UDC 330.3; 336.647/648

https://doi.org/10.33271/nvngu/2021-4/110

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THE ENTERPRISE CAPITAL STRUCTURE MANAGEMENT MODEL

Purpose. To create management algorithms for the enterprise's capital structure and mathematical formalization of optimization of this structure. To investigate the dynamics of changes in the share of profitable enterprises to assess, analyze and forecast changes in the capital structure of homogeneous groups of enterprises.

Methodology. Both empirical and theoretical methods of cognition are used to conduct the research. Methods of scientific observation and comparison are used to form the topic of scientific work, goals and objectives of the study. Methods of analysis and synthesis, induction and deduction, abstraction are used to determine the essential features of capital structure management. Methods of system structuring and modeling are used to create a mathematical model. The analogy method is used to find the weight factor of the objective function. The axiomatic method and the method of convergence from the abstract to the concrete were used for the practical application of the mathematical model, in particular, to analyze the dynamic index of related companies, stratified by size, industry, and so on.

Findings. The dynamics of the preconditions for changing the capital structure is studied, the regularities of this change for groups of homogeneous enterprises are revealed. The uneven influence of the crisis on the approaches to the formation of capital structure in groups of homogeneous enterprises is revealed, and the reasons for this are investigated. The similarity of tendencies of formation of capital structure in groups of inhomogeneous enterprises is pointed out. A correlation was found between the decrease in the share of equity and a significant prevalence of external borrowing with an increase in net loss. Moreover, it is established that enterprises, whose total amount of equity and current liabilities is stable and comparable in size with external borrowing, show a decrease in losses.

Originality. Algorithms for capital structure management and a mathematical model for optimizing capital structure are proposed. A method of comparative analysis of changes in capital structure for homogeneous groups of enterprises has been introduced, which provides an opportunity to assess the impact of external risks and crisis factors in the past and predict the necessary changes in capital structure during both the new crisis and after the crisis.

Practical value. The developed algorithms and mathematical model can be used in research and management practice to manage capital structure. Useful for different categories of professionals are approaches to the analysis of capital structure, the results of the analysis of the causes of change, the study on trends and their consequences for homogeneous enterprises.

Keywords: *capital, management, structure, optimization, model, industrial enterprise*

Introduction. The impact of unfavorable external conditions of enterprises, significantly exacerbated by the economic crisis in Ukraine, leads to a shortage of financial resources. This deficit, in particular, is due to limited opportunities to obtain bank loans. Loan rates are quite high. Lack of financial resources has a systemic, macroeconomic component – low incomes cause low purchasing power and limit the range of product groups that are in great demand. At the same time, inefficient use of financial resources of enterprises, due to the impact of internal risks, exacerbates the economic troubles of enterprises. The formation of the optimal capital structure allows the company to reduce production costs, increase the return on investment, accelerate their turnover, and increase revenue. But there are difficulties in applying proven Western approaches to capital structure management in Ukraine. The direct use of such approaches leads to significant negative consequences, because it forms the basis for incorrect management decisions. This is due to the differences in the Ukrainian realities of enterprise operation, as well as the presence of significant sectoral differences in the regulatory framework and the presence of a significant number of shortcomings and unresolved issues that leave opportunities for different interpretations by managers, on the one hand, and officials and taxmen, on the other.

Literature review. Management of the capital structure of enterprises is within attention of scientists. Thus, Berenda [1] indicates that the determination of the amount of credit resources affects the ratio of borrowed and own funds, which would maximize the financial profitability of the enterprise and reduce the weighted average cost of capital, while minimizing financial risks. Shcherban [2] proposes the use of financial leverage, whose fluctuations indicate fluctuations in

the level of risk. The problems of optimizing the capital structure of enterprises in the conditions of economic instability, endogenous and exogenous factors influencing it are studied by Rekova, et al. [3]. Liezina, et al. [4] uses the economic-mathematical model of optimization of capital structure taking into account micro- and macroeconomic factors influencing the activities of the enterprise. Rohanova [5] offers simulation modeling of capital structure using the Monte Carlo method. Mustafa [6] suggested using the Ordinary Least Square regression model to test the relationship between variables and to study the effect of financial leverage. Ashmarina [7] indicated the value of the financial leverage index taking into account the differential of financial leverage for capital structure management. Mari [8] used the method of Weighted Average Cost of Capital (WACC) to assess the financial flexibility of the enterprise in a crisis. Kovtun, et al. [9] used multiple linear regression data analysis to study the impact of financial leverage on revenue management. Tham [10] studied the WACC approach in detail. Kalinichenko, et al. [11] proposed a functional model for the optimization of current assets. Grynko, et al. [12] introduced the approach of mathematical processing of the system of independent indicators and comparative analysis of different enterprises. Berzhanir [13] proposed an approach based on an integrated assessment of the financial condition of enterprises. PeiZhi [14], using M- and S-estimators of stable regression, investigated the impact of corporate capital management structures on the activities of enterprises. Effendi [15] believes that in the companies he studies, debt minimization optimizes profits. Jiang [16] considers exogenous and endogenous factors that affect the capital structure of small and medium enterprises and the methodology of countermeasures against the effects of risks. Zhuravlyova [17], Slyvenko [18], Rozin [19], and Svyrydenko [20] use cluster analysis of the capital structure of enterprises as a factor in ensuring their financial stability.

Unsolved aspects of the problem. The review of the literature indicates a significant amount of research on the management of capital structure of the enterprise. But the same review proves the lack of standardized methods for optimizing the capital structure of the enterprise. Also, there are still no reliable algorithms for managing the capital structure of enterprises and such mathematical formalization of the problem of optimizing the capital structure, which, based on the analysis of past activities of an enterprise and other similar enterprises, would provide relevant forecasts for future periods using the optimized capital structure.

Purpose. To create algorithmic approaches to enterprise capital structure management and mathematical formalization to optimize the enterprise capital structure. To study the dynamics of changes in the share of profitable enterprises in their total number to assess, analyze and forecast changes in the capital structure of homogeneous groups of enterprises.

Methods. Both empirical and theoretical methods of cognition were used for scientific work. Methods of scientific observation and comparison were used to form the relevance of the topic of scientific work, tasks and objectives of the study. Methods of analysis and synthesis, induction and deduction, abstraction were used to determine the essential features of the problem of capital structure management. Methods of system structuring and modeling were used to create a mathematical model. The method of analogies was used to find the weight factor of the objective function. The axiomatic method and the method of convergence from the abstract to the concrete were used for the practical application of the mathematical model, in particular, for the analysis of dynamic indicators of related enterprises stratified by size, industry, and so on.

Results. First of all, the formation of the algorithm of the problem of capital structure management (Fig. 1) is considered as a tactical measure to address the complex strategic goal of the enterprise. Management of capital structure is ensured by the implementation of the following tasks: the creation of sufficient amount of funds to ensure the functioning of the enterprise; effective allocation of funds to solve these problems; finding the optimal capital structure, the minimum level of risk at a certain rate of return; organization of channels for rapid reinvestment of capital in case of changes in the operating conditions of the enterprise; constant monitoring to maintain the capital structure at a given level.

The complexity of the problem necessitates the block application of the following analysis tools: structural-functional, analog, expert, comparative sensitivity analysis, mathematical (including factor analysis, matrix, statistical, etc.), and others, which are used as required.

The development of management objectives and risk mitigation measures should assume that certain measures have a set of side effects, because risk minimization can result not only in reduction, but even in minimization of profits. This is due to the necessary measures to minimize risk: refusal from risky financial transactions, which are often carried out to make a profit; refusal to cooperate with toxic contractors; reduction of borrowed capital; use of free funds for short-term lending, and so on. In strategic terms, this may create restrictions not only on the development of the enterprise, but even on its operation. Various mechanisms are used to neutralize risks; diversification, limitation, external and internal insurance, hedging, gaining control in related industries.

To estimate the required volumes, rates and limits of such an instrument as diversification, it is proposed to use the algorithm of inverse proportional relationship between the number

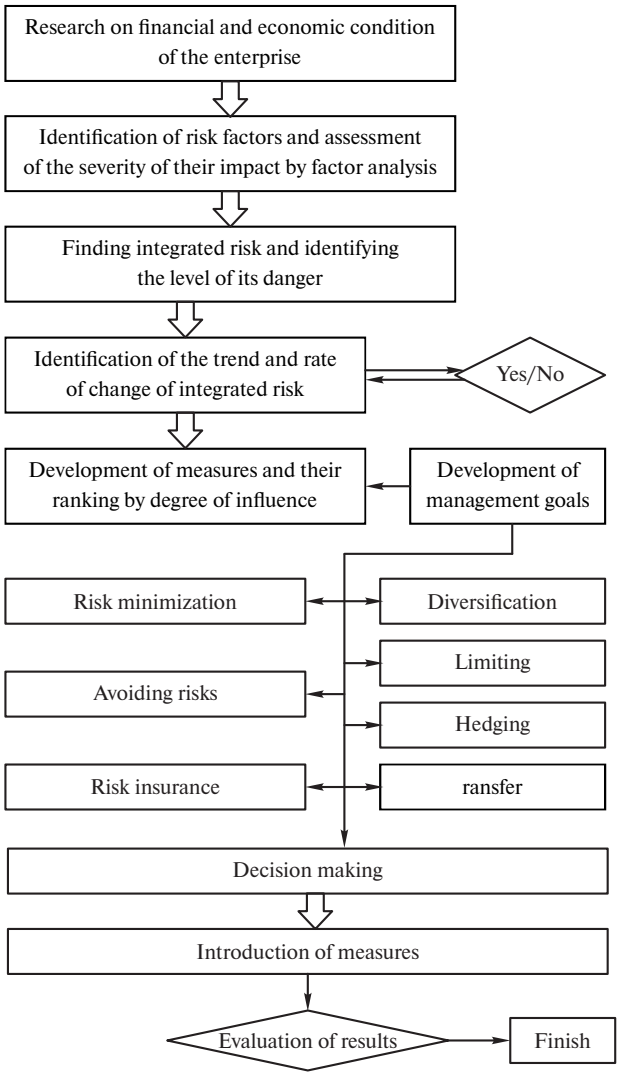

Fig. 1. Algorithm for managing the capital structure of enterprises

of risk spreading objects, taking into account their weight in this process and the magnitude of risk.

The introduction of the limiting instrument requires conducting an analytical study on the necessary margins of limits according to their types: debt capital, the share of highly liquid assets, receivables and so on for each enterprise.

The same study requires finding the ratio of internal and external insurance. The formation of domestic insurance resources together with obvious benefits will also result in narrowing the ability to quickly maneuver the company's own money, which, accordingly, will reduce the efficiency of equity.

The analytical study established a direct correlation between the ratio of credit to personal capital with the level of financial risk and economic stability of the enterprise. The correlation of credit leverage growth with the increase in the degree of integrated risk was also confirmed.

The system principle in the implementation of capital structure management is proposed to be implemented by the organization of subsystems (blocks) and their interrelation (Fig. 2).

Mathematical formalization, proposed to optimize the capital structure of the enterprise, should be based on a combined analysis of the past activities of the enterprise and provide an opportunity to forecast activities for future periods, is as follows

$$\langle Q_i, F \rangle = \{P_{re} \to \max P_{cb} \to \max G \to \min \to opt\}, \quad (1)$$

where Q_i is structural components of capital; $i = 1, 2, 3, ...$; F is financial leverage; P_{re} is return on equity; P_{bc} is return on borrowed capital; G is weighted average cost of capital.

To assess the degree of approximation to the optimal level of capital structure of the enterprise as an objective function, the integrated indicator is used. This study proposes to include the following components of the integrated indicator of capital structure assessment: forecast level of financial risk, weighted average cost of capital, financial leverage effect, type of asset financing, profitability, financial stability, liquidity, level of business activity, autonomy and financial dependence ratios, financial performance. Then, in space, the dimension of which is equal to the total number of capital components, the number of parameters of capital management efficiency (liquidity, business activity, financial stability, the level of risk of using a form of capital) and taking into account the axis of the objective function $\overrightarrow{f_j}$, for a particular company a response surface is formed on which the point of intersection is calculated in accordance with the weight or significance of each of the components a_j of the objective function, namely: increasing profitability; stabilization of financial and economic condition; increase in the value of the enterprise; increase in the value of capital or share price; increase in solvency, return on capital, financial stability. The coordinates of the point provide the required quantitative values of the structural components of capital

$$\overrightarrow{Q_j} = \varphi_1^n(a_j \overrightarrow{f_j}). \quad (2)$$

Equation (2) is specially presented in the form of a polynomial of arbitrary degree, similar to the usual econometric model for later use in combination with standard programs adapted to it. Finding the weight factor a_j by more relevant pinch method is an extremely difficult task, which takes a significant amount of computer resources and time. Therefore, at the first stage, the use of the method of analogies is proposed.

Management of capital structure for each enterprise has its own characteristics. The model of capital structure management has significant differences not only in national, but also in sectoral, regional characteristics. The management model will be different for large, medium and small enterprises. But the analysis of general approaches to the formation of this model for homogeneous (on various grounds) groups of enterprises, on the one hand, makes it possible to use the method of analogies and, on the other hand, to point out differences, which allows analyzing the causes of such differences and their consequences.

Analysis of changes in the capital structure of homogeneous (on various grounds) groups of enterprises provides an opportunity to assess the impact of external risks and crises in the past and predict the necessary changes in capital structure both at the onset of a new crisis and after the crisis.

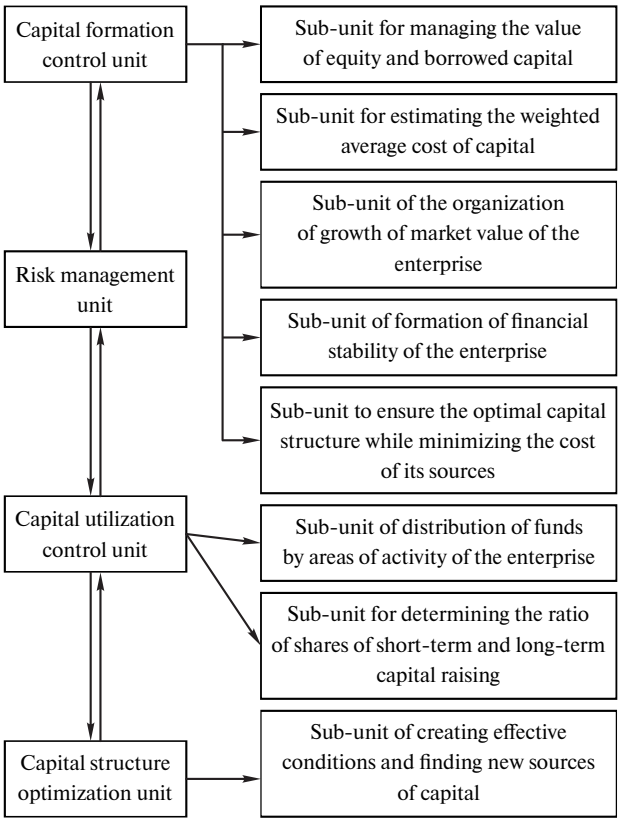

Fig. 2. Algorithm of the block scheme of management of capital structure of the enterprises

Results. Analysis of dynamic changes in the structure of enterprises by type of economic activity (State Statistics Service of Ukraine, 2020) indicates that for a relatively short period from 2011 to 2019 due to increased risks the share of industrial enterprises was reduced in the total (by 1 to 12 %), construction, wholesale and retail trade (by 2 %), financial and insurance activities – by 50 %. During this period, the number of enterprises decreased: large ones (by 32 %), medium ones (by 29 %), small ones (by 19 %). That is, the share of large enterprises in the economic structure is decreasing at the fastest pace. This is explained by the fact that the closure of small and medium-sized enterprises can be offset by the creation of new ones, in such a way maintaining a balance which is not true for large enterprises. At the same time, a larger share of their own funds in the capital structure allows large enterprises to provide a higher rate of financial results (balance) in the post-crisis period (Fig. 3) (State Statistics Service of Ukraine, 2020).

Analysis of the dynamics of financial results (balance) of large, medium and small enterprises before taxation (Fig. 3) indicates the unequal impact of external risks in a crisis. The crisis of 2012–2015 had a greater impact on the financial results of large enterprises and to a relatively small extent on smaller enterprises (Fig. 4). Smaller amplitude of fluctuations in financial results is characteristic for micro-enterprises for the period of 2010–2019.

The more favorable period of 2016–2019 is characterized by different trends in the dynamics of financial results; for example, medium-sized companies from 2018 increased the balance faster than large ones. This proves the usefulness of analyzing the dynamics of the balance first in the country as a whole, then by industry and region to assess the impact of integrated external risk on the financial activities of the enterprise and to make

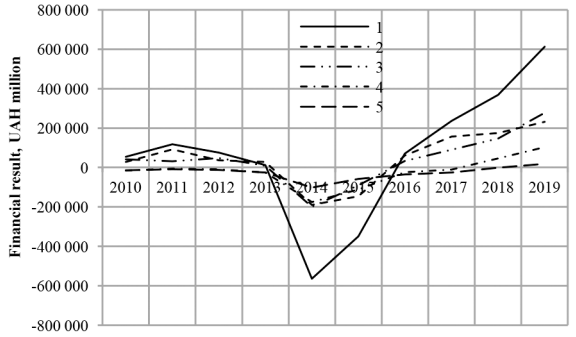

Fig. 3. Financial results before taxation of enterprises divided into large, medium, small and micro enterprises for 2010–2019, UAH million:

1 – in the whole country; 2 – large enterprises; 3 – medium-sized enterprises; 4 – small businesses; 5 – micro enterprises

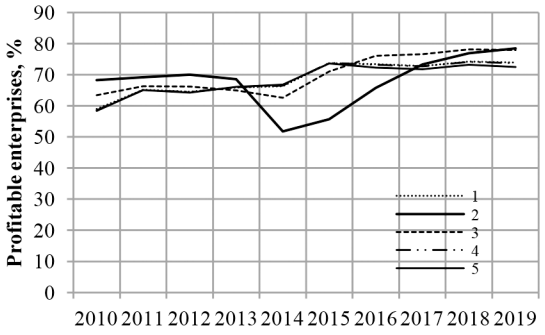

Fig. 4. Dynamics of the share of enterprises in the country as a whole that made a profit (in % of the total number of enterprises):

1 – in the whole country; 2 – large enterprises; 3 – medium-sized enterprises; 4 – small businesses; 5 – micro enterprises

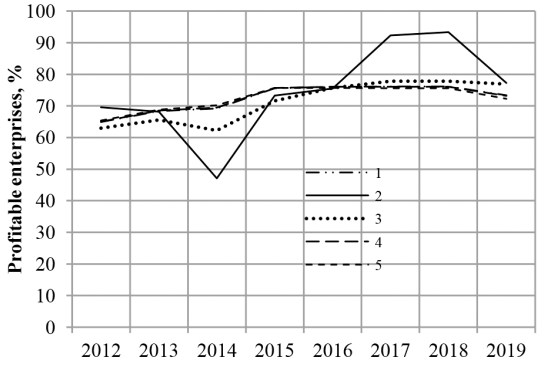

Fig. 5. Enterprises of Odesa region that made a profit (in % of the total number of enterprises):

1 – across the region as a whole; 2 – large enterprises; 3 – medium-sized enterprises; 4 – small businesses; 5 – micro enterprises

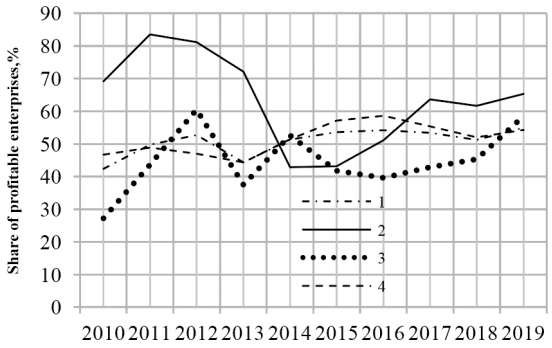

Fig. 6. Dynamics of change in the share of electricity, gas, steam and conditioned air supply companies that made a profit:

1 – industrywide; 2 – large enterprises; 3 – medium-sized enterprises; 4 – small businesses

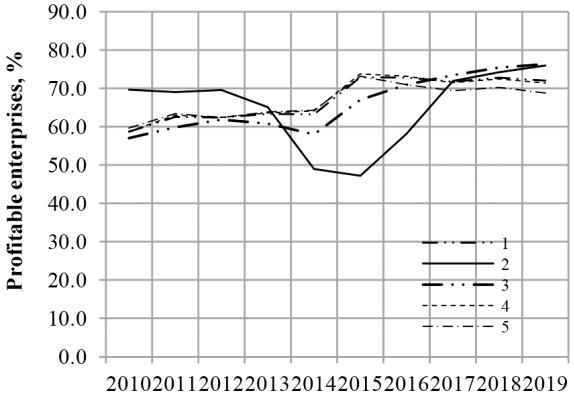

Fig. 7. Dynamics of change in the share of industrial enterprises that made a profit:

1 – in the country as a whole; 2 – large enterprises; 3 – medium-sized enterprises; 4 – small businesses; 5 – micro enterprises

decisions about the capital structure of a particular enterprise.

The analysis showed that there is a correlation between a decrease in the share of equity, a significant prevalence of external borrowing with an increase in net loss. At the same time, enterprises whose total equity and current liabilities are stable and comparable in size to external borrowing (Fig. 4) show a decrease in losses. But the growth of the share of external borrowing in the capital structure does not correlate with a high degree of reliability with increasing profits.

The impact of sectoral differences is confirmed by a comparative analysis of the dynamics of changes in the share of profitable enterprises (Figs. 6, 7) in the supply of electricity, gas, steam and air-conditioned air (Code *D* according to NACE-2010) and industry (Code $B + C + D + E$ for NACE-2010).

At the same time, analyzing the tendencies of changes in the trends of financial results, it is also necessary to turn to the analysis of homogeneous groups of enterprises at the regional level. The analysis of the dynamics, in particular, of the enterprises of Odesa region, which received a profit (Fig. 5), indicates certain differences in trends from the same indicators in the country as a whole (Fig. 4). Trends of small and micro enterprises for the period of 2015–2019 are similar, but trends for large enterprises of Odesa region have completely different rates and amplitudes of changes. This indicates a more significant regional and sectoral impact on indicators (enterprises of Odesa region are more connected with the sea economic complex).

The analysis of indicators of the balance of enterprises as a whole in the country (Fig. 8) indicates significant excess values of borrowed funds, which are almost 2–3 times more than the equity of enterprises. There is also a tendency to reduce the share of equity during crisis periods. This is due to the lack of their own resources in the presence of losses during the crisis and the emission, which limits the ability to form reserve capital. At the same time, the total values of equity and current liabilities are relatively stable at ~40 % over a fairly long period of time (Fig. 8).

The dynamics of balance sheet indicators of large, medium and small enterprises show significant differences in their capital structure in terms of equity, long-term and current liabilities and collateral as well as differences in trends. The impact of the crisis on the formation of the capital structure of these enterprises is quite different – both in the strength of influence and the lag of influence over time.

A comparative analysis of the capital structure in the dynamics for small and micro enterprises indicated their identity

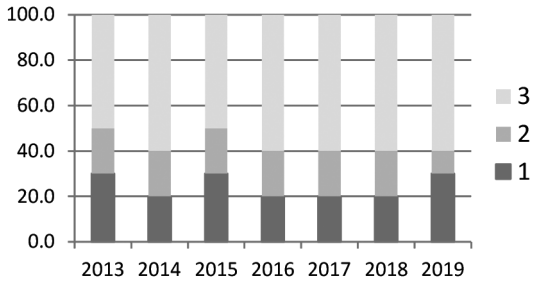

Fig. 8. Dynamics of balance sheets of enterprises as a whole in the country:

1 – equity; 2 – long-term liabilities and collateral; 3 – current liabilities and collateral

within the statistical error. The dynamics of balance sheet indicators of large, medium and small enterprises, their comparison and comparison with the dynamics of balance sheet indicators in the country as a whole (Fig. 8) allows us to establish the following: the total share of equity and long-term liabilities and collateral tends to decrease in vector large and small enterprises; the impact of the crisis on this share for large and small enterprises is opposite in direction (large enterprises increased this share by more than 60 % in 2016, medium – reduced to ~ 30 %, small – reduced to ~ 20 %); at the same time, there is a drop in this share from 2013 to 2014 for all enterprises, which is a consequence of the comprehensive crisis. Signs of the beginning of the crisis in 2019 were felt by large enterprises first, reducing this share, large and small enterprises keep this share in 2019 at the level of 2017–2019. At the same time, for medium and small enterprises in 2019 there is a tendency to increase the share of equity. Thus, approaches to the formation of the capital structure on the vector of large and small enterprises are different. The analysis shows that for large and medium-sized enterprises, only 14 % of money is spent on renewing production rather than consumption. Given the depreciation of fixed assets, this is a fairly small share of the required capital. Depreciation of fixed assets of industry is 69.1 % as of 2019. This also creates additional risks.

The analysis of the capital structure should also be carried out not only on the relative scale of measurement of indicators, but also on their absolute value. The example for such an analysis is Figs. 9 and 10. Changes in the structural components of capital in absolute terms (national currency) for two industries: electricity, gas, steam and air-conditioned air and industry can clearly assess how different industry differences can be in the dynamics of capital structure. The conducted research allows establishing, first of all, the cardinal branch difference of trends of current liabilities and collateral in their dynamics.

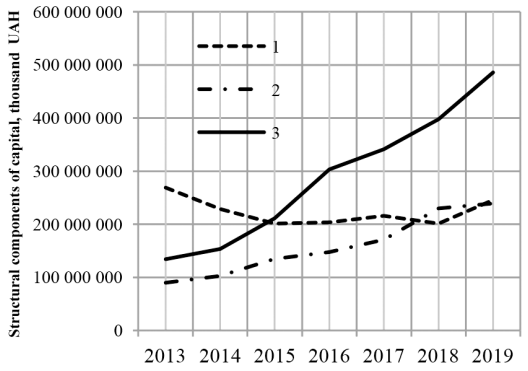

Fig. 9. Dynamics of the components of the capital structure for enterprises in the field of electricity, gas, steam and air conditioning:

1 – equity; 2 – long-term liabilities and collateral; 3 – current liabilities and collateral

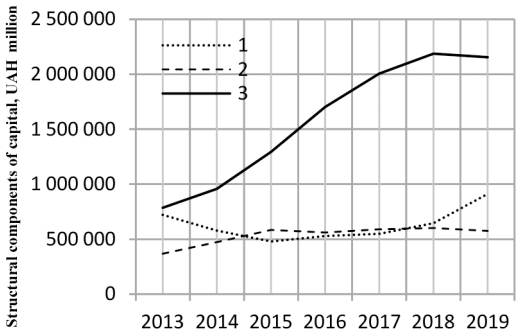

Fig. 10. Dynamics of the components of the capital structure for industrial enterprises:

1 – equity; 2 – long-term liabilities and collateral; 3 – current liabilities and collateral

We observe that the crisis period had consequences for the post-crisis period. Moreover, this growth is typical in 2016 compared to 2015 for all types of agricultural enterprises: both large (57787097.0 thousand UAH to 82184486.0 thousand UAH), and medium (138875122.7 thousand UAH to 230071134.6 thousand UAH), and small ones (145696784.3 thousand UAH to 793736239.3 thousand UAH), as well as micro-enterprises (61114885.6 thousand UAH to 524041357.1 thousand UAH). The natural reaction of the industry was to increase the share of equity in its structure.

At the same time, long-term liabilities in the agricultural industry changed much more slowly, deviating slightly from a certain level.

Conclusions. Algorithmic approaches to enterprise capital structure management and mathematical formalization for optimization of enterprise capital structure are proposed. Also, it is proposed to introduce capital structure management according to the system principle with the allocation of subsystems and the organization of their relationship. A study on the change dynamics of profitable enterprises to assess, analyze and forecast changes in the capital structure of homogeneous groups of enterprises is conducted. The analysis, in particular, showed a correlation between a decrease in the share of equity and a significant prevalence of external borrowing with an increase in net loss. At the same time, enterprises whose total equity and current liabilities are stable and comparable in size to external borrowing show a decrease in losses. At the same time, the growth of the share of external borrowings in the capital structure does not correlate with increasing profits with a high degree of reliability. The study on the dynamics of the balance sheet of enterprises in the country as a whole indicated a significant excess of borrowed funds, which is 2–3 times more than equity. There is a tendency to reduce the share of equity during periods of crisis. It is established that at the same time the total values of equity and current liabilities of enterprises in the country as a whole are relatively stable over a long period of time and amount to ~ 40 %. According to the analysis of the dynamics of the capital structure of large, medium and small enterprises, it is established that the total share of equity and long-term liabilities tends to decrease in the vector of large and small enterprises; the impact of the crisis on this share for large and small enterprises may be of the opposite direction. It is also established that the tactics of increasing the share of equity in the pre-crisis period is a characteristic trend in forming its structure.

References.

1. Berenda, N., Redzuk, T., & Vorona, K. (2018). Management of the capital structure of the enterprise. *Scientific Bulletin of Uzhhorod National University, 19*(1), 14-18.

2. Shcherban, O., Nasibova, O., & Suhorukov, R. (2017). Methods of regulation and optimization of enterprise capital structure. *Economy and state*, *12*, 82-88.

3. Rekova, N., Dolozina, I., Nitsenko, V., Zaitsev, Y., & Zamlynskyi, V. (2018). Budgetary revenue structure at central level of public administration in the federal countries. *Administratie si Management Public*, *30*, 37-50. https://doi.org/10.24818/amp/2018.30-03.
4. Liezina, A., Andriushchenko, K., Rozhko, O., Datsii, O., Mishchenko, L., & Cherniaieva, O. (2020). Resource planning for risk diversification in the formation of a digital twin enterprise. *Accounting*, *6*, 1337-1344. https://doi.org/10.5267/j.ac.2020.8.016.
5. Rohanova, H., & Pidvysotskyi, V. (2020). Similar modeling of enterprise capital structure: Monte-Carlo method. *Young scientist*, *2*(78), 44-49. https://doi.org/10.32839/2304-5809/2020-2-78-10.
6. Mustafa, S., Saeed, A., & Zafar, A. (2017). The Effect of Financial Leverage and Market Size on Stock Returns on the Karachi Stock Exchange: Evidence from Selected Stocks in the Non-Financial Sector of Pakistan. *The International Journal of Business & Management*, *5*(10), 246-252.
7. Ashmarina, S., Zotova, A., & Smolina, E. (2016). Implementation of Financial Sustainability in Organizations through Valuation of Financial Leverage Effect in Russian Practice of Financial Management. *International journal of environmental & science education, 11*(10), 3775-3782.
8. Mari, C., & Marra, M. (2019). Valuing firm's financial flexibility under default risk and bankruptcy costs: a WACC based approach. *International Journal of Managerial Finance*, *15*(5), 688-699. https://doi.org/10.1108/IJMF-05-2018-0151.
9. Mustamin, I., Usman, A., & Amiruddin (2019). The Effect of Financial Leverage on Profit Management with Managerial Ownership as Moderating. International Journal of Academic Research in Accounting, Finance and Management Sciences, Human Resource Management Academic Research Society. *International Journal of Academic Research in Accounting, Finance and Management Sciences*, *9*(2), 83-91. https://doi.org/10.6007/IJARAFMS/v9-i2/6034.
10. Tham, J., & Velez-Pareja, I. (2019). An Embarrassment of Riches: Winning Ways to Value with the WACC. *Embarrassment Riches WACC_2019,* 1-13. https://doi.org/10.2139/ssrn.352180.
11. Kalinichenko, A., Havrysh, V., & Nitsenko, V. (2019). Alternative Vehicle Fuel Management: Impact on Energy Security Indicators. In: Krakowiak-Bal, A., & Vaverkova, M. (Eds.) *Infrastructure and Environment*, (pp. 367-374). Springer, Cham. https://doi.org/10.1007/978-3-030-16542-0_45.
12. Grynko, T., Krupskyi, O., Koshevyi, M., & Maximchuk, O. (2017). Modern concepts of financial and non-financial motivation of Service Industries Staff. *Journal of Advanced Research in Law and Economics*, *8*(4), 1100-1112.
13. Berzhanir, I., & Vinnytska, O. (2018). Integral assessment of the financial state of an enterprise. *Young scientist, 2*(54), 682-686.
14. PeiZhi, W., & Ramzan, M. (2020). Do corporate governance structure and capital structure matter for the performance of the firms? An empirical testing with the contemplation of outliers. *PLoS ONE, 15*(2). https://doi.org/10.1371/journal.pone.0229157.
15. Effendi, K.A. (2017). The Optimization of Capital Structure in Maximizing Profit and Corporate Value. *Binus Business Review*, *8*(1), 41-47. https://doi.org/10.21512/bbr.v8i1.1678.
16. Jiang, J., Dong, F., & Du, B. (2018). Analysis on the Factors Affecting the Capital Structure of Small and Medium-Sized Enterprises in China. *American Journal of Industrial and Business Management*, *8*, 156-162. https://doi.org/10.4236/ajibm.2018.81010.
17. Zhuravlyova, I., Berest, M., & Honcharenko, A. (2019). Capital structure of enterprises as a factor of ensuring financial stability. *Sakarya Üniversitesi İşletme Enstitüsü Dergisi, 1*(1), 7-16.
18. Slyvenko, V., & Slyvenko, O. (2020). Economic security of tourism in Germany: models for overcoming the crisis. *European Journal of Management Issues*, *28*(3), 110-120. https://doi.org/10.15421/192011.
19. Rozin, V. (2020). The Pandemic, the Crisis of Modernity, and the Need for a New Semantic Project of Civilization. *Philosophy and Cosmology*, *25,* 32-42. https://doi.org/10.29202/phil-cosm/25/3.
20. Svyrydenko, D., & Stovpets, O. (2020). Cultural and Economic Strategies of Modern China: In Search of the Cooperation Models across the Global World. *Future Human Image*, *13*, 102-112. https://doi.org/10.29202/fhi/13/11.

Модель управління структурою капіталу підприємств

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Мета. Створити алгоритмізовані підходи до управління структурою капіталу підприємств і математичну формалізацію для проведення оптимізації цієї структури. Провести дослідження динаміки зміни частки прибуткових підприємств від загальної їх кількості для оцінки, аналізу та прогнозу зміни структури капіталу однорідних груп підприємств.

Методика. Для проведення наукової роботи застосовувалися як емпіричні, так і теоретичні методи пізнання. Методи наукового спостереження й порівняння були використані для формування актуальності теми наукової роботи, мети й завдань дослідження. Методи аналізу та синтезу, індукції та дедукції, абстрагування були використані для визначення сутнісних ознак задачі управління структурою капіталу. Методи системного структурування й моделювання були використані для створення математичної моделі. Для знаходження фактору ваги цільової функції використано метод аналогій. Аксіоматичний метод і метод сходження від абстрактного до конкретного були використані для практичного застосування математичної моделі, зокрема, для аналізу динамічних показників споріднених підприємств, стратифікованих за розмірами, галузями тощо.

Результати. Проведено дослідження динаміки передумов зміни структури капіталу й виявлені певні закономірності цієї зміни для груп однорідних підприємств. Виявлено, з однієї сторони, нерівномірний вплив кризи на підходи до формування структури капіталу у групах однорідних підприємств, та досліджені причини цього, а, з іншої сторони, вказано на схожість тенденцій формування структури капіталу у групах неоднорідних підприємств. Аналіз дозволив виявити кореляцію між зменшенням частки власного капіталу та значним превалюванням зовнішніх запозичень зі зростанням обсягу чистого збитку. У той же час, вказано, що підприємства, сумарний обсяг власного капіталу й поточних зобов'язань яких є сталим і порівнюваним за величиною із зовнішніми запозиченнями, показують зменшення збитків.

Наукова новизна. Запропоновані алгоритми для автоматизованого управління структурою капіталу підприємств і математична модель для проведення оптимізації структури капіталу підприємства. Запроваджена методика порівняльного аналізу зміни структури капіталу для однорідних, за різними ознаками, груп підприємств, що надає можливість оцінити вплив зовнішніх ризиків і чинників кризи в минулому та прогнозувати проведення необхідних змін структури капіталу як за настання нової кризи, так і за післякризового періоду.

Практична значимість. Розроблені алгоритми й математична модель можуть бути використані як у наукових дослідженнях, так і у практиці менеджменту для управління структурою капіталу підприємств. Корисними для різних категорій фахівців будуть не тільки виявлені підходи до аналізу структури капіталу підприємств, але й результати наведеного аналізу причин змін, дослідження тенденцій зміни та їх наслідки для однорідних, за різними ознаками, груп підприємств.

Ключові слова: *капітал, управління, структура, оптимізація, модель, промислове підприємство*

Recommended for publication by I. V. Fedulova, Doctor of Economic Sciences. The manuscript was submitted 23.02.21.