

ECONOMICS AND MANAGEMENT

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## MODELING OF FINANCIAL AND ECONOMIC SECURITY OF TRANSPORT ENTERPRISES BASED ON FACTOR ANALYSIS

**Purpose.** Financial and economic security defines sustainable (balanced and continuous) financial development of the enterprise, that is, it justifies the necessity to achieve it through the effective use of all kinds of resources that are available at the enterprise. The purpose of the article is to improve the methodical estimation bases of the financial and economic security state at the transport enterprises, taking into account sector specificity for making the effective management decisions. **Methodology.** Theoretical and methodical basis of the research is in the systematic analysis of the assessment process and modeling of the financial and economic security of enterprises in transport sector, theoretical principles of economic science in the sphere of financial efficiency evaluation of economic activities in a changing environment. **Findings.** The structure of the financial and economic security of the enterprises in transport industry was studied. The internal communication between the partial indicators of the investigated process for selection the necessary and sufficient quantities of the most indicative factors of influence were defined. Partial components of the financial and economic security based on the modeling results of its formation at the transport enterprises using factor analysis methods were systematized. **Originality.** Authors have improved the methodological basis of quantitative evaluation of the financial and economic security level at the transport enterprises on the basis of the aggregate partial indicators, which had been formed with industry specificity. This allows evaluating complex estimation of the degree of external and internal factors influence on the financial and economic security at the enterprises to ensure the effective management decisions making in order to achieve planned financial performance indicators of their activity. **Practical value.** Certain trends of forming ability of the transport companies to protect their financial interests are common for the studied objects. They explain 72% of the total variability of partial characteristics and reflect the modern process features of financial management and economic security. This justifies practical use expediency of the formed aggregate of the partial indicators of the financial and economic security as the basic parameters of the integrated assessment of its state at the transport industry enterprises for providing timely detection and prevention possible threats of company functioning in the financial environment.

*Keywords:* financial and economic security; transport companies; modeling of financial and economic security; factor analyses

### Introduction

Support process efficiency of the necessary financial and state economic security is stipulated by the presence of essential conditions for timely detection and prevention possible threats of company functioning in the financial environment, liquidation the negative effects of certain factors on meso and macro levels of financial relations.

The analysis of scientific sources revealed that financial and economic security of the transport sector is characterized by diversity and it is difficult to structure. There is a significant amount of methodological approaches for its detection and assessment [1 - 13]. However, the single assessment implementation algorithm of its level at enterprises in transport industry, which would set up the nec-

essary methodological basis for achieving the goals of the company concerning ensuring the essential state of its financial and economic security is still missing.

It updates the object of forming the necessary methodological bases for financial and economic security assessment in transport industry.

### Purpose

The purpose is to improve the methodological bases of financial and economic security assessment of transport enterprises, taking into account sectoral specificity based on its modeling to ensure effective management decisions making in order to achieve planned financial performance indicators of their activity.

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**Methodology**

The problem of detection and assessment the state and the level of financial and economic security at the enterprise is the subject of research by many scientists, who have formed different views concerning choice of partial indicators complex of financial and economic security of enterprises.

Analysis and synthesis of existing methodological approaches leads to the conclusions that majority of them are grounded on the comparison principles of calculated values of partial indicators with established standards. They have been identified by scientists based on the data about activities of institutions in appropriate economic environment. However, this environment do not always meet modern context in which transport industry of Ukraine function [5, c. 54].

Thus, many scientists emphasize the importance of industry characteristics record, life cycle stages of enterprises and strategies of their development, establishing certain criterion values as the basis for determining the level of financial and economic security. However, these criterion values often correspond to common standards and in highly changeable conditions of enterprise operation in transport industry of Ukraine can not be the same for all parties of financial relations, and, therefore, can not be used as a standard of comparison [5; 10, c. 84, 85].

It should be also noted that in most cases in analyzed methodological approaches concerning assessment the financial and economic security of enterprises, systems of its partial indicators were proposed. They characterize exactly financial stability of enterprises, not the level of their financial and economic security. It does not always ensure essential possibility for effective management process of enterprises and for quantitative and qualitative threat effect assessment of macro and meso-environment on the state of its financial and economic security.

Thus, we can conclude that there are differences between the existing methodological approaches proposed by economists, the evaluation of the financial and economic security associated with both the choice of initial partial indicators justification evaluation criteria and using different procedures folding feature space information and the release of certain classes of financial and economic security.

This justifies the need to improve the methodological basis of an assessment of the financial and economic security of the transport industry through the development of an integrated approach to its assessment of the company as the financial relationships.

**Findings**

The degree of objectivity and adequacy of the results of the evaluation of business performance depends on improving the effectiveness of the management of financial and economic security of both meso and macro level. The complexity of the evaluation process is justified by the fact that most performance indicators often a sous-contradictory, because of the instability of the operation of the business environment [4, c. 11].

Insufficient information transparency of external agents of economic activity, duplication presence of certain financial aspects of the enterprise by internal information database complicate the level evaluation process of financial and economic security at the enterprise and the procedures of the impact analysis of external negative factors on providing its necessary state. All this substantiates the necessity of determining the internal connections between partial performances of the investigated process for selection necessary and sufficient quantities of the most indicative factors [5, c.55].

With regard to the results functions of the assessment process, updating the information base definition and assessment of financial and economic security of the enterprise foresees the set of indicators formation. It should be based on the principles of consistency, namely, all the indicators are interrelated, but do not duplicate each other. This will fully describe the real processes and functioning phenomena of economic agent in the system of financial relations. As the activity of the economic agent is characterized by a variety of processes, there is a need for consideration the significant number of indicators in assessment the status of its financial and economic security [5].

Therefore, set of indicators for the certain transport industry was proposed. It had been formed using sectoral specifics. Set of indicators provides a base for comprehensive assessment implementation of partial indicators state and integral level of financial and economic security at the enterprise. It allows implementing the impact comprehensive measuring of external and internal

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threats on the level of financial and economic security at the enterprise and ensure effective management decision-making in the future.

The analysis results of the existing methodological foundations, dealing with the monitoring subject, allowed forming a set of 43 indicators. Accordingly them it is expedient to carry out the assessment of the financial and economic security in the transport industry [1, c. 125-137; 3, c. 10; 7, c. 163].

Unlike the existing one, set of performance indicators of economic and financial security, proposed in the study for the transport industry, is characterized by a refined list of indicators for each component and added by indicators that take into account specific features of the enterprises in a given system and in terms of the uncertainty of the external environment and with the principles of consistency, completeness, and adequacy.

The next step after determining the set of original partial indicators of financial and economic security at the enterprise in order to ensure methods applicability of multivariate statistical analysis is carrying-out the preliminary data analysis for the presence of «emissions» and subordination to the normal probability law [5].

Values check of formed set of original partial indicators of economic and financial security on the basis of statistical data regarding the activity of the 5 transport enterprises in the Kharkiv region for 2009-2013 years was conducted using the MAO criteria, Smirnov-Hrabs and Titien-Mur [2, c. 3-7; 9].

The following is information base updating of the assessment process of financial and economic security at enterprises, which it is advisable to implement on the base of factor analysis usage as one of the most efficient methods of multivariate statistical analysis [5; 9]. The results of the analysis based on the correlation between the partial indicators that characterize the level of financial and economic security at the enterprises let generate new complex factors characterizing the principal dynamic trends of its level.

Using factor analysis allows continuously defining more exactly the set of indicators that characterize the level of financial and economic security at the enterprise in rapidly changing transformational environment; it does not distort the statistical information and allows making scientifically-grounded conclusions; synthesizes a set of relevant

indicators specific to general trends of the level of financial and economic security [2; 5].

The main objective of factor analysis is combining the original number of initial parameters that characterize the economic and financial security assurance process of the transport industry in a smaller number of artificially constructed factors based on it. Adequacy requirements of the meaningful interpretation and characteristics accuracy of the sample data advance demands to the resulting analysis implementation of the factors set. For the optimal solution of this problem during the implementation of factor analysis specific methods and techniques are widely used.

The rationale for the number of factors that take part in further research, is the fact that the next factor is not very informative regarding the functioning of economic systems, because it explains less than 5% of variability (spread in values does not significantly change when the value of the factor is changed). The factor includes the variables that have the most significant values of the correlation coefficients with a factor, depending on what is given its economic interpretation [9, c. 109].

Thus, reduction of the features space that describes the phenomenon under investigation with methods of factor analysis, let determine the essential features, characterizing the object and latent links and reflecting the internal mechanisms of its functioning.

From the view point of multi iterative process of the proposed method and with optimization object all the necessary calculations have been implemented in STATISTICA 10.0.

Primary results of the factor analysis led to the conclusion that at the modern stage of the enterprise performance in transport industry, not all assessment indicators of financial and economic security level as agents of financial relations are quite informative and relevant. These conclusions are grounded on the obtained values of the factor loadings for such indicators, which are less than the level of 0.7 and consequently they are not sufficiently influential and factor forming. Iterating procedures application of the factor analysis allowed obtaining the results presented in table 1.

Therefore, obtained results of factor analysis justify such a model of economic and financial security at the transport enterprise:

$$Y=6,53F_1+2,94F_2+2,13F_3$$

where  $F_1$  – the factor that characterizes financial

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autonomy and sustainability of enterprise performance (41% of the total variability). Structure is defined by indicators such as the leverage ratio; financial leverage; receivable turnover; sales to total assets; turnover of equity; the stability ratio of economic growth; return on equity;

$F_2$  – factor describing the effectiveness and efficiency of the enterprise performance (18 % of the total variability). Structure is defined by indicators such as the structure rate of debt capital of return on assets; profitability of the equity capital; the structure rate of the attracted capital; capital stock turnover and the duration of the operating cycle;

$F_3$  – factor, characterizing property state of the enterprise (13% of the total variability). Structure is defined by such indicators as depreciation ratio; validity coefficient of fixed assets; a part of current assets in total assets and the ratio of the concentration of debt capital.

### Originality and practical value

Grounded structure of factors and values of their loadings on partial indicators allow realizing an economic interpretation of economic and financial security components, which is inherent in the enterprises of transport industry, Kharkiv region. A significant percentage of the explanatory variability and high loadings of the first factor on these figures indicate that for the analyzed enterprises in transport industry exactly own sources of funding both as operating and investment activities is the most significant basis for their ability to protect the financial interests from meso-and macro environment threats.

All of the indicators determined the structure of the first factor are closely interrelated and determine the capacity of industrial enterprises concerning the high level control of financial autonomy and the adaptation ability to external economic agents in the overall system of financial relations.

The structure of the second factor determines the indicators, which are characterized by a stimulating effect on the dynamics of the studied phenomenon. The structure of the factor allows interpreting it as a component, which characterizes just the effectiveness of enterprise performance. Its partial indexes are one of the most important indicators of changes the level of financial and economic security at the enterprises in transport industry, since when combining the set of partial effectiveness characteristics they describe various aspects of its functioning. Analysis of their relationship allows identifying the factors that have both positive and negative impact on the company's ability to protect financial interests, and, consequently, in case of destabilizing actions, to develop an appropriate complex of countermeasures [5, c. 63].

Concerning the third factor, it should be noted that it is reasonable to interpret as a component characterizing the property status of the enterprise transport industry. Taking into account the fact that one of the major problems in the transport industry is the moral and physical obsolescence of fixed as-

Table 1

#### Load characteristics of partial indicators of financial and economic security at transport enterprises

Partial indicators of financial and economic security at the enterprise	Loading characteristics		
	Factor 1	Factor 2	Factor 3
Aptitude index of fixed assets	-0,522	-0,428	0,718
The share of current funds in the assets	0,291	-0,163	0,754
The wear coefficient of fixed assets	0,520	0,408	-0,788
Conversion rate of own funds (leverage ratio)	-0,752	0,381	0,275
The concentration ratio of borrowed capital	0,128	0,355	0,716
The ratio of borrowed and own funds	-0,739	0,407	0,315
The structure ration of outside funds	-0,491	0,720	-0,083
Turnover ratio of credit debts	0,899	0,128	0,055
Ratio asset turnover	0,753	-0,502	0,031
The duration of the operating cycle	0,295	0,700	-0,106
The turnover ratio equity	0,927	0,012	0,265
The turnover ratio of fixed capital	-0,653	0,702	0,031
The stability factor of economic growth	0,917	-0,148	0,222
Return on assets	-0,295	0,767	-0,290
Profitability of own capital	0,917	-0,148	0,222
Profitability of basic capital	-0,391	0,751	-0,281

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sets, the implementation of effective investment policy is becoming increasingly important and should be aimed at strengthening the position of the economic agent in the interaction with the external environment. The high value of the total variance of this component shows that today the urgent problem of capital investments scaling in accordance with the real financial capacity of the enterprise.

### Conclusions

Thus, the iterative procedures implementation of factorial modeling revealed aggregated factors characterizing the effect degree of the private indicators set on the financial and economic security formation of the transport industry. Defined trends of forming ability to protect their financial interests are common for research and transport industry. They explain 72% of the total variability of partial characteristics and reflect the modern process features in control of it. This justifies the usage advisability of the formed partial indicators set as basic parameters of state integrated assessment of financial and economic security in the transport industry.

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## МОДЕЛЮВАННЯ ФІНАНСОВО-ЕКОНОМІЧНОЇ БЕЗПЕКИ ТРАНСПОРТНИХ ПІДПРИЄМСТВ НА ОСНОВІ ФАКТОРНОГО АНАЛІЗУ

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**Мета.** Фінансово-економічна безпека зумовлює стійкий (збалансований і безупинний) фінансовий розвиток підприємства, що обґрунтовує необхідність її досягнення на основі ефективного використання усіх видів наявних ресурсів. Мета статті полягає у вдосконаленні методичних основ оцінювання стану фінансово-економічної безпеки транспортних підприємств із урахуванням галузевої специфіки для забезпечення прийняття ефективних управлінських рішень. **Методика.** Теоретичну та методичну основу дослідження становлять системний аналіз процесів оцінювання та моделювання фінансово-економічної безпеки підприємств транспортної галузі, теоретичні положення економічної науки в галузі оцінювання фінансової ефективності господарської діяльності в умовах мінливого навколишнього середовища. **Результати.** Досліджено структуру фінансово-економічної безпеки підприємств транспортної галузі. Визначено внутрішні зв'язки між частинними показниками досліджуваного процесу для виділення необхідної та достатньої кількості найбільш індикативних факторів. Систематизовано частинні складові фінансово-економічної безпеки на основі моделювання процесу її формування на підприємствах транспортної галузі, використовуючи методи факторного аналізу. **Наукова новизна.** Авторами вдосконалені методичні основи щодо кількісної оцінки рівня фінансово-економічної безпеки підприємств транспортної галузі на основі побудованої сукупності частинних показників окремих складових, які сформовані з урахуванням галузевої специфіки. Це дозволяє здійснити комплексну оцінку ступеня впливу зовнішніх та внутрішніх факторів на рівень фінансово-економічної безпеки підприємств для забезпечення прийняття ефективних управлінських рішень щодо досягнення запланованих фінансових показників результативності їх діяльності. **Практична значимість.** Визначені тенденції формування спроможності транспортних підприємств щодо захисту своїх фінансових інтересів є загальними для досліджуваних об'єктів, пояснюють 72 % загальної мінливості частинних характеристик та відображають особливості сучасного процесу управління фінансово-економічною безпекою. Це обґрунтовує доцільність використання сформованої сукупності частинних показників фінансово-економічної безпеки як базисних параметрів інтегрального оцінювання її стану на підприємствах транспортної галузі для забезпечення своєчасного виявлення та уникнення можливих загроз функціонуванню підприємства у фінансовому середовищі.

*Ключові слова:* фінансово-економічна безпека; транспортні підприємства; моделювання фінансово-економічної безпеки; факторний аналіз

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## МОДЕЛИРОВАНИЕ ФИНАНСОВО-ЭКОНОМИЧЕСКОЙ БЕЗОПАСНОСТИ ТРАНСПОРТНЫХ ПРЕДПРИЯТИЙ НА ОСНОВЕ ФАКТОРНОГО АНАЛИЗА

**Цель.** Финансово-экономическая безопасность определяет устойчивое (сбалансированное и непрерывное) финансовое развитие предприятия, что обосновывает необходимость ее достижения на основе эффективного использования всех видов имеющихся ресурсов на предприятии. Цель статьи заключается в совершенствовании методических основ оценки состояния финансово-экономической безопасности транспортных предприятий с учетом отраслевой специфики для обеспечения принятия эффективных управленческих решений. **Методика.** Теоретическую и методическую основу исследования составляют системный анализ процессов оценивания и моделирования финансово-экономической безопасности предприятий транспортной отрасли, теоретические положения экономической науки в области оценивания финансовой эффективности хозяйственной деятельности в условиях меняющейся окружающей среды. **Результаты.** Исследована структура финансово-экономической безопасности предприятий транспортной отрасли. Определены внутренние связи между частными показателями исследуемого процесса для выделения необходимого и достаточного количества наиболее индикативных факторов влияния. Систематизированы частные составляющие финансово-экономической безопасности на основе результатов моделирования процесса ее формирования на транспортных предприятиях при помощи методов факторного анализа. **Научная новизна.** Авторами усовершенствованы методические основы количественного оценивания уровня финансово-экономической

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безопасности предприятий транспортной отрасли на основе обоснованной совокупности частных показателей отдельных составляющих, которые были сформированы с учетом отраслевой специфики. Это позволяет осуществить комплексное оценивание степени влияния внешних и внутренних факторов на уровень финансово-экономической безопасности предприятий для обеспечения принятия эффективных управленческих решений по достижению запланированных финансовых показателей результативности их деятельности. **Практическая значимость.** Определены тенденции формирования способности транспортных предприятий к защите своих финансовых интересов, которые являются общими для исследуемых объектов, объясняют 72% общей изменчивости частных характеристик и отражают особенности современного процесса управления финансово-экономической безопасностью. Это обосновывает целесообразность практического использования сформированной совокупности частных показателей финансово-экономической безопасности в качестве базисных параметров интегральной оценки ее состояния на предприятиях транспортной отрасли для обеспечения своевременного выявления и предотвращения возможных угроз функционированию предприятия в финансовой среде.

*Ключевые слова:* финансово-экономическая безопасность; транспортные предприятия; моделирование финансово-экономической безопасности; факторный анализ

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