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MEASURING THE STRUCTURAL EFFECTS OF COST INFLATION IN INDUSTRY

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ИЗМЕРЕНИЕ СТРУКТУРНЫХ ЭФФЕКТОВ ИНФЛЯЦИИ ЗАТРАТ В ПРОМЫШЛЕННОСТИ

The article describes the methodical aspect of constructing index schemes for analyzing complex structured phenomena of an economic nature based on Varzar's ideology as two- or three-factor multipliers. The index method is widespread in branch-specific analytics, , in particular, in industrial branches of the real sector of the national economy. Using the group of price indices for measuring the dynamics of the actual production volumes, for analyzing the dynamics of purchase, wholesale, selling, contractual marketing, transfer and other prices and tariffs, for calculating the inflation during monitoring has been tested and has proved a trustworthy method; the theory behind the index method itself is well-developed in Russian statistical theory, which allows, in our opinion, to reliably measure the structural component of the inflationary spiral. It is studying the structure of cost inflation that is of special interest for academic economists in connection with searching for exit strategies from the protracted crisis. attribute factors. This article reveals for the first time a method for assessing the effect of cost inflation which forms the above-mentioned structural component, using as an example machinery manufacturing for two selected time periods and three specified attribute factors. For illustrating the construction of an index scheme, the paper presents visuals of the planar and the spatial procedures for analyzing the factor increments of the process of cost forming as an effect of combined changes, reflecting the structural features of the inflationary motion. he stages of the study conducted are provided with comprehensive commentary on the results of the analytical expansion of production costs with respect to its structure, unit costs and the prices of the purchased raw materials used. We believe that the advantages of the offered measurement technique are obvious.

INFLATIONARY PROCESS; INFLATION IN THE INDUSTRY; INFLATION OF EXPENSES AND EXPENSES; INDEX METHOD; ANALYTICAL INDEX; MULTIPLIER; SCHEME OF FACTORIAL ANALYSIS.

Представлен методический аспект построения индексных схем анализа сложных структурированных явлений экономической природы по идеологии В. Варзара в виде двух- и трехфакторного мультипликаторов. Широко распространен индексный метод в отраслевой аналитике, в частности в промышленных отраслях реального сектора национальной экономики. Традиционно надежное, испытанное использование группы ценовых индексов при измерении динамики физических объемов промышленного производства, анализе динамики закупочных, оптовых, отпускных, договорных сбытовых, трансфертных и иных цен и тарифов, исчисления уровня инфляции в режиме мониторинга, а также теоретическая разработанность собственно индексного метода в отечественной статистической теории позволяют достоверно измерить структурную компоненту инфляционной спирали. Именно изучение структуры инфляции затрат в последнее время представляет особый интерес в научном сообществе экономистов в связи с поиском путей выхода из надолго затянувшей кризисной ситуации. Впервые демонстрируется способ оценки эффекта инфляции затрат, который и формирует указанную структурную компоненту, на примере изготовления продукции машиностроительного профиля за два выделенных периода по трем учтенным признакам-факторам. В качестве наглядной интерпретации процедуры построения индексной схемы приведены графические иллюстрации плоскостной и пространственной процедуры анализа по-

факторных приращений процесса формирования затрат как эффекта совместных изменений, отражающего структурные особенности инфляционного движения. Изложенные этапы проведенного исследования снабжены содержательным комментарием к результатам аналитического разложения показателя себестоимости товарной продукции в отношении ее структуры, удельных издержек и цен на покупное используемое сырье.

ИНФЛЯЦИОННЫЙ ПРОЦЕСС; ИНФЛЯЦИЯ В ПРОМЫШЛЕННОСТИ; ИНФЛЯЦИЯ ИЗДЕРЖЕК И ЗАТРАТ; ИНДЕКСНЫЙ МЕТОД; АНАЛИТИЧЕСКИЙ ИНДЕКС; МУЛЬТИПЛИКАТОР; СХЕМА ФАКТОРНОГО АНАЛИЗА.

Introduction. It has been long noticed long by historians of science that there is an isomorphism between quantum physics and mathematical economy which relies on their general communication with mathematical statistics. The task of comparing various types of countable indicators and indices has currently become particularly relevant in the analytical methodology for assessing the development of the industrial sectors of the national economy. A special place in this methodology is held by a group of factorial analytical indices assessing the dynamics of prices, the inflationary spiral, the mobility of structural shifts and other statistical aspects of the economic processes happening in the national economy.

By nature of the tasks solved, composite indices are divided into the simple and the analytical. A simple index estimates the quantitative changes of some primary or secondary attribute without connection to other related attributes, and these analyzed (or indexed) factors are considered in the analysis as measured attribute factors, but summarily for each of the reporting periods.

An analytical index estimates the change of a productive attribute that happened due to a change in one of the considered attribute factors included in the aggregate analytical index. This method of constructing an analytical index is based on the statistical concept of *rigidly determined connections*. The change or the influence of other attribute factors taken into account in the analysis is in this case eliminated by the artificial fact that their level is fixed in a certain pre- stipulated period.

Let us consider as an example an elementary two-factorial multiplier linking in the form of a direct characteristic of statistical connection the amount of commodity turnover $W^{(j)}$ for a jth commodity position with the general variety of the commodity range $j = \overline{1, m}$, the physical sales volume (commodity weight in physical terms) $Q^{(j)}$ and the sale price for a commodity unit $p^{(j)}$. Their connection is defined in the so-called reporting and basic periods by the following multipliers

$$W_1^{(j)} = Q_1^{(j)} p_1^{(j)}; \quad W_0^{(j)} = Q_0^{(j)} p_0^{(j)}. \qquad (1)$$

While no theoretical or technical problems arise concerning index analysis of the productive attribute $W^{(j)}$, the same cannot be claimed with certainty concerning the factorial analysis of the right part of the multiplier for two causal attribute factors from expressions (1), even in the rather trivial case when $k = 2$ (number of independent attribute factors).

Two approaches to solving this difficult question have been developed in the statistical theory of the index method. *The first approach* (regulated) connects the choice of the period of weights with the character and the nature of the indexed quantity. Namely, if the so-called *primary* attribute is indexed/analyzed in the aggregate, the corresponding 'weights' are fixed at the level of the basic period; if the *secondary* sign is indexed/analyzed, it is weighed according to the reported data of the weight characteristics.

Such procedure for creating analytical indices satisfactorily provides the interrelation of the indices of the productive attribute and the attribute factors, provides their *circular reducibility* both in relative terms and in absolute expressions of the numerically estimated factor increments. The considered procedure for creating factorial analytical indices historically generated the widely known rather universal and powerful method of economic analysis, the method *of chain substitutions* using a similar way of forming direct characteristics of statistical interrelations between attributes within the so-called I and II index systems. The analyzed interrelation is realized through the initial fairly

clear expression (2) in general over the considered commodity range of *m* positions

$$\Im_{W(Q,p)1/0} = \Im_{W(Q)1/0} \times \Im_{W(p)1/0} = \\ = \frac{\sum_{j=1}^{m} Q_1^{(j)} p_0^{(j)}}{\sum_{j=1}^{m} Q_0^{(j)} p_0^{(j)}} \times \frac{\sum_{j=1}^{m} p_1^{(j)} Q_1^{(j)}}{\sum_{j=1}^{m} p_0^{(j)} Q_1^{(j)}} = \\ = \frac{\sum_{j=1}^{m} Q_1^{(j)} p_1^{(j)}}{\sum_{j=1}^{m} Q_0^{(j)} p_0^{(j)}} = \frac{\sum_{j=1}^{m} W_1^{(j)}}{\sum_{j=1}^{m} W_0^{(j)}}. \quad (2)$$

The first approach has the advantages and disadvantages which have been considered in detail by such researchers as Allen, Kauffman, Kazinets, Kevesh, Konyus, Rotstein, Ploshko, Tornquist, Frenkel, Edelgauz, Edgeworth, Marshall, Chetverikov, and others. Fischer's compound index, created in 1933 and modestly and unpretentiously called ideal by the author, was supposed to eliminate the disadvantages inherent to this approach; however, that did not happen. Nevertheless, this method for determining the weight period is standard in Russian and foreign official statistics and in the operational economic analysis though shortcomings of this approach are fairly obvious. For example, fixing weights in indices of the secondary attributes constructed according to regulations at the level of the reporting period creates artificial obstacles to objectively assessing how each isolated attribute factors was taken into account in dynamics.

For instance, when analyzing the change in the price factor in the $p_0^{(j)} \Rightarrow p_1^{(j)}$ dynamics, the index constructed by the reported weight characteristics takes into account, in addition to the change in the actual indexed quantity, the influence and the state of the weight $Q_1^{(j)}$, changed by the start of the reporting period, i.e., its *structural and quantitative determinacy* quantitative certainty, but for the dynamics of the subsequent period. This circumstance can be simplistically considered the main drawback of the traditional scheme of index analysis, established by regulations.

The second approach to determining the weight period in analytical indices assumes constructing all interconnected indices exclusively for basic period weights. This analytical approach is acceptable as it fully answers the purposes and problems of any study, i.e., to obtain the most reliable assessment of an isolated influence (action) of each of the considered causal attribute factors on the productive attribute factor provided that circular reducibility of all obtained index characteristics will be observed. Respectively, all considered attribute factors are one by one subjected to index analysis in a sequence set in some way , which is certainly reasonable substantially and taking into account the requirements of logical and substantial coordination.

Here it is interesting to note the application of both approaches to the creation of the classical *Paashe price indices* (from now on denoted with *P*), devised in 1874, and *Laspeyres price indices* (from now on denoted with *L*), introduced into scientific circulation even earlier in 1864. Both price indices are used in statistical practice, sometimes even at the same time, for measuring the cost of life, i.e., the monetary costs incurred for maintaining a certain standard of living in the above-mentioned *ideal*[1] index. The canonical form of these indices is shown in expressions (3)

$$\Im_{p_{1/0}}^{(P)} = \frac{\sum_{j=1}^{m} p_1^{(j)} Q_1^{(j)}}{\sum_{j=1}^{m} p_0^{(j)} Q_1^{(j)}}; \quad \Im_{p_{1/0}}^{(L)} = \frac{\sum_{j=1}^{m} p_1^{(j)} Q_0^{(j)}}{\sum_{j=1}^{m} p_0^{(j)} Q_0^{(j)}}. \quad (3)$$

The Paashe price indices, i.e., with weights of the reporting period, are calculated for a wider range of goods, works and services. Because weights of these indices are not the structure of consumer expenses, but the structure of either the commodity turnover, or the gross value added, or the production manufactured in the current period, the weights can be defined only after the reporting period. Therefore the Paashe index takes into account the results of the mutual substitution of economic benefits but does not reflect the simultaneous decrease in the welfare of the population.

[1] The Fisher index has a traditional form $\Im_{p_{1/0}}^{(F)} = \sqrt{\Im_{p_{1/0}}^{(L)} \times \Im_{p_{1/0}}^{(P)}}$ in the expressions presented in the paper

Problem setting. The index $\Im_{p_{1/0}}^{(P)}$ is used for measuring the dynamics of the prices of GDP components, purchase prices in agriculture, budget prices in construction, export-import prices, tariffs, etc. The Paashe index algorithm is also used for calculating such a major macroeconomic indicator as the deflator of gross domestic product, an index deflator, or *Gross Domestic Product deflator* (*GDP-deflator*) reflecting the relation of the nominal GDP volume to its real volume.

In the middle of the 20th century, Alexander Gershenkron, an American researcher of Russian origin, used both indices in the form of formulae from expression (3) for designing his own index by means of which he studied specific effects (*Gerschenkron's effect*) in the Soviet and the American economies during industrialization and World War II. The scientist thus made a noticeable contribution to the analysis of the interrelation of inflationary and structural processes. This index characteristic is often called the analytical price index according to Gershenkron's scheme ($\Im_{p_{1|/0}}^{(G)}$) to distinguish it from the Paashe and Laspeyres price indices, and the characteristic has the following appearance and value:

$$\Im_{p1/0}^{(G)} = \Im_{p1/0}^{(L)} : \Im_{p1/0}^{(P)} = \\ = \frac{\sum_{j=1}^{m} p_1^{(j)} Q_0^{(j)}}{\sum_{j=1}^{m} p_0^{(j)} Q_0^{(j)}} : \frac{\sum_{j=1}^{m} p_1^{(j)} Q_1^{(j)}}{\sum_{j=1}^{m} p_0^{(j)} Q_1^{(j)}} > 1. \quad (4)$$

The systematic lag of $\Im_{p1/0}^{(P)}$ from $\Im_{p1/0}^{(L)}$ fixed by the formula from expression (4) allowed the latter index to claim the role of the main inflationary indicator. Due to this circumstance, the Laspeyres index received the name of the *Consumer Price Index* (CPI)[2]. For price indices this is caused by the redistribution of demand from goods whose prices rise relatively faster to goods whose relative prices, respectively, decrease in the studied periods.

The index $\Im_{p1/0}^{(L)}$ does not take into account the possibility of replacing more expensive goods with less expensive ones. The CPI represents one of the approaches to measuring the shifts in the prices of a market basket from an invariable set of goods and services. The CPI is the index indicator of an overall price level reflecting the change in the price of many consumer goods and services and representing the relation of the price of the consumer basket to its price in the basic year. The structure of the consumer basket, as appears from this definition, is fixed at the level of the basic period.

Interpreting the so-called Marshall-Edgeworth spatial and territorial index whose formula is also capable to catch shifts in the structure of production and sales is even more problematic. However, the aggregate of the index is attached to arbitrary structure of the weights, not typical for any of the real periods. Additionally, the technique of index calculation is known to encounter obstacles when statistical information is collected, so actually interpreting the literal economic sense is thus traditionally complicated.

The price indices calculated using the Laspeyres formula are especially widely applied for calculating producer price indices for industrial goods by the data on the prices of representative goods (the so-called comparable circle of elements of statistical observation). However, this index does not include investment goods, but takes into account the prices of import production. Another direction for using the $\Im_{p1/0}^{(L)}$ indicator is its inclusion in the inflation assessment model; for example, Gazprombank uses the so-called seasonally adjusted basic consumer price index (BCPIUS) in calculations of inflation for the bank's own purposes .

Inflationary processes in the national economy are estimated, as a rule, by means of the two above-described indices, and they are applied when data is generalized by unit of population (for example, by enterprises, regions, countries) or by element (for example, by types of goods), and also by units and elements. So, the 'Provision on the order of supervision over the change in prices and tariffs for goods and services and determining the consumer price index', approved by a Resolution of Goskomstat

[2] The main purpose of the CPI is to assess the dynamics of the consumer price. The resolution of the International Labor Organization (ILO) stipulates that 'the purpose of CPI calculation is the evaluation of the change in the general price level of goods and services acquired, used or paid for by the population for non-productive consumption over time'.

of the Russian Federation, it is specified that CPI is 'one of the major indicators characterizing the rate of inflation and is used for implementation of the state financial policy, the analysis and the forecast of price processes in economy, regulations of real rate of national currency, revision of the minimum social guarantees, solutions of legal disputes' [9].

Exact knowledge of the inflationary characteristics is extremely important for adopting reasonable political decisions with serious social consequences. For example, at meetings of the first half of 2015, representatives of the Ministry of Finance and Ministry of Economic Development suggested to index pensions in 2016–2018 only at the level of target inflation, that is, approximately by 4–5.5%, while official inflation in 2014 reached 11.4%, and was already planned at 12.2% in 2015 [11].

CPI is calculated weekly, monthly, or quarterly, and also as a year to date figure. Final CPI values in a month, quarter, or year are determined before the 15th of the month following the reporting period. One of the major problems concerning the substantial characteristic of the CPI is connected with determining the methodological approaches to establishing the size and structure of a consumer basket. Determining the size and choosing the structure of the consumer basket is a difficult problem whose solution is based on special statistical studies as the consumer basket has to reflect the structure of the consumed goods typical for a specific country, so that the change in the price of these goods could objectively show the direction of the economic processes occurring.

According to Rosstat's methodical guideline, the calculation of the CPI involves processing the information on consumer prices of 380 goods and services in 350 cities of the Russian Federation. The Russian version of the CPI includes all main groups of goods and services, covering 400 thousand quotations of prices and tariffs, 30 thousand enterprises of retail trade and rendering services. The set of the goods and services used for calculating the CPI includes goods and services of mass consumer demand, and also separate goods and services of optional use (cars, jewelry, and others). The composition of the analyzed consumer basket is made up of 26.2% foods, 52.6 % nonfoods, and 21.2 % paid services.

The structure of the consumer expenses of the population for the previous year is used as weights for the current year. The CPI is calculated using weights of the previous year which are updated every year. The main data source for obtaining the weights is the annually conducted examination of household budgets. Households are selected for budget inspection based on the principles of random sampling. The basis for the sample is made up of the information array created by the materials of the microcensus of population carried out in the Russian Federation 2012. The volume of the sample is 48.7 thousand households, i.e., about 0.1% of the total number of households in the Russian Federation.

The statistics involved in calculating the *CPI* index in the USA covers more than 19 thousand retail trading companies and 57 thousand households as a representative sample of about 80% of the population of the country. The consumer basket is made up of 44.1% goods and 55.9% services. As the sample for inspection covering goods and services of stable demand (food, clothes, fuel, transport, medical care, etc.) is sufficiently representative, we must agree with the opinion of analysts from statistical institutions both in the Russian Federation, and in other countries, in particular, in the USA (Bureau of Labor Statistics) that the CPI can actually be considered as the main indicator for measuring inflation. However, the specifics of the current crisis that the national economy is experiencing, in particular, the significant reduction in production volumes that began in 2015, necessitates paying close attention to measuring a specific type of inflation that is cost inflation.

Cost inflation in a market economy is caused by a short-term excess of the cumulative offer over the cumulative demand in connection with a sharp increase in prices for production factors. Such an increase, as a rule, is caused by either poor crops and a considerable rise in the price of exported raw materials, or by a heavy fall in the rate of the national currency. Even in a quasimarket economy, such a process is followed by reduction of outputs and growth of unemployment[3]. With invariable cumulative demand it can cause reduction of salary costs and decrease in other costs of production factors that can ultimately lead to reduction of prices.

[3] The unemployment rate in the Russian Federation is rapidly approaching 6.5% of economically active population.

If the money supply and the nominal expenses of the federal budget grow in a situation with these parameters, cumulative demand increases, and respectively, production volumes increase and unemployment is reduced, but there is a further increase in prices for end products in the chain of cost formation. A similar kind of inflation, as it is treated by the economic theory, is also produced when the key branches of the economy (with the specifics of a resource-based economy) often coinciding with the fields of activity of natural monopolies cease to function according to market laws and slip out of state control and regulation. Then these market agents set an increase in the prices and tariffs for their economic goods above the average increase of the prices.

Inflationary analysts point out that the growth rates of *monetary inflation* in crisis conditions significantly exceed the growth rates of structural inflation [12, 14–16]. Monetary inflation does not include seasonal and administrative influence on the prices. Structural inflation, as it should, reflects structural shifts in production and leads to an increase in prices mainly in the branches where the demand for production exceeds the commodity offer.

Analysts consider the weakening ruble to be a major factor increasing the monetary inflation, as its depreciation, besides the obvious rise in import prices, stimulates the acceleration of cash turnover. The latter circumstance in itself is capable of having inflationary consequences. An additional factor increasing monetary inflation is the *tendency* to consumption increasing in the conditions of unstable economy, which was discussed in our previous study [13]. The upward dynamics of this tendency, sometimes accompanied by speculative demand, is fed by a mistrust of legal entities and individuals to the unstable banking system and by noticeable inflationary expectations.

Coming back to the $\mathfrak{I}^{(G)}_{p_{1|/0}}$ index, we should note that Gershenkron's effect manifests itself not only in the analysis of prices and tariffs, but also in the analysis of quantities, i.e., physical volume, or commodity weight[4] and also in studying the obligatory components of the temporal trend of the environment of indices of industrial production (indices of physical volume) which are calculated each month by the Analytical Center for the Government of the Russian Federation. Using only basic weights eliminates the main defect of the first approach. However, another problem emerges then, which is in ensuring the mutual coordination of the analytical indices (which we will from now on call the basic indices) in a coherent system suitable for indicating the phenomenon. The constructed factor indices do not generate such a system with the productive attribute index in their initial (pure) form. We will illustrate this difficulty using the example of the afore-mentioned commodity turnover with such a ratio from expression (5)

$$\mathfrak{I}_{W(Q)1/0} \times \mathfrak{I}_{W(p)1/0} \neq \mathfrak{I}_{W(Q,p)_{1/0}}. \qquad (5)$$

$Q_0 \to Q_1$	$Q_0 = \text{const}$	$Q_0 \to Q_1$
$p_0 = \text{const}$	$p_0 \to p_1$	$p_0 \to p_1$

Research technique. These considerations serve as a convincing explanation of this seemingly natural result following from expression (5): the isolated assessment of the change in the separate factors does not take into account the circumstance that their actual changes ($Q_0^{(j)} \Rightarrow Q_1^{(j)}$; $p_0^{(j)} \Rightarrow p_1^{(j)}$) happened in a real economic environment, in specific trade and commodity operations, and were carried out not only in combination but also interdependently. This circumstance causes the special statistical effect supplementing the effects of the isolated change of separate factors. It is obvious in the theory of economic analysis that such combined change of factors needs to be taken into account. The effect is measured according to Varzar's[5] scheme in the form of the *Index of Joint Changes (IJC)* with its different modifications used for different analytical tasks.

[4] Gershenkron's effect is one of the so-called transformational effects observed in the course of the change of the structure of a developing economic system;it consists in reduction of values of a production index with transition to weights of later periods, since goods whose production grows in advancing rates are usually characterized by decreasing relative prices.

[5] Vassily Egorovich Varzar (1851–1940) was a Russian and Soviet statistician and economist, academician, the founder of industrial statistics in Russia. He organized two first large statistical inspections (censuses) of the Russian industry in 1900 and in 1908.

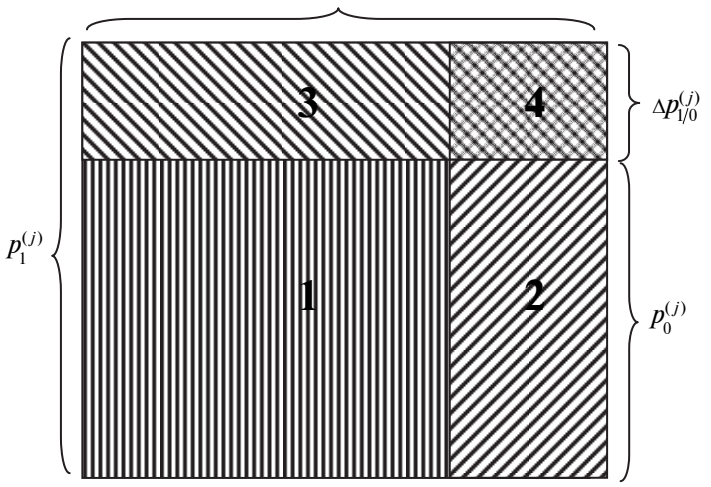

Fig. 1. Graphical representation of Varzar's index of joint changes (IJC)

Let us consider a plane illustration of the diagram, or Varzar's sign" on the example of commodity turnover, i.e., with respect to the two-factorial multiplier from expression (1). The diagram shown on the plane is oriented at the two-factorial multiplicative model. Basic and reporting conditions of the cost volume of commodity turnover of a *j*th commodity coincide by their meaning with the areas of the rectangles with the respective sides $\{Q_0^{(j)}, p_0^{(j)}\}$ and $\{Q_1^{(j)}, p_1^{(j)}\}$. The transition of the commodity turnover volume from the basic state $W(Q_0^{(j)}, p_0^{(j)})$ to the reporting one $W(Q_1^{(j)}, p_1^{(j)})$ geometrically means the change of the initial area (rectangle 1) W_0 due to the addition of three more areas as it is presented in Fig. 1.

$$W(Q_1^{(j)}, p_1^{(j)}) = W(Q_0^{(j)}, p_0^{(j)}) + \\ + W(\Delta Q_{1/0}^{(j)}, p_0^{(j)}) + W(\Delta p_{1/0}^{(j)}, Q_0^{(j)}) + \\ + W(\Delta Q_{1/0}^{(j)}, \Delta p_{1/0}^{(j)}). \qquad (6)$$

To find an absolute increment of the commodity turnover volume in the reporting period in comparison with the basic one, it is necessary to transfer its basic characteristic $W(Q_0^{(j)}, p_0^{(j)})$ to the left part of expression (6), respectively, with an opposite sign

$$\Delta W(Q^{(j)}, p^{(j)})_{1/0} = W(Q_1^{(j)}, p_1^{(j)}) - \\ - W(Q_0^{(j)}, p_0^{(j)}) = W(\Delta Q_{1/0}^{(j)}, p_0^{(j)}) + \\ + W(\Delta p_{1/0}^{(j)}, Q_0^{(j)}) + W(\Delta Q_{1/0}^{(j)}, \Delta p_{1/0}^{(j)}). \qquad (7)$$

1 is the initial volume of cost of commodity turnover, or output in the basic period (previous year); 2 is the change of cost due to the growth of commodity weight in the reporting period (current year); 3 is the change of cost due to the change of the price factor; 4 is the change of cost due to simultaneous and combined change both of the physical volume and the price

Expression (7) represents a differential form of the corresponding simple and analytical indices (i.e., in absolute expression) each of which has its own special purpose and semantic meaning. Upon transition to the traditional form of analytical indices in relative expression, each of which corresponds to differential forms from expression (7) as separate components, the so-called III Index system is formed which is oriented at taking into account the phenomenon of combined changes (rectangle 4 in Fig. 1), and this allows to measure Varzar's effect.

$$\Im_{W(Q,p)1/0} = \Im_{W(Q)1/0} \times \Im_{W(p)1/0} \times$$

$$\begin{array}{|c|} \hline Q_0 \to Q_1 \\ \hline p_0 \to p_1 \\ \hline \end{array} \quad \begin{array}{|c|} \hline Q_0 \to Q_1 \\ \hline p_0 = \text{const} \\ \hline \end{array} \quad \begin{array}{|c|} \hline Q_0 = \text{const} \\ \hline p_0 \to p_1 \\ \hline \end{array}$$

$$\times \Im_{W(\Delta Q_{1/0}, \Delta p_{1/0})1/0} = \frac{\sum\limits_{j=1}^{m} Q_1^{(j)} p_0^{(j)}}{\sum\limits_{j=1}^{m} Q_0^{(j)} p_0^{(j)}} \times \frac{\sum\limits_{j=1}^{m} p_1^{(j)} Q_0^{(j)}}{\sum\limits_{j=1}^{m} p_0^{(j)} Q_0^{(j)}} \times$$

$$\times \left[\frac{\sum\limits_{j=1}^{m} p_1^{(j)} Q_1^{(j)}}{\sum\limits_{j=1}^{m} p_0^{(j)} Q_1^{(j)}} : \frac{\sum\limits_{j=1}^{m} p_1^{(j)} Q_0^{(j)}}{\sum\limits_{j=1}^{m} p_0^{(j)} Q_0^{(j)}} \right]. \qquad (8)$$

Writing the component in square brackets of the formula from expression (6) allows to obtain two significant modifications of the index of joint changes $\Im_{W(\Delta Q_{1/0}, \Delta p_{01/0})1/0}$. The first modification presents is actually Varzar's index ($\Im_{p_{1|/0}}^{(V)}$) itself in the form of a ratio inverse to Gershenkron's index, i.e., quantitatively

characterizing the systematic lag of the Paashe price index (*P*) from the Laspeyres index (*L*).

$$1)\quad \frac{\sum_{j=1}^{m} p_1^{(j)} Q_1^{(j)}}{\sum_{j=1}^{m} p_0^{(j)} Q_1^{(j)}} : \frac{\sum_{j=1}^{m} p_1^{(j)} Q_0^{(j)}}{\sum_{j=1}^{m} p_0^{(j)} Q_0^{(j)}} = \Im_{p1/0}^{(V)}. \qquad (9)$$

This means that the index of joint changes from expression (9) apparently represents the relation of two other above-mentioned price indices stated to the corresponding value of their ratio:

$$\Im_{p1/0}^{(V)} = \Im_{p1/0}^{(P)} : \Im_{p1/0}^{(L)} < 1. \qquad (10)$$

This analytical characteristic allows to estimate the dynamics of the changing prices calculated for the reporting and the basic range of the produced and sold commodity weight that is extremely important for identifying the deterioration/improvement of the quality of consumption of paid goods by the population and, ultimately, the quality of life. We should also note that the indices $\Im_{p_{1|/0}}^{(G)}$ and $\Im_{p_{1|/0}}^{(V)}$ are inversely proportional, which follows from expressions (4) and (10) and still allows to trace the influence of structural shifts in the commodity assortment on the price level and inflationary expectations in any set sequence.

Another modification of the index of joint changes can be obtained based on expression (7) as initial by using an analytical technique of the so-called *replacement of the elements of the minor diagonal* and subsequently rearranging the multipliers in numerators and denominators of the respective indices of physical volume, $\Im_{Q(p_1)1/0}$ and $\Im_{Q(p_0)1/0}$.

$$2)\quad \frac{\sum_{j=1}^{m} p_1^{(j)} Q_1^{(j)}}{\sum_{j=1}^{m} p_0^{(j)} Q_1^{(j)}} : \frac{\sum_{j=1}^{m} p_1^{(j)} Q_0^{(j)}}{\sum_{j=1}^{m} p_0^{(j)} Q_0^{(j)}} = \qquad (11)$$

$$= \frac{\sum_{j=1}^{m} p_1^{(j)} Q_1^{(j)}}{\sum_{j=1}^{m} p_1^{(j)} Q_0^{(j)}} : \frac{\sum_{j=1}^{m} p_0^{(j)} Q_1^{(j)}}{\sum_{j=1}^{m} p_0^{(j)} Q_0^{(j)}} =$$

$$= \frac{\sum_{j=1}^{m} Q_1^{(j)} p_1^{(j)}}{\sum_{j=1}^{m} Q_0^{(j)} p_1^{(j)}} : \frac{\sum_{j=1}^{m} Q_1^{(j)} p_0^{(j)}}{\sum_{j=1}^{m} Q_0^{(j)} p_0^{(j)}} = \Im_{Q(p_1/p_0)1/0}.$$

During these elementary transformations we obtained two indices of physical volume of commodity weight for the reporting and the basic level of pricing whose ratio yields the second modification of Varzar's index of joint changes better known as *the index of shift of the commodity range* (not to be confused with the second analytical index that is the structure index, or the index of structural shift from the I Index system).

Both modifications of the index of joint changes (Varzar's index and Index of shift of the commodity range) account from different positions for the combined price change and the commodity weight with respect to commodity turnover which 'with the same rate of success and equally unreasonably' can be attributed to both the first and the second factor. The modifications convincingly demonstrate the diversity of index measurement, the arbitrariness of certain index characteristics, the objective limitation of the sphere and at the same time the specific requirements for applying each of them. Creating the index of joint changes upon transition from the planar to the volume standpoint, i.e., carrying out similar procedures concerning the three-factorial multiplier, can cause difficulties regarding substantial interpretation even for an experienced researcher.

For example, for the model of the direct characteristic of the statistical relation of raw material costs in the production of a *j*th detail *C(j)*, its dependence on the number of details *Q(j)*; the specific cost of raw materials $s^{(j)}$ and the price per unit of raw materials $p^{(j)}$ for the entire range of manufactured products, respectively, formulae from expression (12) in the reporting and basic periods of the processing departments of a machine-building enterprise hold true

$$\sum_{j=1}^{m} C_0^{(j)} = \sum_{j=1}^{m} Q_0^{(j)} s_0^{(j)} p_0^{(j)};$$
$$\sum_{j=1}^{m} C_1^{(j)} = \sum_{j=1}^{m} Q_1^{(j)} s_1^{(j)} p_1^{(j)}. \qquad (12)$$

There is no other possible combination of attribute factors as economically and

substantially coherent indicators can be obtained only in the set sequence: first, the *physical volume* of raw materials used for producing a *j*th detail of the form $Q(j) \times s^{(j)}$, and then the *cost* of the current assets spent per volume of production $(Q^{(j)} \times s^{(j)}) \times p^{(j)}$. The structural transition from a basic assessment (state) of the overall costs of raw materials to the actual expenses of the reporting period can be shown by analogy with the sequence of calculating operations in Fig. 1 on the scheme of forming the index of joint changes in a three-dimensional space $\{Q, m, p\}$ in Fig. 2.

In the three-dimensional visual in Fig. 2, the areas of the base of an arbitrary parallelepiped in the form of the quantity of the raw materials spent on manufacturing a *j*th type of production are geometrically estimated at first, then the volume parameters of the attributes numerically coinciding with the cost $C^{(j)}$ are calculated. In this case the summary index of the change of cost of expenses in the reporting period (for example in a day, week, month, quarter, etc.) will have in comparison with the basic form within the III Index system (of basic indices) the following appearance containing a comment (in frames) under each of the analytical indices in formulae from expression (13):

$$\Im_{C(Q,s,p)1/0} = \Im_{C(Q)1/0} \times \Im_{C(s)1/0} \times \Im_{C(p)1/0} \times$$

$Q_0 \Rightarrow Q_1$	$Q_0 \Rightarrow Q_1$	$Q_0 = \text{const}$	$Q_0 = \text{const}$
$s_0 \Rightarrow s_1$	$s_0 = \text{const}$	$s_0 \Rightarrow s_1$	$s_0 = \text{const}$
$p_0 \Rightarrow p_1$	$p_0 = \text{const}$	$p_0 = \text{const}$	$p_0 \Rightarrow p_1$

$$\times \Im_{C(\Delta Q,\Delta s,\Delta p)1/0} = \frac{\sum_{j=1}^{m} Q_1^{(j)} s_0^{(j)} p_0^{(j)}}{\sum_{j=1}^{m} Q_0^{(j)} s_0^{(j)} p_0^{(j)}} \times$$

$$\times \frac{\sum_{j=1}^{m} Q_0^{(j)} s_1^{(j)} p_0^{(j)}}{\sum_{j=1}^{m} Q_0^{(j)} s_0^{(j)} p_0^{(j)}} \times \frac{\sum_{j=1}^{m} Q_0^{(j)} s_0^{(j)} p_1^{(j)}}{\sum_{j=1}^{m} Q_0^{(j)} s_0^{(j)} p_0^{(j)}} \times$$

$$\times \left\{ \left[\frac{\sum_{j=1}^{m} Q_1^{(j)} s_1^{(j)} p_1^{(j)}}{\sum_{j=1}^{m} Q_1^{(j)} s_1^{(j)} p_0^{(j)}} \times \frac{\sum_{j=1}^{m} Q_1^{(j)} s_1^{(j)} p_0^{(j)}}{\sum_{j=1}^{m} Q_1^{(j)} s_0^{(j)} p_0^{(j)}} \right] : \right. \quad (13)$$

$$\left. : \left[\frac{\sum_{j=1}^{m} Q_0^{(j)} s_1^{(j)} p_0^{(j)}}{\sum_{j=1}^{m} Q_0^{(j)} s_0^{(j)} p_0^{(j)}} \times \frac{\sum_{j=1}^{m} Q_0^{(j)} s_0^{(j)} p_1^{(j)}}{\sum_{j=1}^{m} Q_0^{(j)} s_0^{(j)} p_0^{(j)}} \right] \right\}.$$

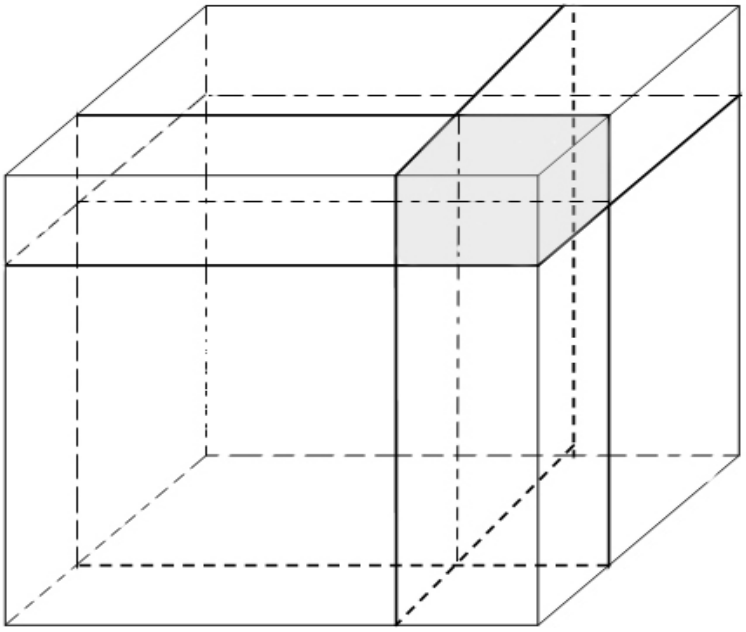

Fig. 2. 3D illustration of the procedure of creating the index of joint changes in the costs of the current assets consumed in production in the space of variables $\{Q, s, p\}$.

Table 1

Basic data for analyzing the cost index of material costs of a machine-tool manufacturing enterprise by the index method of the three-factorial multiplier

Item no.	Name of the detail in the commodity range	Basic period			Reporting period		
		number, units	rate of consumption, kg/unit	raw material costs, rub/kg	quantity, units	rate of consumption, kg/unit	raw material costs, rub/kg
$j = \overline{1, m}$	j	$Q_0^{(j)}$	$s_0^{(j)}$	$p_0^{(j)}$	$Q_1^{(j)}$	$s_1^{(j)}$	$p_1^{(j)}$
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	Valve saddle	3 000	2,5	3 132	2 900	2,2	3 256
2	Unit roll	2 000	5,5	862	1 700	5,0	911

It follows from expressions (11) and (13) that the index of joint changes in this form represents the relation of a number of indices such as the dynamics of the prices and the specific costs of raw materials used in production according to both the Paashe scheme and the Laspeyres schemes:

$$\Im_{C(\Delta Q,\Delta s,\Delta p)1/0} = \frac{\Im_{s1/0}^{(P)} \times \Im_{p1/0}^{(P)}}{\Im_{s1/0}^{(L)} \times \Im_{p1/0}^{(L)}}. \qquad (14)$$

However, the same formula from expression (14) allows to write an identical notation through two Varzar indices for the changes of the specific costs of raw materials and the change of costs of the same raw materials with respect to the component in curved braces of expression (13)

$$\Im_{C(\Delta Q,\Delta s,\Delta p)1/0} = \Im_{p1/0}^{(V)} \times \Im_{s1/0}^{(V)}. \qquad (15)$$

These very interesting and substantial ratios of factorial aggregates from expression (14) allow to create a rich set of index combinations of different analytical orientations when determining research problems and use them to carry out complex technical and economic analysis of the dynamics of primary and secondary attributes of any depth and specification when diagnosing the economic performance of an enterprise at the microlevel of the economic subject, or the real sector of economy on meso- and macrolevels of regional and national economy.

Let us illustrate the above-discussed by an arbitrary example for which the data is presented in Tab. 1.

Having carried out the necessary analytical calculations for the traditional regulations and for Varzar's scheme, let us construct a table of summary characteristics from the obtained results. It follows from the data of column 5 of this table that with the general reduction of commodity mass of the producer (-6.69%) reflecting in general the crisis state of the real sector of economy, the specific production generates inflationary processes, and the gain of costs due to increase in prices amounted to 4.42%. This can lead to a deceptive impression of rationalization of production against the general decrease in enterprise costs for these types of products (-13.51%).

Analytical calculations of the dynamics of the aggregated CPI levels and the intensity of inflationary processes can be another area of application for the index of joint changes. A separate direction of using the III Index system can be in fine analysis of the formation of costs and expenses in management accounting, including from modern positions of cost management and adopting reasonable administrative decisions aimed at regimes of savings and innovation of technologies and/or production.

We should also specifically mention the analytical potential of the discussed calculation indices with respect to studying the influence of inflation, which has been increasing in the last months, on the standard of living of various segments of the population. The process of inflation is many-sided, its character is similar to chain reactions in physics, and it can manifest itself in the following directions and positions: 1) increase in prices; 2) devaluation of the ruble in a relatively stable economy; 3) growth of the dollar and euro rates in an absolutely unstable economy; 4) rise in the price of prime costs of gross output and wholesale selling price per unit of commodity weight; 5) inflation of the financial 'bubble' of the economic subject to exceed the standard/recommended level with respect to real assets; 6) sharp reduction of the liquidity of all types of assets of stock markets; 7) excess transaction losses, and missed benefits of modern management.

It is the opinion of the scholars of the Institute of statistics of Rosstat [4, p. 79] that a unified system of measures, instead of separate steps, should be introduced to combat inflation. The differentiated inflation indices constructed on the basis of the IJC technique, including share, currency and similar indices, can indicate which measures should be taken against inflation. These indicators can serve to construct economic tools and adequate mechanisms of compensating for inflationary losses already under state regulation mediated by the megaregulator.

The obtained results. Similar indices can be used to solve the problem of practical implementation of methods for refining the financial statements of an economic subject (for example, for assessing the market value) in the conditions of inflation, which is directly connected with calculating the price index useful for recalculating the indicators of financial statements. Therefore, determining the method for measuring inflation or choosing the statistical indicators reflecting the size of inflationary processes in national economy is one of the most important stages in developing theoretical and methodical bases for updating the financial statements with the purpose of ensuring their comparability and reliability. The degree to which the choice of the indicators describing inflationary processes is scientifically based largely influences the validity of the subsequent assessment procedures.

The considered method for assessing the influence of structural shifts on the level of inflationary expectations can turn out to be in unexpected demand, as on November 10, 2014, the Central Bank of the Russian Federation changed its priorities, and declared the rate of inflation instead of the rate of national currency the main reference point of currency and monetary policy. Practice of te currency corridor which involved the megaregulator buying and selling currency, manipulating the ruble exchange rate, was in effect in the Russian Federation since 1995. Now the so-called *key rate* has become the main instrument of managing the money supply, i.e., aggregates of monetary economy, for the Central Bank of the Russian Federation.

Analyzing the recommendations for adjusting the financial statements contained in publications of the Russian authors showed that the absolute majority suggests using the account model in real terms *(GPP)* and applying the SPI within this model as an index of inflation. However, a number of publications discussing methodical questions of procedures in the conditions of inflation based on the CPI may contain both contentious clauses, and opinions demanding open scientific discussion [10, 15, 16].

The formula of the index of joint changes from expression (14) can be also presented in the form of an extremely useful modification through Varzar's analog indices which flexibly assess the changes of the secondary attributes: the specific costs of the current assets ($s^{(j)}$) and the single price of raw materials ($p^{(j)}$)

$$\Im_{C(\Delta Q,\Delta s,\Delta p)1/0} = 1/(\Im^{(G)}_{s1/0} \times \Im^{(G)}_{p1/0}). \qquad (16)$$

In this case the initial record of the simple index of cumulative costs for using current assets in industrial production according to expression (16) takes the form which is complete and almost classical, and, more importantly, convenient for analytical work and subsequent economic interpretation:

$$\Im_{C(Q,s,p)1/0} = \Im_{C(Q)1/0} \times \Im_{C(s)1/0} \times \times \Im_{C(p)1/0} \times \Im^{(V)}_{s1/0} \times \Im^{(V)}_{p1/0}. \qquad (17)$$

The formula from expression (16) allows to separately estimate the structural changes of attribute factors s and p through the corresponding Gershenkron indices in the form of the following characteristics

a) influences of structure of the prices

$$\Im^{(G)}_{p1/0} = \Im_{C(Q)1/0} \times \Im_{C(s)1/0} \times \Im_{C(p)1/0} \times \times \Im^{(V)}_{s1/0} / \Im_{C(Q,s,p)1/0}; \qquad (18)$$

b) influences of structure of expenditure of current assets

$$\Im^{(G)}_{s1/0} = \Im_{C(Q)1/0} \times \Im_{C(s)1/0} \times \Im_{C(p)1/0} \times \times \Im^{(V)}_{p1/0} / \Im_{C(Q,s,p)1/0}. \qquad (19)$$

The material discussed in article is not presented in didactic literature and is our own methodical development. Such an approach to constructing the III Index system can be useful to practicing economists, financial and market analysts, and also researchers wishing to master the index method independently as a reliable statistical instrument of social and economic studies, in particular, the technique of analyzing the index of joint changes in its different subject modifications when investigating structural inflation.

Conclusions. While a wide variety of indices currently exist, the IJC technique allows to not only perform theoretically reliable calculations,

but also to receive finer (though more labor-consuming) measurement results for term papers and projects, final qualification works, dissertation and applied studies with any imaginable set of causal attribute factors of any dimension, without resorting to specific statistical approaches of multiple correlation and constructing regression equations [13].

It is particularly noteworthy that calculating the influence of the physical output, the specific expenses of current assets and the prices of materials slightly differ from estimates by the traditional (procedural) method. However, the authors consider the assessment of the characteristic of cost inflation produced by a specific unit of an industrial enterprise that is obtained through the IJC technique to be more reliable.

Directions of further research. The approach presented allows to generalize the analytical procedure of decomposition for a *k*-dimensional case without using overly complex mathematical tools, as the purpose of any analytic didactics implies subsequent synthetic generalization. The considered approach also comprises opportunities for assessing the influence of the attribute factors accounted for not only in the traditional relative form (as a percentage), but also, more importantly and more convincing for the management of analytical services and top management of the enterprise, in terms of absolute value through differential forms of special analytical indices. In our opinion, this is can be possibly carried out not only at a microeconomic level of an economic entity in industries, but also at the macrolevel of the national economy.

REFERENCES

1. **Ploschko B.G.** Gruppirovk's flat dish and systems of statistics. Indices. Moscow, Statistics, 1971. 177 p. (rus)

2. **Kazinets L.S.** Growth rates and structural shifts in economy (indicators of planning and statistics). Moscow, Economy, 1981. 184 p. (rus)

3. General theory of statistics. Textbook. 5th prod. Under the editorship of I. I. Yeliseyeva. Moscow, Finance and statistics, 2011. 675 p. (rus)

4. About work of section of statistics of TsDU Russian Academy of Sciences. Statistics questions, 2009, no. 9. (rus)

5. **Varzar V.E.** New way of creation of indicative charts, 2 ed. Moscow, 1926. (rus)

6. Vasily Egorovich Varzar – the scientist, the practician, the public figure: to the 150 anniversary since birth. Collection of scientific works. The Petersburg state. university of economy and finance. St. Petersburg, SPbGEU, 2001. (rus)

7. **Tsatsulin A.N.** Ekonomichesky analysis. Textbook. Vol. 1. 2nd ed. St. Petersburg, Piter, 2015. 704 p. (rus)

8. **Tsatsulin A.N.** Metodichesky aspect of studying of an index of joint changes. *Sb. materials of scientific and methodical conference: the Annual periodical included in the Russian Index of Scientific Citing (RISC)*. St. Petersburg, SZAGS, 2011, pp. 118–130. (rus)

9. The provision on an order of supervision over the change in price and tariffs for goods and services, definitions of a consumer price index : The resolution of Goskomstat of Russia no. 23 of March 25, 2002. (rus)

10. The International Statistical Institute. URL: http://www.isi-web.org/.

11. URL: https://news.mail.ru/politics/22661749/?frommail=1 (accused July 15, 2015). (rus)

12. **Shapovalov A.** Monitoring: inflation in Russia became monetary. *The Businessman*, July 11, 2008, no. 226. (rus)

13. **Tsatsulin A.N., Babkin A.V.** An iterative procedure of consumer research in a narrow market segment. *St. Petersburg State Polytechnical University Journal. Economics*, 2015, no. 5(228), pp. 108–117. DOI: 10.5862/JE.228.11

14. **Babkin A.V.** Methods of an assessment of economic capacity of the industrial enterprise. *St. Petersburg State Polytechnical University Journal. Economics*, 2013, no. 1–2(163), pp. 138–148. (rus)

15. **Alexandrova A.V., Androsenko N. V., Basarev V.G., Bakhmutskaya A.V., Borisov A.A., Vertakova Yu.V., Volkova A.A., Glukhov V.V.,** etc. Economy and industrial policy: theory and Tools. Collective monograph. Under the editorship of the dr. econ. sciences, prof. A.V. Babkin. St. Petersburg, Publishing house SPbGPU, 2014. 612 s.

16. **Kharlamova T.L., Novikov A.O., Babkina N.I., Krasnyuk L.V., Osmanova A.M., Kuznetsova O.P., Yumayev E.A., P.B. Bulatov P.V., Saktoyev V.E., Haltayeva S.R., Bukhvald E.M., Oborina E.D., Rudenko M.N.** Globalization of economy and development of the industry: theory and Practice: the Collective monograph. Under the editorship of the Dr. econ. sciences, prof. A. V. Babkin. St. Petersburg, Publishing house SPbGPU, 2013. 386 p. (rus)

СПИСОК ЛИТЕРАТУРЫ

1. **Плошко Б.Г.** Группировка и системы статистических показателей. Индексы. М.: Статистика, 1971. 177 с.

2. **Казинец Л.С.** Темпы роста и структурные сдвиги в экономике (показатели планирования и статистики). М.: Экономика, 1981. 184 с.

3. Общая теория статистики: учебник. 5-е изд. / под ред. И.И. Елисеевой. М.: Финансы и статистика, 2011. 675 с.

4. О работе секции статистики ЦДУ РАН // Вопросы статистики. 2009. № 9.

5. **Варзар В.Е.** Новый способ построения показательных диаграмм. 2-е изд. М., 1926.

6. Василий Егорович Варзар – ученый, практик, общественный деятель: к 150-летию со дня рождения : сб. науч. тр. Петербургский гос. университет экономики и финансов. СПб.: Изд-во СПбГЭУ, 2001.

7. **Цацулин А.Н.** Экономический анализ: учебник. Т. 1. 2-е изд. СПб.: Питер, 2015. 704 с.

8. **Цацулин А.Н.** Методический аспект изучения индекса совместных изменений // Сб. матер. науч.-метод. конф. : Ежегодное периодическое издание, включенное в Российский индекс научного цитирования (РИНЦ). СПб.: СЗАГС, 2011. С. 118–130.

9. Положение о порядке наблюдения за изменением цен и тарифов на товары и услуги, определения индекса потребительских цен : Постан. Госкомстата России № 23 от 25 марта 2002 г.

10. The International Statistical Institute. URL http://www.isi-web.org/

11. URL https://news.mail.ru/politics/22661749/?frommail=1 (дата обращения: 15.07.2015).

12. **Шаповалов А.** Мониторинг: инфляция в России стала монетарной // Коммерсант. 2008. 11 дек. № 226.

13. **Цацулин А.Н., Бабкин А.В.** Об одной итерационной процедуре исследования потребительского спроса на узком рыночном сегменте// Научно-технические ведомости Санкт-Петербургского государственного политехнического университета. Экономические науки. 2015. № 5(228). С. 108–117. DOI: 10.5862/JE.228.11

14. **Бабкин А.В.** Методы оценки экономического потенциала промышленного пред-приятия // Научно-технические ведомости Санкт-Петербургского государственного политехнического университета. Экономические науки. 2013. № 1–2(163). С. 138–148.

15. **Александрова А.В., Андросенко Н.В., Басарева В.Г., Бахмутская А.В., Борисов А.А., Вертакова Ю.В., Волкова А.А., Глухов В.В.** и др. Экономика и промышленная политика: теория и инструментарий : колл. моногр. / под ред. д-ра экон. наук, проф. А.В. Бабкина. СПб.: Изд-во СПбГПУ, 2014. 612 с.

16. **Харламова Т.Л., Новиков А.О., Бабкина Н.И., Краснюк Л.В., Османова А.М., Кузнецова О.П., Юмаев Е.А., Булатов Р.В., Сактоев В.Е., Халтаева С.Р., Бухвальд Е.М., Оборина Е.Д., Руденко М.Н.** Глобализация экономики и развитие промышленности: теория и практика : колл. моногр. / под ред. д-ра экон. наук, проф. А.В. Бабкина. СПб.: Изд-во СПбГПУ, 2013. 386 с.

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