficient of riskiness of financing enterprise's innovation and investment activity should be used in the process of optimizing the structure of financial coverage of enterprises' innovation and investment activity.

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