EVALUATION OF INVESTMENT PROJECTS IN UNDEVELOPED MARKETS

© 2018 **USHERENKO S. V., KHARCHENKO YE. YU.**

Usherenko S. V., Kharchenko Ye. Yu.
Evaluation of Investment Projects in Undeveloped Markets

Using the example of a diversified industrial enterprise, there developed an approach to evaluating the prospects of the implementation of an innovation and investment project on manufacturing a product under conditions of an undeveloped sales market as well as associated risks. It is substantiated that the project can be promising due to its social significance manifested in obtaining environmental, social, and environmental effect from it realization. To evaluate alternative investment projects, there developed a methodological approach that implies analysis according to the following scheme: volume of the market for the product, designed capacity and production technology, competitive environment; characteristics of consumers. This will allow to demonstrate the advantages and disadvantages of each of the alternative projects at the initial stage of the study. The effectiveness and expediency of the project implementation should be evaluated by the following indicators: payback period (PP), accounting rate of return (ARR), net present value (NPV), profitability index (PI), discounted payback period (DPP), internal rate of return (IRR). When making the decision about the implementation of a particular project, its social effect as well as the forecast of future cash flows reflecting changes in their value over time with regard to the discount rate should be taken into account. In developing markets, it is most appropriate to take for the discount rate the weighted average cost of capital, which is calculated in accordance with the CAPM model using the central bank discount rate as risk-free rate, and to calculated the risk premium using the methodology developed by A. Damodaran, based on the data on the country's credit rating by Moody's. The identification of the main risks of the project is possible by conducting an expert survey providing for the evaluation of importance and probability of occurrence of individual risk. The subjectivity of an expert survey has to be reduced by identifying the main mental traps. A more in-depth study of an impact of each risk has to be conducted by using the VaR concept and analysing the sensitivity of impact of simultaneous two risks to the net present value of the project.

Keywords: investment project, weighted average cost of capital, capital asset pricing model, net present value, analysis of sensitivity, value at risk.

Fig.: 5. Tbl.: 11. Formulae: 3. Bibl.: 12.

Usherenko Svitlana V. – Candidate of Sciences (Economics), Associate Professor, Associate Professor of the Department of Corporate Finance and Controlling, Kyiv National Economic University named after V. Hetman (54/1 Peremohy Ave., Kyiv, 03057, Ukraine)

E-mail: usherenko_svitlana@kneu.edu.ua

ORCHID: https://orcid.org/0000-0003-0694-3862

Researcher ID: O-2624-2018

Kharchenko Yevhinii Yu. – Graduate Student, Department of Corporate Finance and Controlling, Kyiv National Economic University named after V. Hetman (54/1 Peremohy Ave., Kyiv, 03057, Ukraine)

E-mail: kharchenko_yevhenii@kneu.edu.ua

ORCHID: 0000-0003-4289-2919

Researcher ID: O-2168-2018

Ушеренко С. В., Харченко Є. Ю. Оцінювання інвестиційних проектів на нерозвинених ринках

На прикладі диверсифікованого промислового підприємства розроблений підхід до оцінки перспектив впровадження інноваційного та інвестиційного проекту виробництва продукції в умовах нерозвиненого ринку її збуту і супутніх ризиків. Обґрунтовано, що проект може бути перспективним завдяки його суспільній значущості, що полягає в отриманні економічного, соціального, екологічного ефектів від реалізації. Був розроблений методологічний підхід до оцінки альтернативних інвестиційних проектів, який забезпечує аналіз за такою схемою: обсяг ринку споживання продукції, розрахункова потужність, технологія виробництва, конкурентне середовище, характеристика споживачів. Це дозволить продемонструвати переваги та недоліки кожного альтернативного проекту на початковому етапі дослідження. Ефективність і доцільність реалізації проектів слід оцінювати за такими показниками: період окупності (PP), облікова ставка прибутковості (ARR), чиста приведена вартість (NPV), індекс прибутковості (PI), дисконтований період окупності (DPP), внутрішня норма прибутковості (IRR). При прийнятті рішення про здійснення конкретного проекту необхідно враховувати його соціальний ефект, прогноз майбутніх

Ушеренко С. В., Харченко Е. Ю. Оценивание инвестиционных проектов на неразвитых рынках

На примере диверсифицированного промышленного предприятия разработан подход к оценке перспектив внедрения инновационного и инвестиционного проекта производства продукции в условиях неразвитого рынка её сбыта и сопутствующих рисков. Обосновано, что проект может быть перспективным благодаря его общественной значимости, заключающейся в получении экономического, социального, экологического эффектов от реализации. Был разработан методологический подход к оценке альтернативных инвестиционных проектов, который обеспечивает анализ по следующей схеме: объем рынка потребления продукции, расчетная мощность, технология производства, конкурентная среда, характеристика потребителей. Это позволит продемонстрировать преимущества и недостатки каждого альтернативного проекта на начальном этапе исследования. Эффективность и целесообразность реализации проектов следует оценивать по следующим показателям: период окупаемости (PP), учетная ставка доходности (ARR), чистая приведенная стоимость (NPV), индекс доходности (PI), дисконтированный период окупаемости (DPP), внутренняя норма доходности (IRR). При принятии решения об

грошових потоків із змінами їх вартості з плином часу з урахуванням ставки дисконтування. На ринках, що розвиваються, найбільш доцільно приймати за ставку дисконтування середньозважену вартість капіталу, яка розраховується відповідно до моделі САРМ з використанням облікової ставки центрального банку як безризикової ставки, а при розрахунку премії за ризик використовувати методику А. Дамодаран, засновану на даних про кредитний рейтинг країни агентства Moody's. Визначення основних ризиків проекту можливо шляхом експертного опитування, що оцінює важливість і ймовірність виникнення індивідуального ризику. Суб'єктивність експертного опитування повинна бути зменшена шляхом визначення основних пасток. Більш глибоке дослідження впливу кожного ризику повинно проводитися з використанням концепції VaR і аналізу чутливості одночасного впливу двох ризиків на чисту приведену вартість проекту.

Ключові слова: інвестиційний проект, середньозважена вартість капіталу, модель ціноутворення на основні засоби, чиста приведена вартість, аналіз чутливості, вартісна міра ризику.

Рис.: 5. Табл.: 11. Формул: 3. Бібл.: 12.

Ушеренко Світлана Василівна – кандидат економічних наук, доцент, доцент кафедри корпоративних фінансів і контролінгу, Київський національний економічний університет ім. В. Гетьмана (просп. Перемоги, 54/1, Київ, 03057, Україна)

E-mail: usherenko_svitlana@kneu.edu.ua

ORCHID: 0000-0003-0694-3862

Researcher ID: O-2624-2018

Харченко Євгеній Юрійович – магістрант, кафедра корпоративних фінансів і контролінгу, Київський національний економічний університет ім. В. Гетьмана (просп. Перемоги, 54/1, Київ, 03057, Україна)

E-mail: kharchenko_yevhenii@kneu.edu.ua

ORCHID: 0000-0003-4289-2919

Researcher ID: O-2168-2018

осуществлении конкретного проекта необходимо учитывать его социальный эффект, прогноз будущих денежных потоков с изменениями их стоимости с течением времени с учётом ставки дисконтирования. На развивающихся рынках наиболее целесообразно принимать за ставку дисконтирования средневзвешенную стоимость капитала, которая рассчитывается в соответствии с моделью САРМ с использованием учётной ставки центрального банка как безрисковой ставки, а при расчете премии за риск использовать методику А. Дамодаран, основанную на данных о кредитном рейтинге страны агентства Moody's. Определение основных рисков проекта возможно путем экспертного опроса, оценивающего важность и вероятность возникновения индивидуального риска. Субъективность экспертного опроса должна быть уменьшена путем определения основных ловушек. Более глубокое исследование влияния каждого риска должно проводиться с использованием концепции VaR и анализа чувствительности одновременного воздействия двух рисков на чистую приведенную стоимость проекта.

Ключевые слова: инвестиционный проект, средневзвешенная стоимость капитала, модель ценообразования на основные средства, чистая приведенная стоимость, анализ чувствительности, стоимостная мера риска.

Рис.: 5. Табл.: 11. Формул: 3. Библ.: 12.

Ушеренко Светлана Васильевна – кандидат экономических наук, доцент, доцент кафедры корпоративных финансов и контроллинга, Киевский национальный экономический университет им. В. Гетьмана (просп. Победы, 54/1, Киев, 03057, Украина)

E-mail: usherenko_svitlana@kneu.edu.ua

ORCHID: 0000-0003-0694-3862

Researcher ID: O-2624-2018

Харченко Евгений Юрьевич – магистрант, кафедра корпоративных финансов и контроллинга, Киевский национальный экономический университет им. В. Гетьмана (просп. Победы, 54/1, Киев, 03057, Украина)

E-mail: kharchenko_yevhenii@kneu.edu.ua

ORCHID: 0000-0003-4289-2919

Researcher ID: O-2168-2018

Introduction. One of the innovative features of investment projects may be the formation of a segment of consumption in an undeveloped market for a particular product. With the availability of high risks of production and promotion of products to undeveloped segments of its market consumption, there is a need to form an appropriate infrastructure for selling this product in this segment. At the same time, the development of innovation and investment projects on the production and promotion of such products may be promising as a result of receiving both economic and social, environmental effects or public importance of the realization. [6, p.278]

Problem statement. In this context, there is a problem of using the methodology for comprehensive evaluation of the expediency of developing investment projects with the manufacturing of product (provision of services) for underdeveloped markets, taking into account the risks of product sales, assessing the competitiveness of its production technology and the volume of the consumption market, etc.

Analysis of recent researches and publications. Some aspects of the methodology for evaluating investment projects are discussed in a number of publications. The works [3; 4] present an analysis of approaches to project risk assessment. An ap-

proach to manage financial risks is developed in [4]. A model of portfolio of project analysis is introduced in [6]. The VaR methodology is described in [7]. At the same time, there is a l ack of a systems approach to the integration of the developed in these publications methods to evaluate investment projects on manufacturing a product for an undeveloped market.

The aim of the article is to develop a systems approach to evaluating the implementation prospects of an innovation and investment project on manufacturing a product under conditions of its sales market being undeveloped and associated risks, which includes the integration of methods developed in the publications [3–7]. To achieve the aim, there used the example of the investment project selected by the multisectoral enterprise PJSC Vesko involved in utilization of coal mine methane. Based on the systems approach, the enterprise carried out an analysis of two alternative proposals: the production of gaprin (feed protein) and motor fuels from the methane-air mixture, and as a result has chosen the gaprin production project.

In this context, there is a problem of a relevant evaluation of the appropriateness of development such projects, which was considered based on the example of choosing the invest-

ment project for utilization of coal mine methane among other alternative projects by PJSC Vesko. The developed approach to the selection of the mentioned project is of a methodological interest for evaluating innovation and investment projects in undeveloped markets.

Presentation of basic material of the research. The enterprise PJSC Vesko has several activity areas, but the main product of the enterprise is clay of the Andriivka deposit. The uniqueness of this enterprise is in the fact that more than 7 % of the world's market of white plastic clays belongs to it. According to the results of 2016, more than 2.2 million tons of clay were sold. Only 10 % of the production is used in the domestic market, and 90 % is exported to more than 25 countries, mainly EU members [8].

As for investment activity, the enterprise takes all measures to expand its scope, every year it puts into practice new investment projects. The yearly net cash flow from its investment activity is negative. Figure 1 shows that the negative value increases every year, and the average annual rate of decrease over the last three years is 189.7 %. It is explained by the fact that in 2015, compared to 2014, the net cash flow from its investment activity decreased more than 6 times, and in 2016 compared to 2015 – 1.4 times.
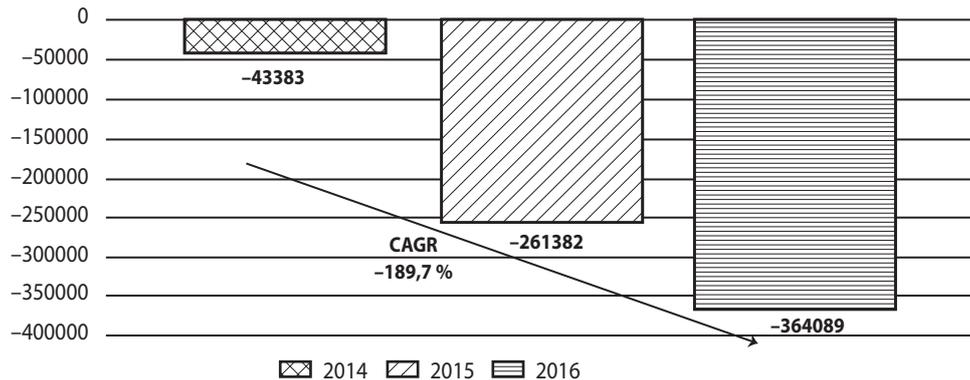

Fig. 1 Dynamics of the net cash flow from investment activity, thousand UAH

Source: developed by the authors based on [8]

Over the last three years PJSC Veskohas have actively been investing in new directions, namely: ash-slag products, including microspheres, dolomites, technical gases, mining. We will focus on the last of the mentioned directions – mining – as the least active direction at this stage due to the technological complexity of extraction, but quite forward-looking in economic terms.

The technological complexities of mining are connected with extraction of coal lying at the depth in strata between which there is extremely explosive gas – methane. During coal mining, methane goes into the air, and in order to prevent the explosion, air in the mine is saturated with oxygen and with the help of degassing systems the methane-air mixture is pumped out of the mine and released into the atmosphere. Thus, pollution of the environment takes place and the mine has to pay the environmental tax for the emission of methane, which is classified as a "greenhouse gas".

Currently, this direction of the activity of PJSC Vesko is in the processing of the residual products of mining. However, in our opinion, the idea of accumulation of methane-air mixture with its further processing would be more useful from the economic point of view and have a better socio-environmental effect.

Thus, on the one hand, there would be a positive social effect – a decrease in the pollution of the environment; on the other hand, a considerable economic effect resulting from the absence of the necessity to pay the environmental tax; the receipt of additional economic benefits due to producing and selling finished product from the methane-air mixture (e.g., soot, acetylene, natural gas, motor fuel (methane), gaprin (feed protein), methanol) as well as processing the mixture in cogeneration plants to supply energy carriers to thermal and power networks).

There is a need to consider what products can be produced using the methane-air mixture with regard to the technological base of the enterprise. The raw material base is one of the mines belonging to the strategic holding company DTEK, with which a memorandum of comprehensive cooperation was concluded. If necessary, the number of mines can be increased to 14. Every year the mine emits 19.7 million m^3 of methane-air mixture with an average methane concentration of 35 %. Several options of the finished product, including soot, acetylene, natural gas, motor fuel (methane), gaprin (feed protein), methanol, were considered.

At the preliminary stage of the study, it was discovered that setting up production of most of the possible products is unnecessary, mainly due to the availability of a cheaper production method.

Therefore, two directions of the processing of the methane-air mixture were analyzed in more detail: production of motor fuel and gaprin. We will briefly characterize each of the directions according to the following scheme: market volume, enterprise designed capacity and production technology, competitors, consumers, and focus in more detail just on the economic component of both projects.

The market for gas motor fuel deals with two main products: methane and propane-butane mixture. Following the results of 2016, according to the State Statistics Service of Ukraine [9], the volume of this market amounted to 173 million m^3. The designed capacity of the raw material base – one mine – amounts to 6.9 million m^3/ year, which is less than 4 % of the market volume.

The production of motor fuel from methane-air mixture comprises several stages, namely: increase of methane concentration up to 95 %, removal of hydrogen sulfide, gas compression, storage and transportation in special containers under pressure.

Besides the classical product-competitor – petrol – and such modern technologies as Electric Vehicle Technology, the propane butane mixture can also be used as a substitute of traditional fuels. One of the advantages of using the substitute is a more developed infrastructure for its delivery – more than 2000 filling stations in Ukraine, while the figure for methane ones is less than 200 according to the results of 2016. Also, the propane butane mixture is transported more easily, and when used it causes no engine power loss in contrast to the methane mixture (engine power loss is at the level of 10-15 %) [9].

One of the major disadvantages in the situation with NGV-refueling compressor stations, because every plant producing methane mixtures has its own NGV-refueling compressor stations.

Thus, there arises the necessity to build the own NGV-refueling compressor station. Moreover, funds for free re-equipment of vehicles, in order to increase the number of potential consumers, were also included in the project. It should also be mentioned that the potential consumers are owners of already re-equipped vehicles, their number comprising about 400 thousand motorists.

Regarding gaprin, it is a complete protein produced as a result of microbiological synthesis and intended to be used as a feed protein supplement. Gaprin is approved by an EU safety certificate, according to which this product is considered environmentally friendly.

The Ukrainian market of feed proteins is estimated at 800 thousand tons annually while the designed capacity of the project is 12.6 tons, which is less than 0.01 % of the market volume, i.e., in view of having certain competitive advantages, there should be no difficulties with a sale of finished products [8].

The production of gaprin is based on the consumption of the methane-air mixture by special bacteria followed by the formation of biomass, which is to be dried and packaged.

At the moment, gaprin is not represented on the Ukrainian market, but it is widely used in most European countries. The main competitors of gaprin are soy oil meal and fish flour. However, gaprin is better than these two competitive products both in terms of the protein content and other characteristics.

The main potential consumers of gaprin are poultry farms, pig farms, and households. Poultry farms, as a rule, have a closed cycle of production, including that of feed stuff, but these enterprises buy vitamins and protein supplements in addition.

We will evaluate the effectiveness and relevance of the project implementation according to the following indicators: payback period (PP), accounting rate of return; (ARR), net present value (NPV), profitability index (PI), discounted payback period (DPP), and internal rate of return (IRR) [2, p.487].

The planning of investments, determination of their usefulness, profitability always implies forecasting future cash flows. In calculating, estimating, comparing amounts of money that are separated by time periods, the change in their value should be taken into account [1, p. 373; 4, p.255]. Therefore, in order to estimate the capital investments for several alternative projects, it is necessary to take into consideration a different value of money at present and in the future, which is done by a discounting method. The term "discounting" is used to estimate the present (current) value of future cash flows [3, p.260].

There is a need to calculate the weighted average cost of capital as discount rates for investment projects. The WACC is calculated according to the formula:

$$WACC = K_E \times \frac{E}{D+E} + (1-T) \times \frac{D}{D+E}, \qquad (1)$$

where K_E and K_D – cost of own and borrowed capital respectively;

T – profit tax rate;

D – share of payable debt capital;

E – share of equity capital [1, p. 283].

The cost of debt capital is calculated as the weighted average cost of paid credit resources attracted by the enterprise. And the cost of equity capital is calculated according to the CAPM model:

$$CAPM = R_f + \beta \times (R_M - R_f), \qquad (2)$$

where R_f – risk-free rate of return;

β – coefficient of systemic risk;

$R_M - R_f$ – market risk premium [1, p. 292].

We will determine the market risk premium based on the study of A. Damodaran and data presented by Moody's Investors Service [11] (Tbl. 1).

Every year the market risk premium increases, which indicates distrust on the part of investors and a forecast of much higher risk of investing in Ukraine than in developed markets

The next stage is the determination of the coefficient of systemic risk, which depends on the change in share prices of a particular enterprise and changes in the market as a whole. Since the shares of PJSC Veskodo are not listed on the stock exchange, and it is too early to speak about the development of the Ukrainian stock market, we will use the data of sectorial coefficients β, taking into account the capital structure of PJSC Vesko by the formula [2, p. 301]:

Table 1

Investment risk premium in Ukraine in 2014–2016

Year	Moody's rating	Investment risk premium at developed markets, %	Investment risk premium in Ukraine, %	Market risk premium, %
2014	Caa1	5.00	11.25	16.25
2015	Caa3	5.75	15.00	20.75
2016	Caa3	6.25	15.44	21.69

Source: developed by the authors based on [11, 12]

$$\beta_L = \beta_U \times [1 + (1 - T)D / E]. \qquad (3)$$

We will find the sectorial coefficient of systemic risk based on the data presented by A. Damodaran [12], as the weighted average indicator for individual branches of the enterprise activity (mining-chemical activity). When calculating the capital structure we use not balance sheets, but consider only payable loan capital. The resulting values are shown in Table 2.

Table 2

Coefficient of systemic risk

Indicator	2014	2015	2016
β_u	0.780	0.780	0.780
Tax (T), %	18.0%	18.0%	18.0%
Debt (D), %	9.3%	5.4%	8.2%
Equity (E), %	90.7%	94.6%	91.8%
β_L	**0.846**	**0.817**	**0.837**

Source: developed by the authors based on [8]

Determining the risk-free rate in Ukraine is a rather controversial issue, since, in our opinion, using the global risk-free rate is too optimistic. For this reason we will use the accounting rate of the NBU. Over the last three years, it has been frequently changed, so we will use the annual weighted average accounting rate.

The results of calculating the cost of equity capital of PJSC Vesko are shown in Table 3, and indicate a sharp increase in the value of equity capital in 2015 with a further minor decrease in 2016. This is due to the economic and political situation in the country, which is reflected both in the NBU [10] accounting rate and in the risk premium calculated on the basis of the credit ratings of the state.

In calculating the weighted average cost of capital, only payable loan capital will be taken into account, the cost of which, in accordance with the calculations, fluctuated in the analyzed period as follows: in 2014 – 17.9 %, in 2015 – 33.2 %, and in 2016 – 28. 1 %.

Table 4 shows the main components and the weighted average cost of capital of PJSC Vesko in 2014-2016, which, ow-

ing to the structure of capital, depends largely on the value of equity capital.

Table 3

Equity capital

Indicator	2014	2015	2016
Risk-free rate of return	9.40%	24.88%	18,08%
Risk premium	16.25%	20.75%	21,69%
Coefficient of systemic risk	0.846	0.817	0.837
Equity capital (CAMP)	23.1%	41.8%	36,2%

Source: developed by the authors based on [8, 10]

Table 4

Weighted average cost of capital

Indicators	2014	2015	2016
Equity capital (KE), %	23.1 %	41.8 %	36.2 %
Cost of debt capital (KD), %	17.9 %	33.2 %	28.1 %
Tax rate (T), %	18 %	18 %	18 %
Share of paid loan capital (D),%	9.3 %	5.4 %	8.2 %
Share of equity capital (E), %	90.7 %	94.6 %	91.8 %
WACC	22.32 %	41.01 %	35.12 %

Source: developed by the authors

After calculating WACC, we can compare the corresponding values with the CFROI indicators (Fig. 2).

The calculations show that in 2014 and 2015, the average efficiency of investment activity exceeded the weighted average cost of capital by 32 and 20 % respectively, which indicates the effectiveness of the investment policy of the enterprise. However, due to a significant investment in long-term projects in 2016, the efficiency of investments dropped sharply, which led to the fact that the weighted average cost of capital exceeded the CFROI value. That is, the company attracted funds amounting to 35.12 %, and received the return on investment only at the level of about 27-28 %. The main reason for this was, as noted above, is investing in projects that generate cash flows only a
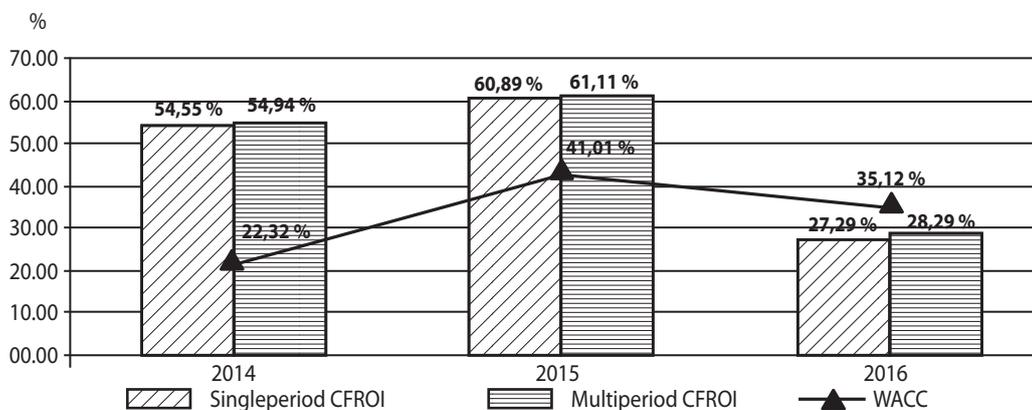

Fig. 2. WACC, single- and multiperiod CFROI for PJSC Vesko

Source: developed by the authors

few years after their implementation. As a result, cash outflow from the enterprise takes place, which in the future may negatively affect both its liquidity and financial sustainability.

On the basis of the found weighted average cost of capital and forecasted cash flows for the two projects, we will find indicators of their efficiency. They demonstrate that both projects are cost-efficient (Tbl. 5), and their implementation will bring additional cash to the enterprise. At the same time, the production of gaprin according to the calculations is more profitable than the production of motor fuel.

Despite a quite attractive effectiveness of the projects, it is also necessary to take into account various risks associated with their implementation. In order to assess the risks, an expert survey in which 15 specialists took part has been conducted. All the participants were asked to rank each of the proposed risks in accordance with the impact on the final project indicators (Tbl. 6).

Also the experts participating in the survey were asked to evaluate the probability of occurrence of each risk (Tbl. 7)

The weighted average impact and probability of occurrence of each risk have been calculated on the basis of the given data (Tbl. 8). This has enabled to illustrate the primary risk map (Fig. 3), according to which nearly all risks, except for the accounts receivable risk, are found to be in the critical area [7].

In view of the fact that people are subjective in their judgments, they have their own fears, habits, etc., we will try to level out or at least minimize the impact of subjectivity on the final result by identifying the main mental traps. The first mental trap can be generally called a habit or a stereotype, which lies in overestimating the probability of occurrence of negative consequences of typical phenomena in crisis situations.

First of all, the situation deals with the change in the accounting rate of the NBU, which has changed a lot of times over the last few years, the similar situation is with the change in the

Table 5

Indicators of the effectiveness of the proposed projects

Indicator	Gaprin	Methane
PP, years	1.48	2.1
ARR, %	60.1 %	35.1 %
PI	1.37	1.06
DPP, years	3.66	4.73
NPV, ths UAH	22 416	8 168
IRR, %	52.1%	38.2 %
WACC		35.12 %

Source: developed by the authors

Table 6

Results of the survey on the impact of financial risk on the NPV

№	Financial risk factor/Impact on NPV	Slight	Low	Middle	High	Critical
1	Accounts receivable	0	1	3	8	3
2	Accounts payable	4	5	3	2	1
3	Currency rate	0	0	5	7	3
4	Inflation	0	2	4	8	1
5	Cost of electricity	2	3	4	5	1
6	Change in implementation costs	0	1	3	6	5
7	Change in sales volume	0	1	2	6	6
8	Change in the accounting rate of the NBU	1	2	3	7	2

Source: developed by the authors based on the results of the expert survey

Table 7

Results of the survey on the probability of financial risk occurrence

№	Financial risk factor /Probability of occurrence	Slight	Low	Middle	High	Very high
1	Accounts receivable	0	4	1	6	4
2	Accounts payable	1	3	6	4	1
3	Currency rate	0	0	3	7	5
4	Inflation	0	1	2	8	4
5	Cost of electricity	1	1	6	5	2
6	Change in implementation costs	3	2	5	4	1
7	Change in sales volume	2	5	5	3	0
8	Change in the accounting rate of the NBU	1	2	7	4	1

Source: developed by the authors based on the results of the expert survey

Matrix of financial risks

№	Financial risk factor	Weighted average impact	Weighted average probability
1	Accounts receivable	3.87	3.67
2	Accounts payable	2.40	3.07
3	Currency rate	3.87	4.13
4	Inflation	3.53	4.00
5	Cost of electricity	3.00	3.40
6	Change in implementation costs	4.00	2.87
7	Change in sales volume	4.13	2.60
8	Change in the accounting rate of the NBU	3.47	3.13

Source: developed by the authors based on the results of the expert survey
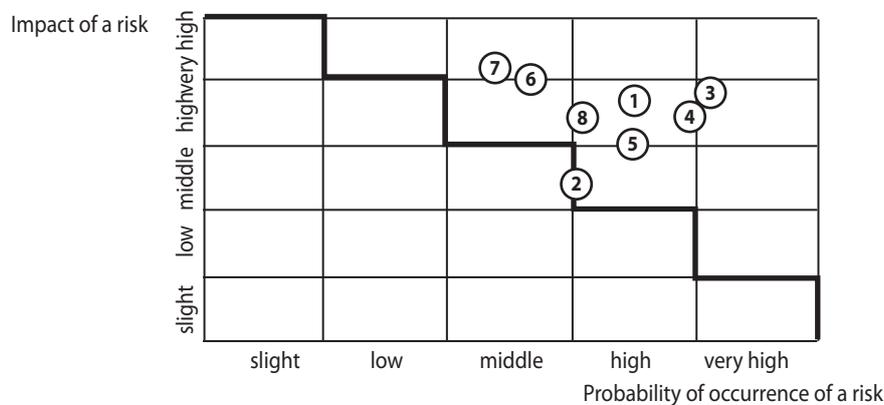

Fig. 3. Primary risk map

Source: developed by the authors based on the results of the expert survey

currency rate. These phenomena are perceived by the population as extremely negative and a high probability of their occurrence is intuitively entailed [5, p. 192].

Another mental trap is the distorted projection, which is in projecting one's own financial experience to an enterprise's activity, e.g., overestimating the influence and probability of increasing prices for electricity or uncontrolled level of inflation. These phenomena have a significant impact on the welfare of the population; therefore, experts project the negative consequences of these processes, which they experience themselves, on results of an enterprise's activity.

Thus, taking into account mental traps, the risk map (Fig. 4) demonstrates that the following risks get into the critical area: change in sales prices, sales volume, inflation rate and a cost of electricity; the last two risks being "on the border".

That is, the project results are mostly influenced by the price risk and operational risk (risk of change in sales volume). Taking into consideration that gaprin is an innovative product for the Ukrainian market, we can estimate the risk of price changes only for motor fuel.

We will use the VaR historical method for quantifying the price risk for motor fuel. First of all, we find rates of price change based on 93 periods (each period is 14 days) and make up a histogram (Fig. 5).

According to the histogram with the probability of 95 %, the price for methane in the following period will decrease by

no more than 1.3 % of the price of the current period. The final stage of the quantitative evaluation of price risk was a forecast of a lower limit of the price for methane for the following 15 periods (30 weeks) (Tbl. 9) using VaR, calculated according to the formula [3, p. 242]:

$$Var = (1 + \sqrt{Number\ of\ pediod} \times Current\ price) \times Value\ of\ quintile.$$

(4)

According to the calculations presented in Table 9, for the following period (14 days), the price for methane with the probability of 95 % will decrease by no more than 2.15 % or by UAH 0.32. However, for the 15 period, i.e., after 30 weeks, the lower limit of the price for methane with the probability of 95 % will be UAH 13.58, i.e., by UAH 1.22 (8.61 %) lower than the current price. While calculating the project, the starting price in the first period was taken at the level of UAH 14.8, i.e., there is a significant level of the risk of price reduction. The impact of the change in the price for motor fuel on the indicators of effectiveness of investments is analyzed below.

By analyzing the NPV sensitivity of both projects to changes in the price and sales volume, we will find a more risky project (Tbls. 10 and 11). According to Table 10, while reducing the price for finished products in the first year of the project implementation by 5 %, the net present value will be UAH 7.35 million, i.e., the NPV will decrease three times. However, taking into consideration the competitive price compared to sub-
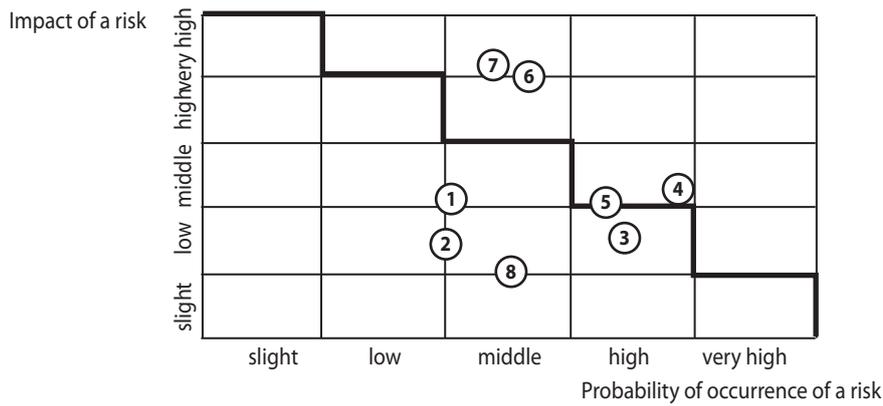
Fig. 4. Risk map with regard to mental traps

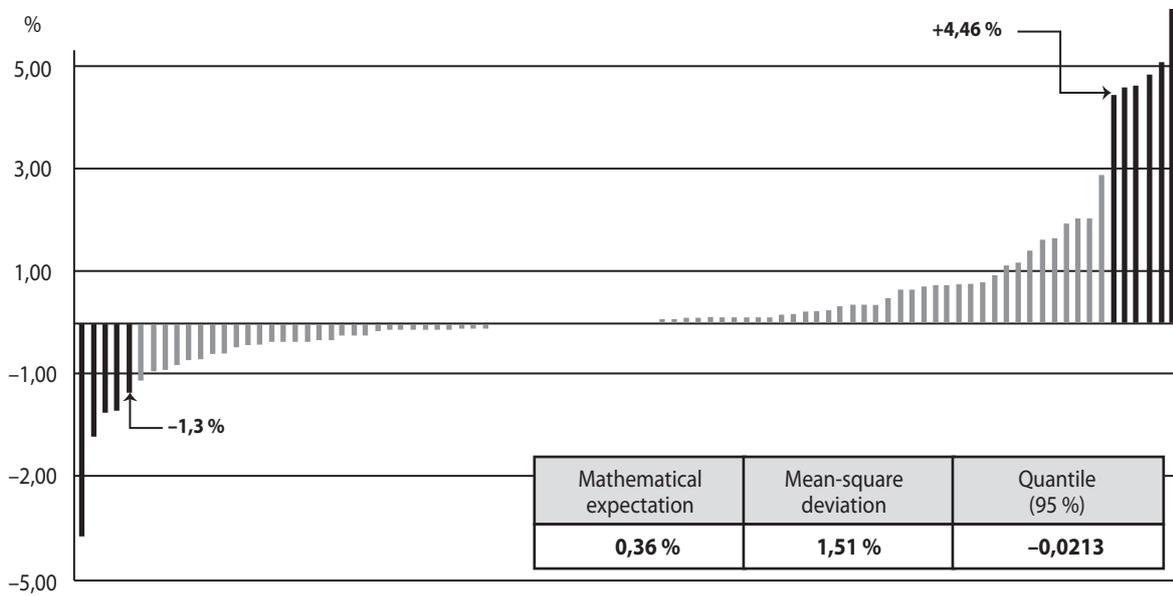*Source:* developed by the authors based on the results of the expert survey

	Mathematical expectation	Mean-square deviation	Quantile (95 %)
	0,36 %	**1,51 %**	**−0,0213**

Fig. 5. Price fluctuations for methane in 2015–2017

Source: developed by the authors

Table 9

End tbl. 9

Calculation of price risk for motor fuel

Period	Price for methane, UAH /m³	VaR, UAH	VaR, %
1	**2**	**3**	**4**
1	14.48	-0.32	-2.15 %
2	14.35	-0.45	-3.06 %
3	14.25	-0.55	-3.76 %
4	14.17	-0.63	-4.35 %
5	14.10	-0.70	-4.88 %
6	14.03	-0.77	-5.36 %
7	13.97	-0.83	-5.80 %
8	13.91	-0.89	-6.21 %
9	13.85	-0.95	-6.60 %

1	2	3	4
10	13.80	-1.00	-6.97 %
11	13.75	-1.05	-7.32 %
12	13.71	-1.09	-7.66 %
13	13.66	-1.14	-7.99 %
14	13.62	-1.18	-8.30 %
15	13.58	-1.22	-8.61 %

Source: developed by the authors

stitute goods and a possibility to increase sales, the project is not highly risky. For instance, if the enterprise has to reduce the price by 10 %, the increase in the sales volume by 20 % will give the net present value of UAH 26.3 million.

The situation with the project of motor fuel production project is more complicated, because according to the data of

Table 10

Analysis of the NPV sensitivity of the project Gaprin to changes in the price and sales volume

	Price	8,910	9,466	10,023	10,580	11,137	11,694	12,251	12,808	13,364
NPV	22,416	80%	85%	90%	95%	100%	105%	110%	115%	120%
7,558	80%	-87,943	-60,847	-43,258	-29,559	- 17,064	- 3,660	10,832	26,608	43,754
8,030	85%	-70,904	-47,403	-33,081	-20,092	- 7,072	7,048	22,445	39,207	57,425
8,503	90%	-55,871	-37,854	-23,488	-10,882	2,805	17,756	34,059	51,795	70,956
8,975	95%	-43,040	-28,305	-14,971	- 1,765	12,682	28,444	45,516	64,114	84,339
9,447	100%	-34,266	-19,860	- 6,549	7,351	22,416	38,885	56,856	76,433	97,722
9,920	105%	-25,825	-11,775	1,771	16,216	32,034	49,326	68,196	88,752	111,106
10,392	110%	-18,042	- 3,919	9,948	25,081	41,652	59,768	79,536	101,071	124,489
10,865	115%	-10,633	3,702	18,124	33,945	51,270	70,209	90,876	113,390	137,872
11,337	120%	- 3,420	11,251	26,301	42,810	60,888	80,651	102,216	125,708	151,256

(Sales volume — row labels in left column)

Source: development by the authors

Table 11, the net present value of the project changes sharply due to the minimal change in sales volume and, even more, the slightest change in prices. For instance, reducing prices in the first year of the project by 2 % leads to a reduction of the net present value six times, compared to the initial calculations.

At the same time, such sensitivity to the change in price and sales volume is more risky than in the situation with gaprin, because due to the stiff competition and the inability to influence the market price as well as the technological inability to increase sales volume, the project for the production of motor fuel should be regarded unreasonably risky.

Increasing sales by 5 % increases the net present value of the project more than twice, but considering the technological capabilities of the equipment, an increase in the volume of methane-air mixture production is not possible.

Table 11

Analysis of the NPV sensitivity of the project Gaprin to changes in the price and sales volume

	Price, $	0.41	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.44
	Price, uah	14.17	14.64	14.65	14.65	14.65	14.65	14.65	14.80	15.10
NPV	8,168	90%	94%	95%	96%	97%	98%	99%	100%	102%
5,863,725	85%	- 50,299	- 37,727	- 34,902	- 32,029	- 29,105	- 26,205	- 23,276	- 20,295	- 14,178
6,208,650	90%	- 41,669	- 29,024	- 26,035	- 23,070	- 20,075	- 17,027	- 13,926	- 10,771	- 4,293
6,553,575	95%	- 33,039	- 20,387	- 17,335	- 14,229	- 11,067	- 7,850	- 4,577	- 1,246	5,549
6,898,500	100%	- 24,410	- 11,870	- 8,657	- 5,387	- 2,060	1,327	4,735	8,168	15,215
7,243,425	105%	- 16,273	- 3,352	21	3,440	6,858	10,337	13,878	17,482	24,882
7,588,350	110%	- 8,360	5,113	8,568	12,086	15,666	19,311	23,020	26,796	34,548
7,933,275	115%	458	13,442	17,054	20,731	24,474	28,285	32,163	36,110	44,214
8,278,200	120%	7,352	21,770	25,539	29,377	33,283	37,258	41,305	45,424	53,881

(Sales volume — row labels in left column)

Source: developed by the authors

Thus, after considering two investment projects related to the mining activity of PJSC Vesko, it can be concluded that the production of gaprin both in terms of efficiency and risk, is more reasonable than the production of motor fuel. In case of the implementation of the proposed project, both an economic effect (NPV of the project is UAH 22.4 million) and social and environmental (reduction of emission of harmful substances into the air) are achieved.

Conclusion. As a result of the study, the following conclusions have been made regarding the peculiarities of evaluating the effectiveness of investment projects in developing markets:

1. While considering various alternative investment projects, it's necessary to characterize briefly each of them according to the following scheme: market volume and designed capacity, technology of production, competitors, consumers. This will allow to reveal the advantages and disadvantages of each of them at the initial stage of the study.

2. Planning investments, determining their expediency, profitability always implies forecasting of future cash flows. Accordingly, in calculations it is necessary to take into account the change of their value in time, i.e., to use a discount rate, in order to bring cash flows to the present value. In developing markets, it is most appropriate to take for the discount rate the weighted average cost of capital and calculate it with regard to the following features:

- to calculate the cost of equity capital according to CAPM model using the central bank discount rate as a risk-free rate;
- to calculate the risk premium using the methodology developed by A. Damodaran, based on the data presented by Moody's Investors Service;
- to take the beta coefficient at a level of industry-average value and adjust it with respect to the structure of capital of a particular enterprise;
- to use the value of only payable loan capital.

3. The effectiveness and expediency of a project implementation should be evaluated according to the following indicators: payback period (PP), accounting rate of return (ARR), net present value (NPV), profitability index (PI), discounted payback period (DPP), internal rate of return (IRR). Also, when making a decision on the implementation of a particular project, its social effect should to be taken into consideration.

4. One of the ways to determine the main risks of a project is the method of expert survey, and determining the significance and probability of occurrence of a particular risk. However, since people are subjective in their judgments, they have their own fears, habits, etc., it is necessary to level out or at least minimize the influence of subjectivity on the final result by identifying the main mental traps.

5. A more thorough study of the impact of each risk should be conducted using the VaR concept and analyzing a sensitivity of impact of two simultaneous risks on the net present value of the project.

LITERATURE

1. Brealey R. A., Myers S. C. Principles of corporate finance. New York : McGrawHill, 2011. 969 p.

2. Brealey R., Myers S, Allen F. Principles of corporate finance. Boston : McGraw-Hill/Irwin, 2014. 659 p.

3. Cabedo J., Moya I. Estimating oil price Value at Risk using the historical simulation approach. *Energy Economics.* 2016. Vol. 25. P. 239–253.

4. Jorion Ph. Value at risk: The new benchmark for management financial risks. New York : McGrawHill, 2017. 603 p.

5. Reichmann T., Form S. Balanced Chance and Risk-Management. *Controlling.* 2016. 12. Jn. S. 189–198.

6. Sharpe W. F. A Simplified Model for Portfolio Analysis. *Management Science.* 2013. Vol. 9, № 2. P. 277–293.

7. Morgan J. P. RiskMetrics – Technical Document. URL: https://edisciplinas.usp.br/pluginfile.php/3257846/mod_resource/content/1/RiskMetrics%20-%20Techinical%20Document.pdf

8. Official site PJSC Vesko. URL: http://www.umginvestments.com/

9. Державна служба статистики України. URL: http: // www.ukrstat.gov.ua

10. Національний банк України. URL: https://bank.gov.ua/control/uk/index

11. Official site of rating agency Moodys. URL: https://www.moodys.com/

12. Official site of A. Damodaran. URL: http://pages.stern.nyu.edu/~adamodar/

REFERENCES

Brealey, R. A., and Myers, S. C. *Principles of corporate finance* New York: McGrawHill, 2011.

Brealey, R., Myers, S., and Allen, F. *Principles of corporate finance* Boston: McGraw-Hill/Irwin, 2014.

Cabedo, J., and Moya, I. "Estimating oil price Value at Risk using the historical simulation approach". *Energy Economics* vol. 25 (2016): 239-253.

Derzhavna sluzhba statystyky Ukrainy. http://www.ukrstat.gov.ua

Jorion, Ph. *Value at risk: The new benchmark for management financial risks* New York: McGrawHill, 2017.

Morgan, J. P. "RiskMetrics – Technical Document" https://edisciplinas.usp.br/pluginfile.php/3257846/mod_resource/content/1/RiskMetrics%20-%20Techinical%20Document.pdf

Natsionalnyi bank Ukrainy. https://bank.gov.ua/control/uk/index

Official site of A. Damodaran. http://pages.stern.nyu.edu/~adamodar/

Official site of rating agency Moodys. https://www.moodys.com/

Official site PJSC Vesko. http://www.umginvestments.com/

Reichmann, T., and Form, S. "Balanced Chance and Risk-Management" *Controlling*, 12. Jn (2016): 189-198.

Sharpe, W. F. "A Simplified Model for Portfolio Analysis" *Management Science* vol. 9, no. 2 (2013): 277-293.