

Nina A. Konevtseva¹APPLICATION OF QUANTITATIVE METHODS
IN THE ANALYSIS OF ECONOMIC INDICATORS

The article presents the peculiarities of the indices theory application in the economic indicators analysis. Conditions are specified under which further implementation of this approach is possible. The main ideas of using modelling for the analysis of indicators of marine transport enterprises are suggested. Coincidence of basic methodological provisions in different approaches is demonstrated.

Keywords: economic indicators; analysis; quantitative methods; mathematical modeling.

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ПРО ЗАСТОСУВАННЯ КІЛЬКІСНИХ МЕТОДІВ
В АНАЛІЗІ ЕКОНОМІЧНИХ ПОКАЗНИКІВ

У статті наведено особливості застосування методу теорії індексів в аналізі економічних показників. Визначено умови, за яких можливо подальше застосування цього підходу. Висвітлено основні ідеї використання моделювання для аналізу показників підприємств морського транспорту. Показано збіг основних положень методологічного характеру в різних підходах.

Ключові слова: економічні показники; аналіз; кількісні методи; математичне моделювання.

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О ПРИМЕНЕНИИ КОЛИЧЕСТВЕННЫХ МЕТОДОВ
В АНАЛИЗЕ ЭКОНОМИЧЕСКИХ ПОКАЗАТЕЛЕЙ

В статье приведены особенности применения метода теории индексов в анализе экономических показателей. Определены условия, при которых возможно дальнейшее применение этого подхода. Изложены основные идеи использования моделирования для анализа показателей предприятий морского транспорта. Показано совпадение основных положений методологического характера в различных подходах.

Ключевые слова: экономические показатели; анализ; количественные методы; математическое моделирование.

Introduction. Actual economic activity is always based on a system of indicators, as well as on processing data by means of quantitative analysis. The current practice includes the use of the most common theory of indices. There are also studies, preferring to employ the model concepts, not only in planning, forecasting, but also in analysis. Today it is useful to compare all the available approaches to understand the perspectives of the new ones.

Recent research and publications analysis. Economists have always paid attention to improving the system of economic indicators (Vishnev, 1968; Zagarulko, 2011; Kaplan and Norton, 2003). The use of the theory of indices in the analysis, with all its limitations, is widely represented in scientific literature (Andrienko, 1983; Kazinets, 1963; Rayatskas and Plakunov, 1987). The monograph by R.L. Rayatskas and M.K. Plakunov (1987) deserves special attention. The authors argue for the idea of the necessity to use model representations in the analysis. The study of O. Zamulin

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and K. Styurin (2012) describes the difficulties distinguishing the causal links when using the correlation analysis. In (Girina, 1993; Konevtseva, 1970) the main idea was the concept of modelling by means by quantitative methods while analyzing the results of enterprises' work in maritime transport. Recently, the emphasis in economic research has shifted to the development of methodology for analysis of new activities in the economy (Volkova et al., 2012).

Study objectives. This research is dedicated to analyzing and summarizing the experience of using quantitative methods in the aforementioned studies, comparing the main methodological ideas and the results obtained independently.

Key research findings. Today, in the analysis of economic activity the indices theory methods are used more often than the others. Extensive statistical literature is dedicated to the problems of their application. The main issues to be decided are: selection and justification of communications forms between the analyzed and factor indicators; the assumption about the nature of factor variables changes; the formation of the partial increments system of an analyzed indicator by the factors in both absolute and relative terms. The formation of private increments in the indices theory is based on the idea of elimination and the assumption of simultaneity or sequence changes of factor values. At the same time the assumption of factors independence is accepted. Traditionally, statistics have viewed the contents, i.e. the economic aspect of the analyzed phenomena or processes. More often the assumption of consistent change of factors was accepted, but in the best case with the justification on the content level: first quantitative and then qualitative factor values, at least because qualitative are always calculated, i.e. they are the result of quantitative changes. The most controversial was the problem of "indecomposable residue", as a result of mutual influence of all factors. There were various proposals on its distribution for various communication forms. This indicated that most researchers lean to the assumption about a simultaneous change of all factors in the analyzed period compared with the baseline (Kazinets, 1963). At the same time in educational literature (Bakanov et al., 2004; Petryaeva and Khmelenko, 2008) the basic idea of presenting material is simplified as much as possible: calculation formulas are given only for the simplest forms of communication (the product of factors, the sum of factors) with an example illustrative of consistent factors change. All this demonstrates that quantitative methods in the analysis of economic indicators have been applied historically, however, there are doubts on the quality of the obtained output.

R.L. Rayatskas and M.K. Plakunov (1987), successfully combined the contents, i.e. the economic aspect of the studied processes, and their mathematical description, setting out the position opposite the prevailing practice. The basic types of equations were used these as a form of links in the analysis.

A. Determination equations. A characteristic feature of these equations is that the required value can not be measured independently of the defining quantities.

B. Composition equations. Here the result is a sum of terms.

C. Distribution equations. Distribution equations are identities, if taken into account all areas of distribution, i.e. they are true by definition. The determination equations (A) also are identities.

D. Transformation equations. These equations describe the relation between some influence on the object and the results of this influence, in particular, between inputs

and outputs. A typical example of transformation equations is the production function. Transformation equations, unlike the first 3 types of equations, describe the causal links being implemented by some existing mechanism. In transformation equations there is a technological aspect as constants, which are set by the empirical data.

E. Behavior and (or) decision-making equation. Typical examples of such equations are a function of supply and demand. They differ from transformation equations in that a decision maker reacts by choosing between different courses of action. The important thing is that solutions can be altered instantaneously, while properties of a technology can not be changed arbitrarily.

The authors are right when argue that the general rule in traditional methods of economic analysis activities based on the index theory, is to use only determination and composition equations. These equations describe the relations between variables at the same moment of time and do not reflect real possibilities of economic systems because it does not describe the mechanism of factors influence on the studied parameters.

For planning and forecasting future, the systems of equations containing only equations A, B, C and not containing transformation equations (D) and behavior equations (D) are not suitable, therefore, they are not suitable in the analysis of operating results. In many examples authors convincingly show the viciousness and inconsistency in the resulting conclusions.

1964–1970 are the years to begin our research on the methods of operational analysis of fleet work. Consideration of quantitative analysis methods for fleet work results force us to turn to the theory of indices (Kazinets, 1963). It was impossible to substantiate the sequence of factors changes. So there was only one thing left to do – take the assumption of simultaneous factors change.

After consideration of the content aspect of the investigated phenomena, i.e. technological and *economic* characteristics, all the factors were divided into primary and secondary groups. The primary ones included: external conditions of transportation (freight flows and their characteristics, the composition of fleet and its characteristics) and the way of organizing fleet work under the proposed conditions. External conditions and fleet composition traditionally could be considered as quantitative *groups* of factors. Way of organizing work, as a group of factors, for our study included the optimization of traffic patterns (routing) and the optimal distribution of ships types along lines (routes). Here we can use the mathematical optimization models of varying complexity of implementation.

The conditional levels of the analyzed index, which were taken as the basis for comparison, were determined by different combinations of primary groups of factors. Then we have got different series of conditional levels indicators and by consistent comparison of the initial series with them we have evaluated the effect of each primary group of factors individually. Statistical series of conditional levels indicators is the basis for comparison, in which the result of interaction of the primary groups of factors is reflected. Consequently, it is the better "quality" base of comparison. Then partial increments, which characterize changes in both primary and secondary factors, were calculated. The second ones were the result of changes in primary factors.

The main ideas of this approach have been successfully applied in (Girina, 1993), for the ports based on more complex optimization models. Also the list of

resulting parameters for more complex forms of communication in the formation of the system of partial increments has been substantially expanded. It is such *economic* indicators as the measure of transport profitability, the speed of cargoes delivery, the intensity of ships handling in port, the cost price and others.

Conclusion. The use of modelling ideas in the analysis is common in the reviewed studies. Different ways were chosen for this. The studies which were carried out for maritime transport, proposing the use of optimization models, since the factor of the way of organization of technical means work was allocated. R.L. Rayatskas and M.K. Plakunov (1987) prove the possibility of using a set of equations as a model, as long as it includes the transformation and behavior equations.

Basically, both considered approaches are methodologically similar: transformation equations, the equations of behavior and the ways of organizing work in a model designed for accounting technology and decisions. It turned out that the approach to the analysis of economic indicators that we have chosen much later was confirmed by the extensive research results of R.L. Rayatskas and M.K. Plakunov (1987).

The proposed in our research approach can be applied to the economic systems and the analysis of improvement reserves of their indicators, in which the optimization approach to modelling can be used.

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