

Assessing the financial security of the engineering enterprises as preconditions of application of anti-crisis management: practical aspect

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Abstract: Today, engineering enterprises in Ukraine are experiencing poor development. The crisis development of many domestic engineering enterprises is reinforced by both internal and external factors, so it is critical to develop new methodologies to comprehensively estimate their level of financial security, thus serving as the information basis for the application of anti-crisis management. The objective of the study is to develop a model to assess the financial security of engineering enterprises. The subjects of the study are the activities of the top ten engineering enterprises in Ukraine for the period 2013-2017. The purpose of our research is to form a methodical approach to assess the financial security of engineering enterprises, which would become the basis for applying a certain type of anti-crisis management and encouragement in domestic engineering enterprises. The results of the study made it possible to form and implement a model to assess financial security, which will help to establish the need to apply anti-crisis management in an enterprise.

JEL Classifications: D21, D81, L62, G32

Keywords: Financial security, engineering enterprises, anti-crisis management, assessing the financial security of the enterprise

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1. Introduction

Today, engineering enterprises in Ukraine are experiencing poor development. There is a decrease in the number of active innovative enterprises, whilst the number of unprofitable enterprises in this industry is growing and the level of profitability and the volume of export operations is decreasing. The crisis development of many domestic engineering enterprises is reinforced by both internal and external factors, namely: the protectionist measures of the importing countries, in particular the Russian Federation, the constant lack of funds to finance their own development, political instability in the country, the growth of inflationary processes and the emigration of specialists. This combination of factors has a negative effect on the financial security of engineering enterprises, and the importance of theoretical developments and the practical application of anti-crisis management. At the same time, anti-crisis management is a large-scale process and requires significant financial resources, which means that it cannot be used continuously. Moreover, it should be noted that despite being able to implement anti-crisis measures at

any time, the top management of domestic enterprises does not always know when to implement it, as in order to develop the financial crisis may have gone unnoticed for some time. To implement the measures, companies must formulate a new methodology to assess financial security for domestic engineering enterprises; this must (1) not be difficult to calculate, (2) take into account the specific features of the sector, (3) be as accessible as possible, (4) cover all the activities of the enterprise and (5) be able to determine when individual anti-crisis measures should be applied.

The existing problems in the activities of Ukrainian engineering enterprises and their crisis development and ineffective financial security management led us to set a goal to form a methodical approach to assess their financial security, which would become the basis for applying a certain type of anti-crisis management.

The article is structured as follows; Section 2 provides a review of the literature. Section 3 presents the model. Section 4 details the data that was applied to the model. Section 5 presents the results of the research, and the results of the data analysis and discussion are given in Section 6. The last section concludes the study.

2. Literature review

The topic of the financial security of enterprises is not deprived of attention from scientists. Goryacheva (2006) investigated the mechanism of companies' financial security management, whereas Kartuzov (2012) carefully approached the study of the conceptual apparatus. Kartuzov (2012) study of enterprise security paid much attention to its foreign counterparts. Lambert (1990) made a significant contribution to the development of this scientific field, proving that there is a direct link between the economic and financial security of the state and the enterprise. Rotfeld (1989) noted that the components of security are acquired or lost depending on both the internal situation of the state and the international environment.

Much attention was also paid to the notion of a "crisis", which, along with financial security, occupies a significant place in our article. Barton (1993) and Greiner (1972) made a significant contribution to the development of the study of enterprise crisis and its impact on the enterprise's main links.

The desire to form an effective methodology for assessing the financial security of engineering enterprises was the goal of a significant number of scientists. Mandzinovska, Shtangret, Kotlyarevskiy, & Melnykov (2016) suggested a four-stage model for assessing financial security; this calculation was based on financial indicators. Subsequently, we believe that four levels of financial security is insufficient. In addition, we believe the use of quality indicators is necessary. Orlova (2008) used forecasting for her model of assessing financial security; she believed that the assessment of financial security should be carried out using only two criteria: competitiveness and financial perseverance. On the other hand, we believe that the assessment of financial security is an extensive process that cannot be effectively evaluated using two criteria alone. Malyk (2015) developed a comprehensive system to estimate enterprises' financial security; the proposed evaluation system includes six components such as budgetary-fiscal, insurance, investment, fund, monetary and credit. Assessing financial security for its main components is subjective, as it is still possible to reach a consensus on how many components there should be. Kuzenko (2017) formed an algorithm to taxonomically analyse and diagnose the financial security situation for subjects of financial relations at the microeconomic level, which

includes five steps, each of which provides for an analysis. However, her model is not transferrable to the activities of domestic engineering enterprises.

In the international practice and scientific literature, methods have long been used to predict the onset of bankruptcy (despite its legal status, bankruptcy remains a phenomenon, precisely for financial reasons) in order to determine when to use anti-crisis management. Such models include two-factor and five-factor Altman (2000) models, Springate (1978) model, Tuffler & Tishhaw (1977) model, and Fulmer model (Fulmer, Moon, Gavin, & Erwin, 1984). All these models are united by the fact that they are simply not adapted to the Ukrainian realities.

Today, Mandzinovska et al. (2016), Ligotenko (2005), and Arefyeva & Proxorova (2011) confirm that a large number of methods for predicting bankruptcy cannot demonstrate accurate results in the current conditions of the Ukrainian economy, while noting that one of the main reasons is the incorrectness of the mechanical transfer of empirical coefficients to domestic practice and their inability to meet Ukrainian inflation rates.

In addition, the scientific literature considers various methods for assessing financial security, thanks to which one can tentatively determine when it is necessary to apply anti-crisis management. Unfortunately, however, they do not always show themselves in practice effectively. The main shortcomings of each method are presented in Table 1.

TABLE 1. BASIC METHODS FOR ASSESSING THE FINANCIAL SECURITY OF THE ENTERPRISE

NO	NAME OF THE METHOD	CHARACTERISTICS OF THE METHOD	DISADVANTAGES OF ITS USE FOR DOMESTIC ENTERPRISES
1	The valuation method	Financial security management through maximizing the value of an enterprise	It is unacceptable to underestimate the level of profit
2	The program-target method	It provides the integration a set of indicators that determine financial security	Through mathematical analysis it is too difficult to apply in practice
3	Indicator method	Provides a preliminary assessing the financial security of the enterprise based on the comparison of the actual performance of the enterprise with the established system of indicators	Does not take into account the specifics of the enterprise
4	Ranking method	Provides an assessing the financial security of the enterprise through the use of rank characteristics	The method is very superficial and suffers from subjectivity in the evaluation
5	Strategically-target method	Provides for an ongoing process of adjusting the company's financial development strategy in accordance with changes in the level of financial security	It requires reflection of the real results of the enterprises activities and the consistency of all financial interests of the participants
6	Resource-functional	Provides an assessing the financial security of the enterprise through an evaluation of the state of use of corporate resources by special criteria	Too broad in application and reduced to the evaluation of enterprise resources
7	Method of the "Golden rule of financing"	It provides calculating the level of financial security of the enterprise by setting the timeframe for mobilized financial resources and so that they were equal to the terms during which invested financial investments.	It is possible to calculate the level of financial security of the enterprise only for a short period

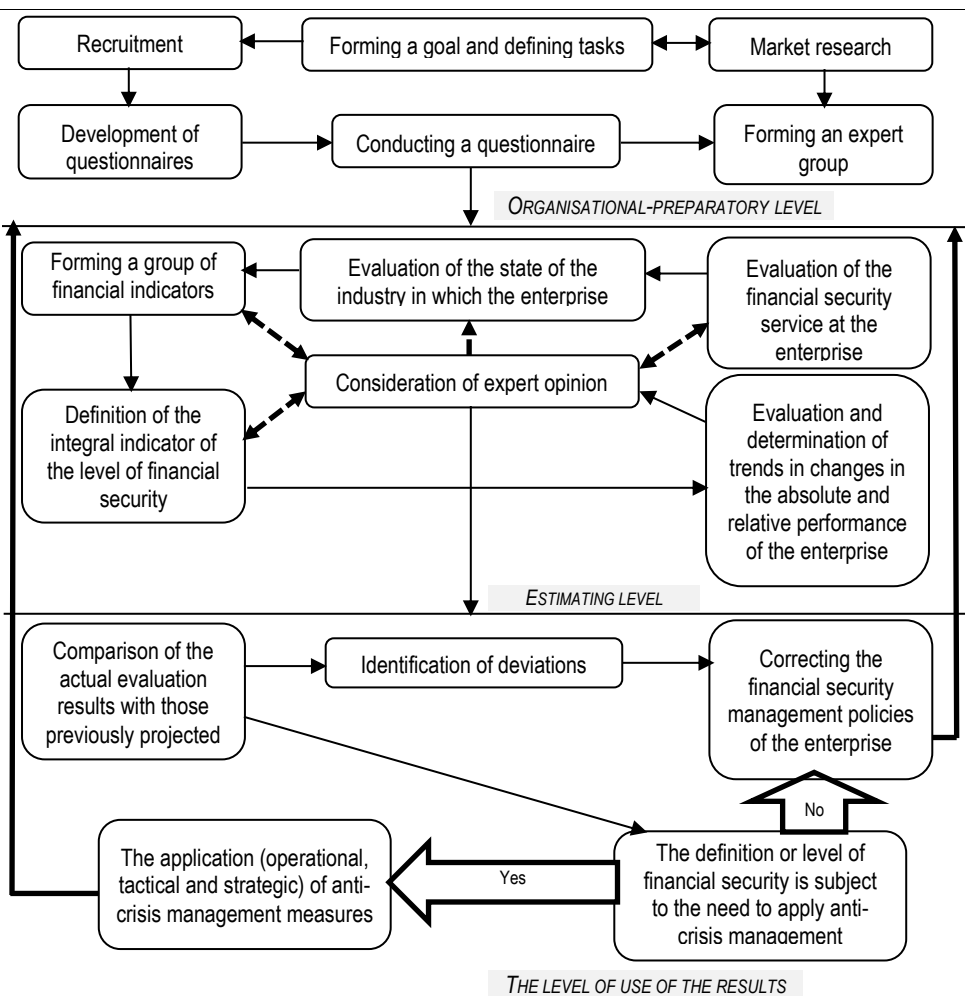
Source: Developed by the authors on the basis of Pojda-Nosyk (2012), Baranovskyj (1999), Shelest (2009), Zabrodskyj (1999), Ilyashenko (2013).

Whilst investigating the scientific literature, we came to the conclusion that the existing approaches to assess the financial security of enterprises, which calculate an integrated indicator, simply do not correspond to the current conditions for the development of engineering enterprises and do not take into account the need for anti-crisis management, in contrast to the model that we have created.

Today, therefore, there is no complete, proven method of assessing financial security, the application of which would provide information about the need to apply anti-crisis management at a domestic engineering enterprise, whilst taking the specificity of their activities into account.

3. Research model

FIGURE 1. SCHEMATIC MAP OF A MULTI-LEVEL ALGORITHM FOR ASSESSING THE FINANCIAL SECURITY AS THE BASIS FOR APPLYING ANTI-CRISIS MANAGEMENT AT THE ENTERPRISE



Source: Formed by the authors.

In our opinion, assessing financial security, and when it is necessary for the enterprise to apply anti-crisis management, should be comprehensive and based on indicators that fully reflect the company's current financial conditions and take into account the specifics of the engineering industry.

In order to better display the algorithm for assessing enterprises' financial security, and indeed when it is necessary to apply anti-crisis management, we will construct a schematic map on which we will distinguish three basic levels: (1) organisational-preparatory, (2) estimating and (3) the level of use of the results (Figure 1). Each level of the algorithm provides for a certain sequence of actions to be applied by top management. For example, if during the determination of the level of financial security it is necessary to apply anti-crisis management, then management should take operational, tactical, or strategic anti-crisis decisions; if the level is high, then it is necessary to apply the action to improve the current financial security management of the enterprise.

Based on the results of the expert evaluation (respondents in the survey indicated that financial indicators were chosen by those who, in their opinion, had the greatest impact on assessing the financial security of the enterprise to the lowest), we determined the specific weight (w) of the financial indicators (I) separately, in addition to the groups to which these indicators refer.

Based on the results of the study, we compiled a model to assess the financial security in which it is necessary to apply anti-crisis management at an engineering enterprise (Figure 2).

First, calculate the integral value for each group of financial indicators using the following formula (1):

$$\sum_{i=1}^3 I_i * w_i \quad (1)$$

Where I_i - the value of the financial indicator that is included in the group, and w_i - weight of the financial indicator that is included in the group.

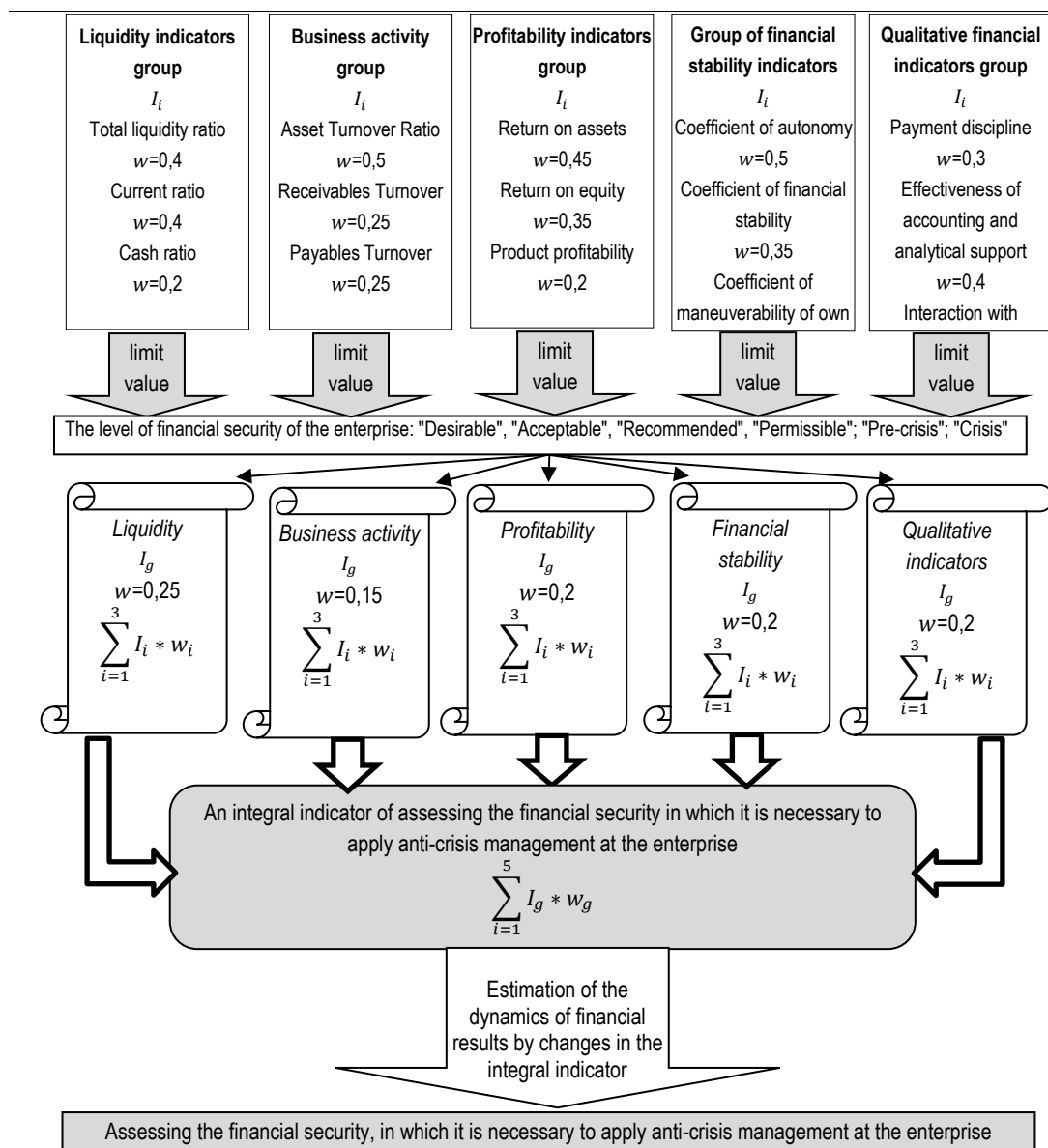
The main formula proposed by us is an integral indicator to assess the financial security in which it is necessary to apply anti-crisis management in an engineering enterprise (2):

$$\sum_{i=1}^5 I_g * w_g \quad (2)$$

Where I_g - the value of a group of financial indicators, and w_g - weight of the main groups of financial indicators.

The integral indicator can reach a value from 0 to 1. After taking into account the opinion of experts in this interval, we formed an opinion of at what values it is necessary to apply anti-crisis management (Table 2).

FIGURE 2. THE MODEL OF ASSESSING THE FINANCIAL SECURITY, IN WHICH IT IS NECESSARY
TO APPLY ANTI-CRISIS MANAGEMENT IN THE ENTERPRISE



Source: Designed by the authors.

According to Table 2, and depending on the value of the integral indicator of the enterprise's financial security level, it is necessary to apply various kinds of anti-crisis management measures, whether strategic, tactical, or operational.

TABLE 2. THE SCALE OF THE INTEGRAL INDICATOR OF ASSESSING THE FINANCIAL SECURITY,
IN WHICH IT IS NECESSARY TO APPLY ANTI-CRISIS MANAGEMENT AT THE ENTERPRISE

No	THE VALUE OF THE INTEGRAL INDICATOR	LEVEL OF FINANCIAL SECURITY	MEASURES TO BE IMPLEMENTED
1	0-0.166	"Crisis"	It is necessary to apply operational anti-crisis measures
2	0.166-0.333	"Pre-crisis"	It is necessary to apply tactical anti-crisis measures
3	0.333-0.5	"Permissible"	It is necessary to apply strategic anti-crisis measures
4	0.5-0.667	"Recommended"	Monitoring compliance with the appropriate level of financial security
5	0.667-0.833	"Acceptable"	
6	0.833-1	"Desirable"	

Source: Designed by the authors.

Note: The value of the integral indicator can range from 0 to 1, and was divided between the established levels of financial security.

4. Data

To calculate the integral indicator, it is necessary to compose a group of indicators that fully reflect the financial condition of the enterprise and determine its current level of financial security: "Desirable", "Acceptable", "Recommended", "Permissible"; "Pre-crisis"; and "Crisis". The established levels of financial security will facilitate the understanding of enterprise executives when there is a need for anti-crisis management.

In order to set out the main indicators - the threshold at which there is a threat of a financial crisis in an engineering enterprise and when there is a need for the use of anti-crisis management - an automated trial was conducted that included the involvement of experts working in this field, each of whom were leading specialists in enterprises' financial security.

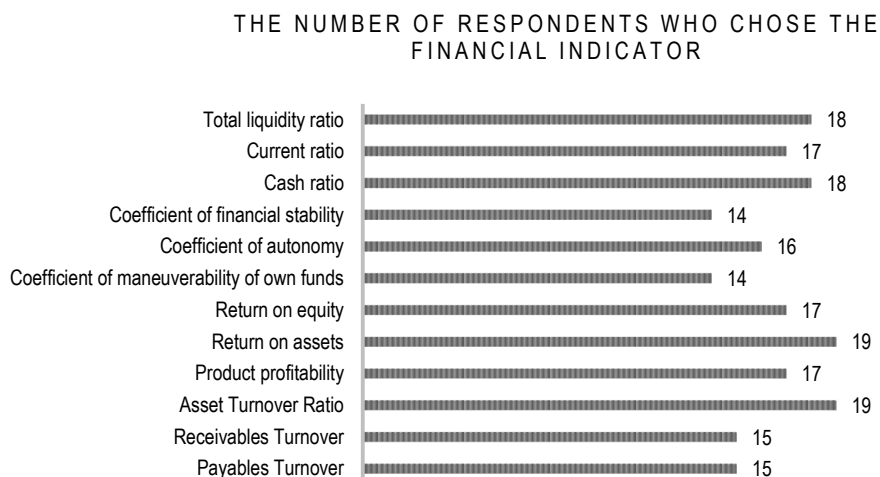
To conduct the survey, a total of 20 experts from the leading domestic engineering enterprises were elected: PJSC "Verkhnodniprovskyi engineering factory"; PJSC "Hrebinkivskyi engineering factory"; PJSC "Factory "TEMP""; PJSC "Konveier"; PJSC "Krasylivskyi engineering factory"; PJSC "Novohrad-Volynskyi agricultural engineering factory"; PJSC "Odeskyi engineering factory"; PJSC "Poltavskyi engineering factory"; PJSC "Smilianskyi engineering factory"; and PJSC "Kharkivskyi electrotechnical factory "Ukrelektromash"".

When contacting the experts, methods of direct and remote contact were chosen. The main tools of expert research were questionnaires, which covered various areas of the scientific research. Due to the fact that among the 20 interviewed respondents, 15 had worked in the field of domestic engineering enterprises for more than 7 years, it is permissible to discuss the professionalism of the survey.

One of the questions respondents were asked to answer was to select financial indicators whose values they believed to best reflect financial security at the engineering enterprise. The results allowed us to highlight the best of all of our listed financial indicators, and we repeatedly sent respondents a list of financial indicators in order to obtain their consent.

Figure 3 demonstrates the respondents' list of financial indicators that, at least in their view, best reflect an enterprise's financial status and level of financial security; the reduction of any of these indicators could signal crisis development.

FIGURE 3. THE LIST OF THE MAIN FINANCIAL INDICATORS THAT WILL BE USED TO ASSESS FINANCIAL SECURITY, IN WHICH IT IS NECESSARY TO APPLY ANTI-CRISIS MANAGEMENT AT THE ENTERPRISE



Source: Formed by the authors following the results of the survey of experts.

Note: The numbers represent the total number of respondents who, after the results of the survey, chose this financial indicator.

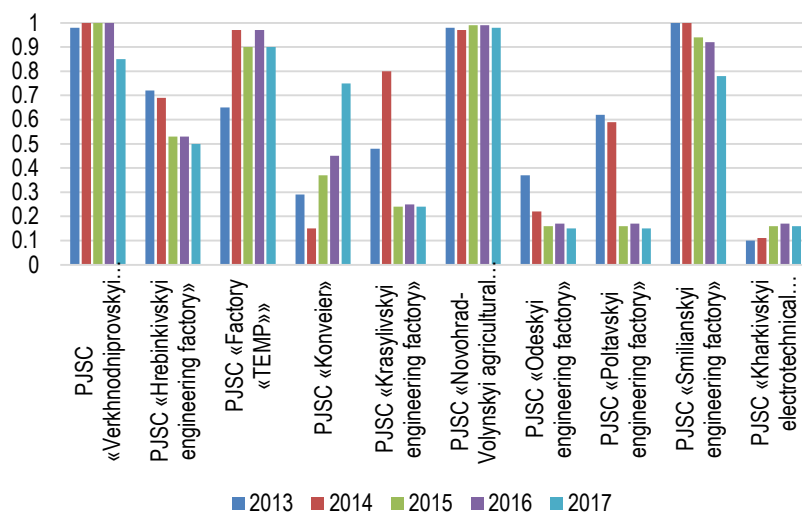
In our opinion, it is not only the groups of indicators formed above that allow us to evaluate an enterprise's current financial security; it is also necessary to pay attention to the qualitative financial indicators. As such, we have compiled a group of "qualitative indicators": payment discipline; effectiveness of accounting and analytical support; and interaction with counterparties.

5. Results and discussion

The analysis showed (Figure 4) that some of the selected engineering enterprises in Ukraine demonstrate a high level of financial security in the liquidity group: PJSC "Verkhnodniprovskyi engineering factory" (high coverage total liquidity ratio and current ratio of 1.99 and 1.00 in 2017), as a result of low volumes of current liabilities and enterprise reserves; PJSC "Factory "TEMP"", PJSC "Novohrad-Volynskyi agricultural engineering factory", and PJSC "Smilianskyi engineering factory", as a result of similar reasons as the previous enterprise being considered.

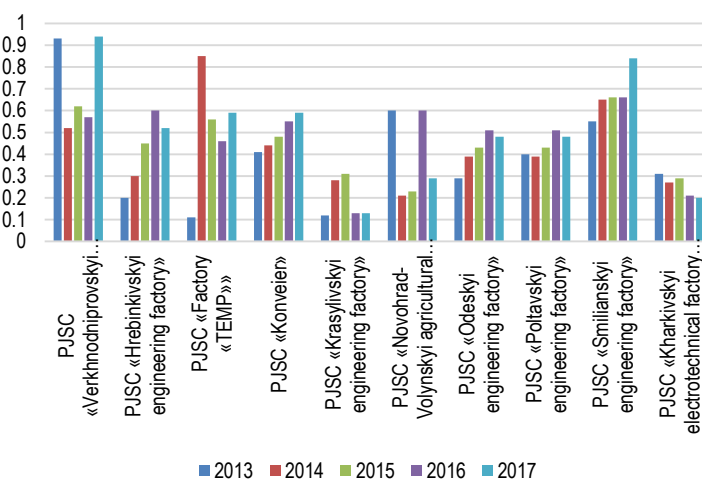
However, not all of the selected engineering enterprises demonstrated a high level of financial security in the "liquidity" group. For example, in 2014 PJSC "Konveier" (during 2013-2015, shows very low Cash ratio results, and only in 2016 does the indicator rise above zero - 0.14) is at the "Pre-crisis" level of financial security, but in 2017 demonstrated an "Acceptable" level of financial security for the "liquidity" group considered.

FIGURE 4. THE DYNAMICS OF THE LEVEL OF FINANCIAL SECURITY FOR THE "LIQUIDITY" GROUP FOR SELECTED ENGINEERING ENTERPRISES (period 2013-2017)



Source: Calculated and compiled by the authors.

FIGURE 5. THE DYNAMICS OF THE LEVEL OF FINANCIAL SECURITY FOR THE "BUSINESS ACTIVITY" GROUP OF SELECTED ENGINEERING ENTERPRISES (period 2013-2017)



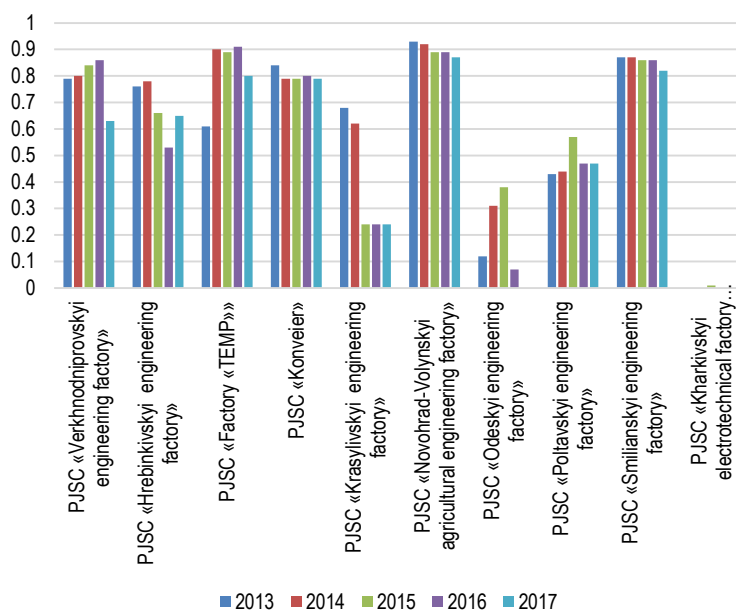
Source: Calculated and compiled by the authors.

The "business activity" group for the selected engineering enterprises (Figure 5) is characterised mainly by average results and instability in individual cases. For example,

PJSC "Verkhodniprovskiy engineering factory" first demonstrated a "Desirable" level of financial security for this group (which, according to our distribution, is considered high), but from 2014-2016 was ranked as "Recommended"; only in 2017 did it return to its previous ranking of "Desirable". Such changes for this enterprise were caused by the growth of its Asset Turnover Ratio to 2.14, Receivables Turnover to 8.75 and Payables Turnover of 30.63 during the last year.

If the level of financial security in the "business activity" group is characterized by an average level of security for the overwhelming number of enterprises, then the "financial stability" group can be approached regarding two types of security: above average or very low. Out of the ten engineering enterprises selected, five were ranked, in the long term, as having an "Acceptable" level of financial security. Separately, it should be noted that these five enterprises, including PJSC "Novohrad-Volynskiy agricultural engineering factory", PJSC "Factory "TEMP"" and PJSC "Smilianskiy engineering factory", had the highest level of financial security during the period covered by us, which is "Desirable".

FIGURE 6. THE DYNAMICS OF THE LEVEL OF FINANCIAL SECURITY FOR THE "FINANCIAL STABILITY" GROUP OF SELECTED ENGINEERING ENTERPRISES (period 2013-2017)



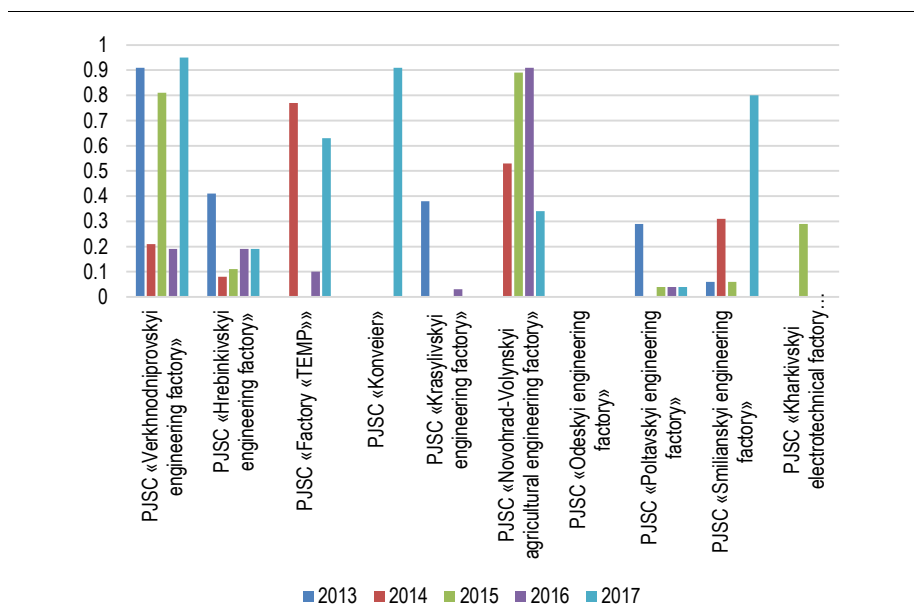
Source: Calculated and compiled by the authors.

But the situation is fundamentally different for the following enterprises (Figure 6): PJSC "Krasylivskiy engineering plant", PJSC "Odeskiy engineering factory", PJSC "Kharkivskiy electrotechnical factory "Ukrelektromash"". The listed enterprises demonstrate "Pre-crisis" and "Crisis" levels of financial security for this group of indicators (coefficient of autonomy of the same PJSC "Odeskiy engineering factory" in 2017 is (-0.28)), which indicates that there is still a significant number of domestic engineering enterprises that

are completely dependent on external sources of financing; their financial condition, therefore, shows clear signs of insolvency.

Domestic engineering enterprises are characterised by very unstable financial results. For example, in PJSC "Novohrad-Volynskiy agricultural engineering factory" in 2013, the enterprise has high net losses, whereas in 2014 it demonstrates one of the highest net profit volumes (in the same year, its return on assets, equity and profitability of products is 0.07, 0.08, and 0.09, respectively, when in the previous year these were negative values). Through such results, we noted significant fluctuations in the dynamics of the level of financial security in the "profitability" group (Figure 7). Even in spite of such "jumps", the decrease in the profitability of financial and economic activity is obvious both in the engineering enterprises and in the industry as a whole.

FIGURE 7. THE DYNAMICS OF THE LEVEL OF FINANCIAL SECURITY FOR THE
"PROFITABILITY" GROUP OF SELECTED ENGINEERING ENTERPRISES (period 2013-2017)



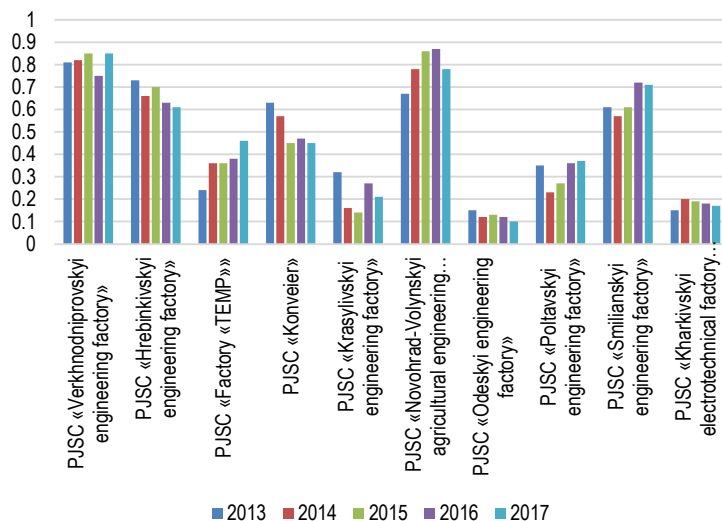
Source: Calculated and compiled by the authors.

It should be noted that even though some of the selected enterprises had a high level of financial security, in other groups they scored low on qualitative indicators (Figure 8). For example, the questionnaire showed that PJSC "Verkhodniprovskiy engineering factory" has problems with effective accounting and analytical support - 0.75 in 2016.

The "outsiders", who used to show a low level of financial security in other groups of indicators, for example, PJSC "Kharkivskiy electrotechnical factory "Ukrelektromash"" and PJSC "Odeskiy engineering factory", demonstrated the lowest scores on the 2014 results of the survey on payment discipline and the level of efficiency of accounting and analytical support - 0.1.

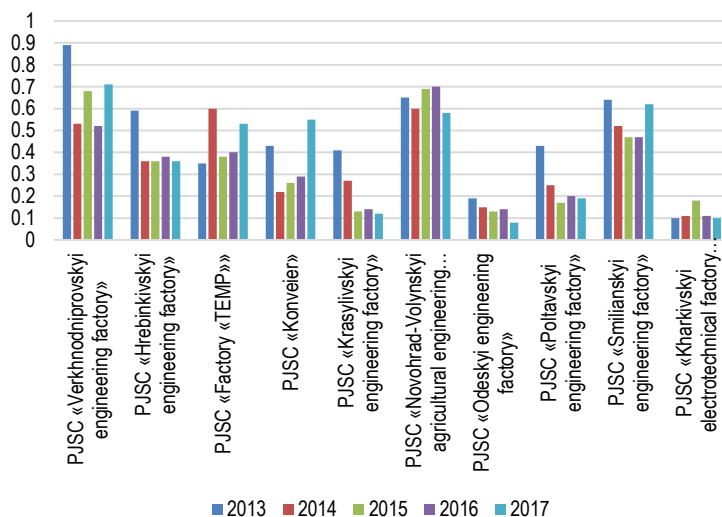
As in the best and in the worst enterprises that have been selected for analysis, experts note the presence of problems in accounting and analytical support and emphasise the need for its improvement.

FIGURE 8. THE DYNAMICS OF THE LEVEL OF FINANCIAL SECURITY FOR THE "QUALITATIVE INDICATORS" GROUP OF SELECTED ENGINEERING ENTERPRISES (period 2013-2017)



Source: Calculated and compiled by the authors.

FIGURE 9. DYNAMICS OF THE RESULTS OF CALCULATING THE INTEGRAL INDICATOR OF THE FINANCIAL SECURITY LEVEL OF THE SELECTED GROUP OF ENGINEERING ENTERPRISES (period 2013-2017)



Source: Calculated and compiled by the authors.

The final stage of the analysis is the calculation of the integral indicator of financial security, taking into account the importance of each group of indicators, the results of which the engineering enterprise needs to see in the application of anti-crisis management, either generally or sporadically (Figure 9).

The results of calculating the integral indicator of the level of financial security for the selected group of enterprises, under which it is necessary to apply anti-crisis management, make it possible to see the following:

1. Sharp and inconsistent changes in the level of the integral indicator of the level of financial security, indicating that in the engineering enterprises there are no effective instruments for risk management, which portrays the need for anti-crisis management.
2. Depending on the level of financial security demonstrated by the integral indicator, it is necessary to: (1) control the observance of an appropriate level of financial security, or (2) apply strategic, tactical, or operational anti-crisis measures. Thus, the crisis level of financial security, which requires the application of operational anti-crisis measures, is demonstrated by the following engineering enterprises (the value of the integral indicator is within the 0 - 0.166 range): PJSC "Odeskyi engineering factory" - 0.08 value in 2017; PJSC "Kharkivskyi electrotechnical factory "Ukrelektromash"" - 0.10 value in 2017; "Krasylivskyi engineering factory" - 0.12 value in 2017.
3. The application of tactical anti-crisis measures is required by the PJSC "Poltavskyi engineering factory", which demonstrates the pre-crisis level of financial security (the value of the integral indicator in the range 0.166-0.333).
4. Enterprises need strategic anti-crisis measures, the value of the integral indicator of which falls within the acceptable level of financial security. We classify such engineering enterprises according to the results of the calculations as follows: PJSC "Hrebinkivskyi engineering factory".
5. Enterprises with an integral indicator value of above the acceptable level of financial security (PJSC "Factory "TEMP""; PJSC "Konveier"; PJSC "Verkhnodniprovskyi engineering factory", PJSC "Novohrad-Volynskyi agricultural engineering factory", PJSC "Smilianskyi engineering factory") do not require the use of anti-crisis management; however, their top management needs to constantly monitor compliance with this level of security, as well as opportunities for its improvement.

6. Conclusion

The methodology of assessing the financial security proposed by us has successfully passed its practical application to the ten leading engineering enterprises of Ukraine, making it possible to determine which of our domestic enterprises need anti-crisis management. Due to expert evaluation, the threshold values of financial indicators take into account the specifics of the chosen industry and the current conditions in which domestic engineering enterprises operate. Having decided what kind of anti-crisis measures should be applied (strategic, tactical, or operational), in the future it is necessary to pay attention to the study of the main threats that may have a negative impact on financial security at the engineering enterprise and which may lead to the formation of a financial crisis. In doing so, it would be possible to form an anti-crisis mechanism to ensure the financial security of the enterprise, thus counteracting its influence.

7. Study limitations

This study is not without limitations. First, the methodical approach to assessing financial security that we have developed is considered only as an information foundation upon which to base the implementation of anti-crisis management. Secondly, the model is developed for engineering enterprises in Ukraine. Future research will include the ability to expand the model for other branch of economy.

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