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Diagnostics of systemic risk impact on the enterprise capacity for financial risk neutralization: the case of Ukrainian metallurgical enterprises

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Keywords: *enterprise financial risk; systemic risk; financial risk neutralization; enterprise insolvency*

Abstract

Research background: A significant share of Ukrainian enterprises in modern conditions is accompanied by unprofitability of their activity. On the back of Ukrainian enterprises unprofita-

bility, there is a problem of methodical provision of financial risk management, which lies in the fact that a major part of scientistific works in this area focus on the study of internal factors and indicators of financial risk. At the same time, the system risk is levelled out.
Purpose of the article: The aim of the study is the improvement of enterprises' financial risk management tools based on the assessment of the company's ability to neutralize financial risk taking into account systemic risk effects.
Methods: The methodological apparatus includes: The "weight center" method; expert appraisal method; multidimensional factor analysis method; neural network apparatus.
Findings & Value added: As a result of the study, an approach to assessing the impact of system risk on the ability of an enterprise to neutralize financial risk is developed. The expert evaluation method is based on an integrated model that allows for estimation of the ability of metallurgical enterprises to neutralize financial risks. The system risk factors, namely the factor of commodity markets state, the political and demographic, fiscal, monetary factors as well as the factor of the external balance financial estimates, were determined. By constructing a neural network, elasticity of enterprises' ability to neutralize financial risk in relation to systemic risk factors was calculated. The proposed approach allows for conducting preventive financial risk diagnostics on the basis of assessing the current financial status and the ability to neutralize financial risk in an open economic system — taking into account the system risk impact.

Introduction

Destructive economic and geopolitical changes in Ukraine have had a negative influence on the financial position of enterprises. According to the official data for January-September 2018, the share of unprofitable enterprises is 29.8% of the total number of functioning ones, compared with the value of this indicator being 27.6% in 2017, 27% in 2016, 26.7% in 2015. This is explained by the negative growth dynamics in the share of unprofitable enterprises during 2015–2018 as well as the ongoing decline in their number (15.89% of large-sized and 5.43% of medium-sized enterprises in 2018).

The high level of enterprises financial risk results from both the negative influence of external factors (system risk) and inefficient risk management system, in particular, inaccuracy of diagnostics, insufficient relevance of international and national standards, low level of scientific and practical achievements implementation in the activity of enterprises.

The common inneffectivness of risk management in Ukraininan enterprises lies in the fact that it focuses on internal factors and indicators of financial risk (Malichová & Ďurišová, 2015; Florio & Leoni, 2017; Fraser & Simkins, 2016), while external factors remain understudied, although their impact on the enterprises financial status is more than 10% (Pustovhar, 2014b). In this view, the aim of the research is to improve the financial risk management tools for enterprises based on the assessment of the company's ability to neutralize financial risk, taking into account systemic risk effects.

The methodological basis for the research was formed by the following methods: the "weight center" method, the use of which is to determine financial indicators of the enterprise financial risk; expert evaluation method — for the purpose of determining the relative importance of financial indicators in order to build the financial risk neutralization model; the method of multidimensional factor analysis — in order to study the system risk associated with macroeconomic instability and the instability of real and financial markets; the neural network apparatus — to simulate system risk impact on the enterprise financial status and to distinguish the capacity for internal financial risk neutralization.

The research findings comprise a developed approach to estimate the system risk impact on the ability of an enterprise to neutralize financial risks. The proposed approach enables to conduct preventive financial risk diagnostics on the basis of the current financial status evaluation and the ability of metallurgical enterprises in Ukraine to neutralize financial risks, taking into account the system risk impact.

Literature review

The major part of scientific research in the field of financial risk diagnosis at the enterprise is focused on the study of internal factors and internal indicators (Malichová & Ďurišová, 2015; Florio & Leoni, 2017; Fraser & Simkins, 2016; Hosaka, 2019; Antunes *et al*., 2017; Kliestik *et al*., 2018b).

The methodology of investigating internal financial risk indicators for enterprises is the coefficient method (Hosaka, 2019; Antunes *et al*., 2017; Kliestik *et al*., 2015; Berent *et al*., 2017; Kovacova & Kliestik, 2017), the essence of which is to conduct enterprise financial analysis. The coefficient methods provide a comprehensive analysis of the financial status. The disadvantages of the investigated diagnostics methods include high complexity, insufficient argumentation of financial factor standards, non-consideration of sectoral orientation, ambiguous interpretation of results, resulting in reduction in the accuracy of the diagnosis, which limits the application of this method in the enterprise risk management system.

Among the economic and mathematical methods, the most common are the models which are built using discriminant analysis (Azayite & Achchab, 2016; Kočišová & Mišanková, 2014) based on the comprehensive analysis of financial ratios with regard to the probability theory and the integral indicator determination, which form the basis for the enterprise bankruptcy risk estimation. The most commonly used discriminant models of enterprise bankruptcy diagnostics are the two-factor model for assessing

the probability of bankruptcy, E. Altman Z-score (Altman & Hotchkiss, 2006), R. Tuffler and G. Tischau model (Toffler & Tishaw, 1977), G. Springeyeta model (Springate, 1978), J. Fulmer model (Fulmer, 1984), and O. Tereshchenko model (Tereschenko & Stetsko, 2017). The advantages of the discriminatory analysis are unambiguous interpretation and high accuracy of the enterprise bankruptcy risk assessment results, taking into account the sectoral orientation and timeliness in domestic models. Despite this, the disadvantages of domestic discriminant models include the conflict between the results of different techniques, low forecast accuracy, the use of static indicators with no account taken of their dynamic characteristics.

The diagnostics methodologies based on the system risk analysis in the risk management system encompass the Through The Cycle Assessment (TTC) (Hamilton *et al*., 2011), which is used by the Basel Committee on Banking Supervision; Wilson's Model (Wilson, 1997); models by Hoggart, Sorensen and Zicchino, Alves, Troutler and Weiner (Chan-Lau, 2006), tested by the World Bank and the IMF to assess the financial sector stability. The advantages of methods include the possibility of obtaining a short-term and long-term assessment of bankruptcy risks, taking into account economic development cyclicity, availability of analytical information, and resilience to different economic conditions, in contrast to the current bankruptcy risk assessment, which becomes different along with the change in the state of the economy. At the same time, the disadvantages of the methodology are the impossibility to determine bankruptcy risks for each enterprise, as the analysis is carried out at the economic segments' level.

The fundamental difference between the proposed approach to the enterprise financial risk diagnostics lies in the fact that, based on the combination of internal environment monitoring and the account taken of the external influence, it enables to ensure high accuracy of the results of both current and prospective state diagnostics.

Research methodology

The development of an approach to evaluate the system risk impact on the enterprise ability to neutralize financial risk is proposed to be carried out using the following algorithm:

1. definition of representative indicators of the enterprise financial risk;
2. construction of a model for enterprise financial risk neutralization;
3. system risk factors identification and quantificative evaluation;
4. modeling the system risk impact on the enterprise financial status and definition of the capacity for internal financial risk neutralization.

The necessity to determine the representative indicators of enterprise financial risk is explained by the fact that the financial risk being a specific feature of the financial state is described by a large number of indicators, the calculation algorithm and normative values determination for which differ in literary sources (Malichová & Ďurišová, 2015; Florio & Leoni, 2017; Fraser & Simkins, 2016; Hosaka, 2019; Antunes *et al*., 2017; Altman & Hotchkiss, 2006; Toffler & Tishaw, 1977; Springate, 1978; Kliestik *et al*., 2018a). In this regard, financial risk assessment based on all financial indicators is not feasible. Moreover, the use of a significant number of indicators leads to multicollinearity of models based on it, which reduces the adequacy of the results. The method of "weight center" based on the calculation of Euclidean distances (Formula 1) between the values of financial indicators was used to determine the representative indicators of the enterprise financial risk. Selection of representative indicators is based on the principle of minimizing the Euclidean distance in the middle of the groups and its maximization between the groups (Klebanova *et al.*, 2006).

$$d_{ij} = \sqrt{\sum_{k=1}^{m}(x_{ik} - x_{jk})^2} \tag{1}$$

where:
d_{ij} – the distance between indices *i* and *j*,
x_{ik} – value of indicator *i* for object *k*,
x_{jk} – value of indicator *j* for object *k*,
m – the number of objects.

In order to build the enterprise's financial risk neutralization model, expert method was used to determine weighted values of indicators. The advantages of the expert method, which predetermined its use, are the simplicity of survey techniques, consideration and use of the knowledge and experience acquired by each expert. The necessity to apply the expert method for building the enterprise financial risk neutralization model is also stipulated by the fact that this method enables to determine the relative importance of the indicators provided that the resultant value is absent.

The experts in the study were 10 employees of the planning and economic, as well as financial departments of the following metallurgical enterprises of Ukraine: PJSC "Dniprospetsstal", PJSC "Mariupol Metallurgical Combine named by Ilyich", PJSC "Zaporizhstal", PJSC "Kremenchug Plant of Metal Products", PJSC "Metal and Steel Plant", PJSC "Kyivmetalloprom", PJSC "Metalloprom", PJSC "Plant" Metallopribor", PJSC "Dneprovsky Metallurgical Combine named by F. E. Dzerzhinsky", PJSC "Evraz-Dnipropetrovsk Metallurgical Plant named by Petrovsky". The sample

of enterprises is formed in such a way as to include representative enterprises with a stable financial position, profitable and unprofitable enterprises with the risk of bankruptcy, which is diagnosed by the results of express analysis. The use of businesses with different financial position allows to take into account all levels of financial indicators, therefore expanding the range of data. The experts were asked to rank the financial indicators by the degree of their significance in the financial risk diagnosis (rank 1 corresponds to the most significant indicator, 6 — the least significant). Weighting coefficients of the financial risk representative indicators are determined by the Fishburne principle (Sitnik, 2017):

$$\alpha_i = \frac{2(n-i+1)}{n(n+1)} \tag{2}$$

where:
n – number of representative indicators,
i – rating position of the indicator.

The Fishburne rule reflects the fact that nothing is known about the significance value of the indicators except their hierarchy.

The quality of expert evaluation is determined by:

1. the competence of experts, which, in this study, is confirmed by the professional orientation of experts: all experts are employees of specialised departments engaged in financial analysis at the enterprise and the financial risk level assessment at the leading metallurgical enterprises of Ukraine;
2. the agreement dimension of expert opinions, which is estimated by the concordance indicator, calculated according to the formula (Rousseau *et al.*, 2018):

$$W = \frac{12S}{m^2(n^3-n)} \tag{3}$$

where:
m – the number of experts,
n – number of representative indicators of financial risk,
S – rank diferentials quadric sum (deviations from the average).

The ability of enterprises to neutralize financial risk is determined by the availability of own financial resources, liquidity, profitability and economic and financial resources performance. Thus, it was proposed to present the enterprise financial risk neutralization model in the form of an integral estimation model, formed on the basis of financial indicators additive convolution, grounded on financial risks representive indicators, ad-

justed by their weight coefficients, determined by the expert method according to formula 2. The enterprise financial risk neutralization model takes the following form:

$$I = a_1 * X_1 + a_2 * X_2 + \ldots + a_n * X_n \tag{4}$$

where:
I – integral assessment of the enterprise financial risk neutralization level,
$a_1, a_2, \ldots, a_n$ – weight coefficient of the financial risk representative indicator significance,
X_n – value of the indicator representing the enterprise financial risk,
n – number of indicators representing the enterprise financial risk.

The findings of the integral assessment can be interpreted in the following way: if the model is formed by the stimulator indicators (their growth positively characterizes the ability to neutralize), then the higher the value of the integral indicator, the higher the ability of the enterprise to neutralize the financial risk. If the model is formed at the expense of distimulator indicators (their growth negatively characterizes the ability to neutralize), then the higher the value of the integral indicator, the lower the ability of the enterprise to neutralize. If the model includes stimulator indicators and distimulator indicators, then all indicators need to be brought to the similar nature of their impact on the level of financial risk by adjusting the signs before the indicators.

The assessment of the system risk impact on the company neutralization capacity is based on the method of multidimensional factor analysis and neural networks.

The use of factor analysis is justified by the fact that a large array of indicators describing system risks requires reduction due to the large dimension. The advantages of factor analysis lie in the fact that it allows to reduce the attribute space dimension and avoid multicollinearity without any loss of informativity. In accordance with the factor analysis method, the composition of the factors is determined by the factor load values for the indicators with the corresponding factor, based on the factor model (Menke, 2018):

$$x_i' = l_1 * F_1 + l_2 * F_2 + \ldots + l_i * F_i + dv \tag{5}$$

where:
x_i' – the normalized value of the indicator,
l_i – factor load,

F_i –factor value,
dv –model residuals.

The calculation of factor loads is based on the hypothesis of the normal law of distribution of x_i, the absence of a correlation between factors F, the normal law of distribution of residuals dv. The optimality criterion in this case is the minimization of deviations in the covariance matrix, obtained by factor loads estimation, based on the covariance matrix of original features (Menke, 2018).

In order to determine the optimal number of factors for system risk description, the Kaiser criterion is used, according to which factors whose own values exceed 1.0 are considered relevant to the analysis (Menke, 2018). Formation of the factors is based on factor loads. The factor is generated by the indicators for which the factor load (correlation coefficient) with the corresponding factor is considered significant, i.e. greater than 0,7 (Menke, 2018).

The model of the system risk impact on the enterprise financial state is constructed using the method of neural networks. The principle of the neural network is as follows: the neuron receives an incoming signal that passes through a connection (synapse) that has intensity. The current state of the neuron is determined by the post-synaptic potential function, which is calculated as a weighted sum of inputs with account taken of the threshold values. For a neural network of a multi-layer perceptron, the post-synaptic function (PSP) has the formula (Hosaka, 2019):

$$net_j = w_0 + \sum_{i=1}^{N} x_i w_{ij} \tag{6}$$

where:
net_j – post-synaptic function,
w_0 – threshold value of the function,
x_i – input signal of neuron *i*,
w_{ij} – weight of synaptic connection between neurons *i* and *j*,
$i, j = 1,2, \dots, N$.

The resulting value of the PSP function is converted using the activation function to the output signal (Hosaka, 2019):

$$y_j = f\left(net_j\right) \tag{7}$$

where:
y_j – the output signal,
$f(net_j)$ – activation function.

In neural networks, depending on the nature of the interaction between neurons, linear, logistic, hyperbolic, exponential, sinusoidal and step functions are used. The possibility of combining various patterns of interaction of its elements in one neural network provides the highest accuracy of the modeling results, compared with other model classes.

In constructing the model of system risk impact on the enterprise financial status and the ability to neutralize, the quarterly values of 5 selected factors (F) describing the system risk were used as the input variables, while the quarterly values of the integral indicator for the enterprise ability to neutralize the financial risk (I) for 2001–2017 were used as output variables.

Research findings

Metallurgical enterprises are the main destructive factor of the functioning of the Ukrainian economy. In 2011–2012, compared with the profitability of industrial enterprises, the activity of enterprises of the metallurgical industry in Ukraine was unprofitable; in 2013, the losses of metallurgical enterprises exceeded by 2.8 times the losses of industrial enterprises. The largest amount of losses was incurred in 2014–2015 as a result of the unstable political and economic situation in the Donetsk region, which specializes in metallurgical production. In 2015, the share of losses of metallurgical enterprises amounted to 23.56% of net losses of industrial enterprises, in 2016 — 33.73%. In 2017, the situation of 2011–2012 repeated, when, at a positive value of the industry financial performance of UAH 56124.0 million, losses of metallurgical enterprises amounted to UAH 9803.2 million (State Statistics Service of Ukraine, 2019).

In order to estimate the financial risk of metallurgical enterprises, the financial status indicators (Florio & Leoni, 2017; Tereschenko & Stetsko, 2017) are taken into account and classified according to the main types of financial risks (see Figure 1). Figure 1 presents the key types of financial risks (risk of business solvency reduction, risk of insolvency, risk of ineffective investment activity), subtypes in case of availability (for group risk of business solvency reduction — risk of irrational capital structure, risk of ineffective financial activity; risk of insolvency — risk of liquidity reduction, risk of ineffective operation activity, risk of cashflow imbalance) (Florio & Leoni,

2017; Fraser & Simkins, 2016) and indicators that describe the corrresponding type / subtype of financial risk. The list of indicators is formed on the basis of theoretical analysis of literary (Antunes *et al.*, 2017; Florio & Leoni, 2017; Ismihan & Ozkan, 2012; Tereschenko & Stetsko, 2017).

The statistical basis for distinguishing the representative indicators of the company ability to neutralize financial risk was formed by the financial indicators for Ukrainian metallurgical enterprises in the period 2001–2017 given in Figure 1. The last year was year 2017, which is explained by the absence of official data obtained from the enterprises annual financial statements for 2018.

One representative sample was chosen from each group of indicators (see Figure 1) on the basis the "weight center" method. This indicator in the group of "risk of irrational capital structure" is the autonomy ratio (X_1), which has the smallest amount of Euclidean distances to the other objects in the group. A representative of the risk group of inefficient financial activity is the capital turnover ratio (X_2). The representative responsible for the liquidity risk is the absolute liquidity ratio (X_3). The risk group of inefficient operating activities represents the return on sales ratio (X_4). In the groups of "cashflow imbalance risk" and "risk of ineffective investment activity", the representative indicators are the cashflow adequacy ratio (X_5) and total return on investment (X_6),respectively. The results of the weight ratio definition for Formula 2 are presented in Table 1.

The resulting weigh ratio is calculated as the arithmetic average, determined by each of the experts. The reliability of the results is confirmed by the competence of the experts and the value of the concordation coefficient, which is 0.86 at a sufficient level of 0.7.

The integral model of enterprise financial risk neutralization with regard to certain weight ratios takes the following form:

$$I = 0.28 * X_1 + 0.18 * X_2 + 0.25 * X_3 + 0.15 * X_4 + 0.09 * X_5 + 0.05 * X_6 \quad (8)$$

where:
X_1 – the value of the autonomy ratio,
X_2 – value of the capital turnover ratio,
X_3 – the value of the absolute liquidity ratio,
X_4 – the value of the return on sales ratio,
X_5 – the value of cashflow adequacy ratio,
X_6 – the value of total return on investment ratio.

The integral model (Formula 8) is grounded on financial indicators, whose values are interpreted with regard to the enterprise financial risk level as follows: the higher the values of indicators *X1-X6*, the lower the

level of financial risk, the higher the level of financial stability (indicator *X1*), profitability (*X2*), liquidity (*X3, X5*), efficiency (*X4, X6*), and, consequently, the bigger financial risk neutralization capacity.

An enterprise is an open system, therefore, when assessing the financial risk level and the enterprise neutralization capacity, it is necessary to take into account the system risk impact — the factor of the environment.

In determining the composition of factors, the factor load values and the factor values (Formula 5) were calculated in Statistica program, based on quarterly figures of the general economic, market, political and legal, as well as demographic indicators of the state for 2001–2017. The choice of these indicators is justified by the fact that they are the resultant external factors, which reflect the impact of other indicators that form the system risk and create the threat of insolvency to metallurgical enterprises (Pustovhar, 2014a). The factor analysis was conducted on the basis of quarterly indicator values to ensure sample sufficiency.

The input matrix has formed relative indicators that characterize the state of the selected dominant factors of the environment (economic, market, political and legal as well as demographic). Application of relative indicators, in contrast to absolute indicators, enables to estimate the impact of external factors on the enterprise capacity to neutralize financial risk in statics and dynamics.

GDP is the main economic indicator that characterizes the state of the economy. Therefore, the index that best describes the economic situation of the country and reflects its impact on the company financial risk neutralization capacity is the GDP index.

Investments, being an indicator of the state of the economy, play, on the one hand, an important role in the socio-economic development of the country, and, on the other hand, form prerequisites for economic growth. In order to analyze investment attractiveness, indicators of net inflow of foreign direct investments of GDP (%), net portfolio investment of GDP (%) and capital investments growth were selected.

The real income index, which directly affects gross output sales volumes and the industry output, determines the purchasing power of the population. Indicators of the index of producer prices for industrial products and the consumer price index, which reflect the inflation processes in the economy, are indirectly connected with the indicators of purchasing power.

Due to the fact that the largest amount of net losses in the Ukrainian economy are made by industrial enterprises, in patrticular metallurgical, it is worth analyzing the indicators of the state and development of this industry, namely: the industrial products index and the metallurgical products index (Pustovhar, 2014a). The economy of Ukraine is integrated into the

global economy, therefore, in the process of studying the factors of external influence on the financial status of metallurgical enterprises, external activity indicators should also be taken into account being the indicators of metal export and import growth.

In addition to commodity markets, the financial situation of enterprises is influenced by the currency and the stock market, as well as the banking sector. The main indicator of the domestic stock market development is the PFTS index and the indicator of its dynamics — the level of change in the PFTS index. The national currency devaluation index reflects a change in the national currency exchange rate against the dollar and its purchasing power. The level of the National Bank of Ukraine's discount rate is the main instrument of the NBU monetary policy, which regulates the business activity of economic entities.

The state budget reflects the consolidated budget balance, which characterizes the balance of budgets and demonstrates the level of state budgetary security as the percentage of GDP. Debt indicator is closely connected with the consolidated budget balance — being a source of the budget deficit financing, therefore, the domestic and foreign debt ratio indicators with regard to GDP, namely the indicators of debt security of the country were selected for the analysis of the external environment of the enterprise activity (Ismihan & Ozkan, 2012).

An important factor of the external environment is the demographic factor, which, on the one hand, forms demand for goods and services, and, on the other hand, it forms supply through the economically active population. Demographic factor state indicators, which are used in the analysis, are the natural and migratory population growth ratios (Tyrowicz & van der Velde, 2018).

Another group encompasses political and legal indicators: the level of democracy, the level of political stability, the rule of law, the anticorruption efforts. These indicators characterize freedom of expression, freedom the citizens' will, freedom of the media, political stability, the absence of violence and terrorism, the state of corruption in the country (The World Bank Group, 2019).

The economy of Ukraine is open and significantly depends on the international factors. However, the indicators under study are not international, and their influence is reflected in the internal state of the country — the dynamics of the domestic economic indicators under scrutiny.

Factor loads of system risk indicators obtained as a result of the initials return by means of the Biquartimax method in Statistica software, are presented in Table 2.

System risk indicators analysis enabled to distinguish 5 most significant factors, as shown in Table 2.

The adequacy of the factor analysis results is confirmed by:

1. sample sufficiency: in accordance with the requirements for conducting factor analysis, the number of observations should exceed the number of indicators by 2n + 1 times. With the number of indicators being 23, the number of observations in the study is 68;
2. the percentage of the total dispersion of 85.5% at a sufficient level of 80%;
3. integration of all indicators in factors and absence of one-indicator factors;
4. the results of the internal consistency test (Cronbach's alpha coefficient). Values of the total Cronbach's alpha coefficient (0.88, exceeding 0.7), calculated in Statistica 12.0, indicate the consistency of indicators that describe the financial risk of the enterprise.

According to the conducted analasis, it has been found out that there are 5 factors which have the most significant impact on the metallurgical enterprises financial status and their neutralization capacity (see Table 2), namely the commodity market factor, political and demographic, fiscal and monetary factors, as well as the financial account of payments balance. The percentage of variance for these factors, which correspond to the strength of impact on the company financial risk neutralization capacity, are given in Table 2.

In addition to the direct application of the factor analysis method, which lies in data reduction, in this research it was used to obtain factor values — integral values that were calculated in Statistica software, with account taken of the normalized indicator values and their weight ratios. The calculated factor values that characterize system risk are used to build a model of system risk impact on the enterprise financial risk neutralization capacity. The architecture of the constructed neural network is presented in Figure 2.

The constructed neural network is represented by a multilayered perceptron with 2 layers of hidden neurons. The indicators, which demonstrate the statistical value of the model include educational, test and control errors whose values do not exceed 0.0004 at an acceptable level of 0.05. The error rates can assert the significance of the obtained simulation results with a probability of 95%.

The constructed model of system risk impact on metallurgical company financial risk neutralization capacity enabled to assess the elasticity of enterprise financial risk neutralization capacity in relation to system risk factors. Elasticity as a factor in the state of commodity markets amounted to +4.1. This means that with an increase in the value of the relevant factor by

1%, the integrated assessment of financial risk neutralization capacity will increase by 4.1%. An increase of 3.4% in a metallurgical enterprise's financial risk neutralization capacity leads to an increase in the importance of the political and demographic factor, 3.2% — for the fiscal factor, 2.1% — for the factor of financial payments balance. The destabilizing effect on the company financial risk neutralization capacity is made by the monetary factor increase — the elasticity of the integral indicator for this factor is — 2.9%.

Discussions

The results of the research of improving the methodological procedure of assessing the level enterprises financial risk are aligned with the studies of the authors Malichová and Ďurišová (2015), Fraser and Simkins (2016), Antunes *et al.* (2017), Florio and Leoni (2017) Tereschenko and Stetsko (2017), who propose the lists of indicators for assessing financial risk. However, unlike this sources, the list of financial risk indicators has been updated by adjusting for the economic conditions at the meso and macro levels. The approach in the research of assessing financial risk is distinctive. Thus, in the research (Florio & Leoni, 2017; Fraser & Simkins, 2016), indicators of financial condition are considered as indicators of financial risk or probability of bankruptcy; presented research are offered indicators of neutralizing financial risk, taking into account their stimulating effect on financial stability, liquidity, profitability of business activity.

Compared to the most common methods of estimation of financial risk and the threat of bankruptcy (discriminatory analysis methods described by authors Altman and Hotchkiss (2006), Toffler and Tishaw (1977), Springate (1978), Fulmer (1984), Azayite and Achchab (2016), Kočišová and Mišanková (2014) logit-, pro-regression (Kliestik *et al*., 2015; Kovacova & Kliestik, 2017) the model developed in the research to assess the ability of the enterprise to financial risk neutralization is more flexible, since it is based on a retrospective analysis of financial indicators of enterprises taking into account the subjective factor — expert opinions.

The approach to assessing systemic risk presented in the research is conceptually different from studies (Hamilton *et al*., 2011; Wilson, 1997; Chan-Lau, 2006), which estimate systemic risk from the perspective of time series: determining the threatening dynamics of growth of destructive economic factors and reducing the complementary effect of stimulating factors of economic development. The influence of systemic risk is identified separately from the business entity. The approach of systemic risk

assessment presented in the research makes it possible to estimate the the factors, which characterize systemic risk, and to determine the ability of enterprise to neutralize them.

Thus, as opposed to the existing methodic instruments of estimation of enterprises financial risk, the research has proposed an approach to assess the ability of an enterprise to neutralize financial risk based on taking into account the financial condition of the enterprise and the impact of systemic risk. Systemic risk reflects the state of commodity markets, political, demographic, fiscal, and monetary factors, balance of financial payments, therefore characterizing the risk of influence of external factors at the meso and macro levels. Suggested approach is more complex than existing economic and mathematical models of diagnostics pf financial position (discriminatory, logit- and probit-regression models), coefficient approach which are based on indicators of the financial state of enterprises on the one part, and models of systemic risk assessment the other. In addition, the approach proposed in the article takes into account the objective patterns of financial phenomena in the quantitative assessment of financial and systemic risks and the opinion of experts which are competent in the subject area of research, which add to the research objectivity and adaptability.

Conclusions

As a result of the study, the approach to assessing of the system risk impact on enterprise financial risk neutralization capacity was developed by means of enterprise financial risk neutralization model buildup and its system risk impact modeling.

An integrated model that enables to estimate the financial risk neutralization capacity of a metallurgical enterprise was elaborated on the basis of expert evaluation method. The system risk factors, the composition of which formed the commodity markets factor, political and demographic, fiscal, monetary factors as well as the factor of financial payments balance, was determined. By constructing a neural network, elasticity of enterprise financial payments balance in relation to system risk factors was calculated.

It is determined that the factor of the commodity markets, political-demographic, fiscal factor and the factor of financial calculations of the balance of payments have the positive influence of enterprises capacity for financial risk neutralizatione; monetary factor has a negative impact.

Litmiations of the current research should be also pointed out. They relate to the fact that the presented model does not take into account the balance of payment, which makes the research more static. The assessment of

systemic risk is limited to the assessment of the state of national economic conditions.

The proposed approach enables to conduct preventive diagnostics of financial risk on the basis of the current financial status and the enterprise financial risk neutralization capacity evaluation in an open economic system, taking into account system risk impact. The prospects for further research in this area are the study of insolvency problems and financial risk diagnosis for transnational corporations taking into account international flows of financial resources, the state of international financial markets, volatility of exchange rates, and prices in international markets. Further research will focus on the development of a dynamic component model of neutralizing the enterprise financial risk, including the factor of financial flows balance at the micro and macro levels.

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Annex

Table 1. Value of weight ratios of financial risk indicators for metallurgical enterprises

Experts	Indicator					
	(X_1)	(X_2)	(X_3)	(X_4)	(X_5)	(X_6)
Expert 1	0.29	0.19	0.24	0.14	0.10	0.05
Expert 2	0.24	0.14	0.29	0.19	0.10	0.05
Expert 3	0.29	0.19	0.24	0.14	0.10	0.05
Expert 4	0.29	0.19	0.24	0.14	0.10	0.05
Expert 5	0.29	0.19	0.24	0.14	0.10	0.05
Expert 6	0.29	0.19	0.24	0.14	0.10	0.05
Expert 7	0.29	0.14	0.24	0.19	0.05	0.10
Expert 8	0.24	0.19	0.29	0.14	0.10	0.05
Expert 9	0.29	0.19	0.24	0.14	0.10	0.05
Expert 10	0.29	0.19	0.24	0.14	0.10	0.05
The resulting weighting factor	0.28	0.18	0.25	0.15	0.09	0.05

Table 2. Significant factor loads of system risk indicators

Indicator	Factor loads value	Factor dispersion, %
Factor 1		
GDP index, %	0.96	29.28
Industrial product index, %	0.91	
Metallurgical production index, %	0.89	
Capital investments index, %	0.98	
Metal exports index, %	0.84	
Metal import index, %	0.89	
Factor 2		
Real income index of population, %	0.87	27.47
Natural population increase rate	-0.74	
Net migration rate through external migration	-0.80	
The level of democracy	0.75	
The level of political stability	0.77	
Rule of law index	0.71	
Level of anticorruption efforts	0.76	
Factor 3		
Consolidated budget balance to GDP, %	0.94	14.64
Domestic debt ratio to GDP, %	-0.81	
External debt ratio to GDP, %	-0.76	
PFTS index growth level, %	0.70	
Factor 4		
Industrial producer price index, %	-0.76	10.47
Consumer price index, %	-0.91	
National Bank of Ukraine account rate, %	-0.73	
National currency devaluation index, %	-0.75	
Factor 5		
The ratio of net inflow of foreign direct investment to GDP, %	0.76	3.64
Portfolio investment ratio to GDP, %	0.79	

Figure 1. System of enterprise financial risk assessment indicators

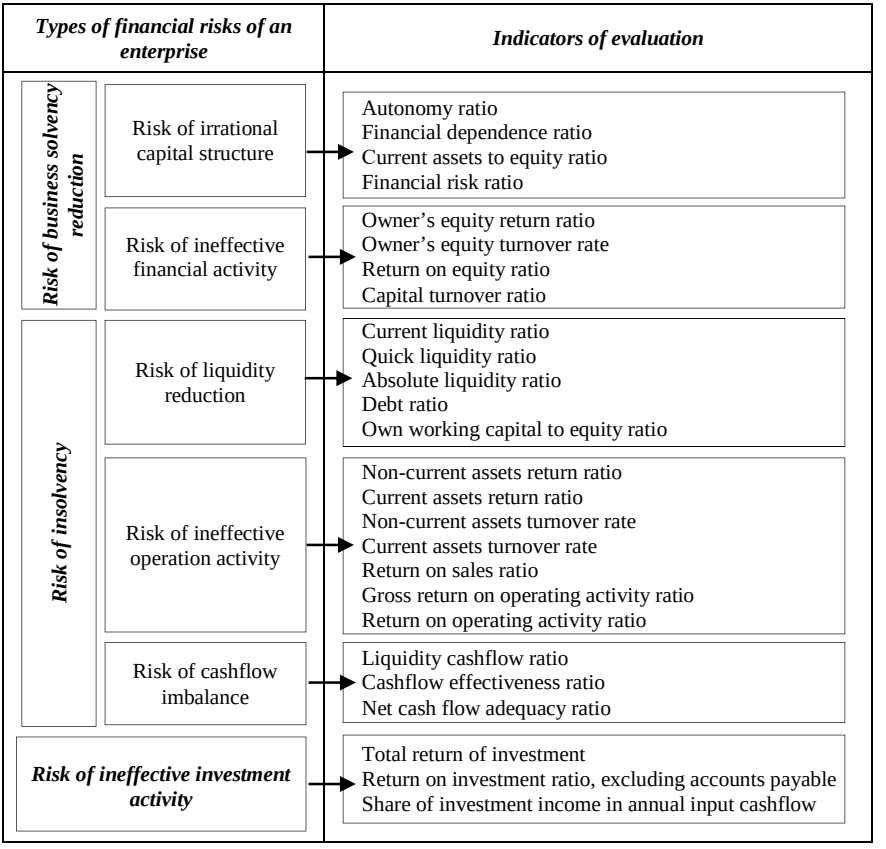

Figure 2. Neural Network Architecture for System Risk Impact on Metallurgical Enterprise Financial Risk Neutralization Capacity