MACROECONOMIC PROBLEMS

Estimating Total Labor Input
for Supporting Informed Economic Policy Decisions

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Abstract—The article provides the methodology for assessing the total labor input in the economy on the basis of a symmetric input–output table. The main directions of its use in modern economics are outlined taking into account the surveyed world experience. The study presents an analysis of estimates of total labor costs in the Russian economy calculated industry-by-industry.

Keywords: total labor input, labor market, demand for labor, input–output balance, input–output tables, employment multipliers, forecasting

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The national labor market projects onto itself most of the structural changes taking place in the economy. The shrinking of some activities and emergence of new ones result in gradual obsolescence of certain professions and occupations and their replacement by new specialties; the sectoral, qualification, and other proportions of employment and unemployment change, novel forms of employment evolve, the mechanisms and time of job search are transformed, etc. The need for workers arises not only directly when the parameters of demand for the products of certain economic sectors change but also indirectly—from related industries, whose products are intermediate in the input structure of the industries that gave the initial impetus. Thus, the aggregate change in the demand for labor in the economy resulting from changes in the industry's parameters of output or final demand is the sum of direct and indirect effects. The existing close intersectoral connectivity of the economy makes it relevant and practically significant to analyze the parameters of the national labor market from the perspective of these connections.

This approach significantly extends the reach for analyzing the impact made by the economic dynamics of industries on the employment and labor market. For example, one of the most painful consequences of the COVID-19 pandemic has been a decline in employment. The scale of this decline and the factors that led to it cannot be estimated without analyzing the indirect effects due to intersectoral links in the economy.

In addition, the presence of a lag in the response from the labor market to structural changes in the economy gives time for economic agents to adjust to new conditions. This raises additional requirements for forecasting the prospective volumes and structural characteristics of labor demand. Thus, the introduc-

tion of digital technologies, the automation of certain spheres of activity, the change in the world model of global integration more or less but change the labor market. Taking into account input–output connections when predicting the prospective volumes of demand for labor can significantly enhance the validity of forecast estimates in this area.

The most common approach to the analysis of employment and the labor market taking into account input–output relations is an approach based on the use of input–output tables and, above all, a symmetric table of input–output balance (IOB). A whole issue of the journal “Problems of Forecasting” [1] has been devoted to covering the application capabilities of this toolkit, together with the analysis and forecasting of Russia's economic development based thereon. IOB provides broad analytical capabilities for studying the current structure and prospective levels of demand for labor, taking into account the economic performance of industries and changes in their production technologies. Despite the importance of such calculations, there is a steady deficit of such studies in Russia.

Methodology for estimating total labor input in the economy. Official statistics contain information on the number of the employed population by type of economic activity (direct labor inputs) but it does not reflect how many workers are employed in the economy, providing the production of goods and services by industries. The output of any product involves the input of materials (raw materials, energy, fuel, services, etc.), the production of which requires the labor of workers in other (related) industries. The sum of all such labor inputs in the production of goods and services of a particular industry is the total labor input of this industry. The value of total labor input per unit of final demand for products and services of a particular

industry is the coefficient of total labor input, the value of which always exceeds the coefficient of direct labor inputs.

The cumulative change in the demand for labor¹ as a result of changes in sectoral production volumes can be subdivided into two components (two effects). The direct effect is associated with a change in the demand for labor on the part of industry i , in which the initial change was observed for the volume of its output. A change in production volumes in one of the industries presupposes a change in its production costs, which is a factor in the output change in related industries. In turn, this triggers a change in the intermediate demand for products of a wider range of industries, etc. Changes in the demand for labor from related industries under the influence of changes in output in the i th industry are an *indirect effect* of changes in demand for labor in the economy².

Thus, there is a change in the labor demand in the economy caused by a change in output in certain economic sectors. The mechanism of this effect is akin to multiplicative. Therefore, in foreign scientific literature, the coefficients of total labor input are known as employment multipliers (see, for example, [2, 3]).

Most often, the *multiplier effect* is understood as “an increase in one of the macroeconomic indicators (gross output, GDP, budget revenues, etc.), which is due to the spread of the initial impulse through the system of input–output connections, a rise in the output in one of the sectors. A multiplier is a coefficient showing how the magnitude of the effect and the initial increase in production that caused it are related to each other” [4].

Thus, the *multiplier effect of employment* reflects the change in employment in the economy due to the spread of the initial impulse through the system of input–output connections, a change in the output in one of the sectors. Total labor input (employment multiplier) is a coefficient that reflects the ratio between the change in employment and the initial growth in production that caused it. Thus, the total labor input of the i th industry representing the sum of direct and indirect labor inputs reflects how much

labor is spent in the economy for the production of final products and services of this industry (per unit of final products and services of this industry).

In order to describe the calculations of the total labor input we introduce the following notation: $Z = (z_1, z_2, \dots, z_n)$ is the row vector of industry employment; $X = (x_1, x_2, \dots, x_n)$ denotes the row vector of the industry output; $T = (t_1, t_2, \dots, t_n)$ is the row vector of the industry's labor intensity calculated as the ratio of the number of employees in the industry to its output; $A = (a_{ij})_{i,j=1,n}$ stands for the matrix of direct cost coefficients calculated on the basis of IOB; $L = (l_{ij})_{i,j=1,n}$ are the matrix coefficients of overall outlayers (Leontief matrix); $Y = (y_1, y_2, \dots, y_n)$ designates the final demand vector; and n is the number of industries.

Direct (t_j) and indirect (ρ_j) labor inputs of the j th industry are interrelated by coefficients of direct costs, a_{ij} :

$$\rho_j = t_j + a_{1j}\rho_1 + a_{2j}\rho_2 + \dots + a_{nj}\rho_n, \quad (1)$$

or in matrix form:

$$P = T + PA, \quad (2)$$

where P is the row vector of total labor input (of employment multipliers) per unit of final products and services of industries.

Relations (1) and (2) reflect the fact that in the process of production of goods and services, which are intermediate costs of the j th industry, there had been also labor inputs in the past. In addition, relation (1) demonstrates the fact that total labor input is the sum of direct (t_j) and indirect costs ($a_{1j}\rho_1 + a_{2j}\rho_2 + \dots + a_{nj}\rho_n$).

The task is to calculate the vector of total labor input on the basis of relation (2):

$$T = P(E - A), \quad (3)$$

hence

$$P = T(E - A)^{-1} = TL, \quad (4)$$

where E is the unit matrix of dimension $n \times n$.

In addition to the total input vector, in order to understand how input–output connections are projected onto the structure of intersectoral labor inputs based on the product $\hat{T}L$ (where $\hat{T}$ is a diagonal matrix with direct labor inputs on the main diagonal), the matrix of total labor input in the economy is calculated. Each column of this matrix reflects the number of jobs (employed) in each industry, supported by the final demand in the industries located in the columns. Thus, the i th element of this matrix represents the number of people employed in the i th industry, ensuring the production of the final product of the j th industry (per unit of its final demand in monetary terms)³. The sum of the elements of each column represents the industry's total labor input, that is, the sum of direct and

¹ The article identifies the concepts of “labor demand”, “jobs” and “employment,” which is not entirely correct. For the reporting period, the number of employed and jobs is not equal due to the existence of secondary, tertiary employment, which can be taken into account in the analysis through correction factors. Labor demand for the reporting period is the sum of job vacancies and the number of people employed in the economy.

² This definition of direct and indirect effects is the most commonly used but not the only one. For example, the Bureau of Economic Analysis of the United States, includes in direct effects calculated on the basis of input–output tables, the growth of indicators (output, employment, etc.) not only of the industry in which the initial impulse arose, but also of related industries affected by changes in the volume of production in the original industry. Nevertheless, regardless of specific understanding of direct and indirect effects, the magnitude of the total multiplier effect remains.

indirect jobs in the economy supported by the corresponding industry (per unit of its final demand in monetary terms).

By multiplying the P vector element-by-element by the Y vector, we can calculate the industry's total labor input in absolute terms. The sum of total labor input broken down by industries in the year t will be equal to the total number of people employed in the economy this year.

The coefficients of direct and total labor inputs can be used for the short- and medium- term forecasts of changes in labor demand (for this period, the technological matrix remains stable over time). By specifying the change in the industry's volumes of final demand (column vector ΔY) or outputs (column vector ΔX) for the forecast period, the total change in demand for labor in the economy (ΔL) can be found based on the following relations:

$$\Delta L = T \times \Delta X = P \times \Delta Y. \quad (5)$$

However, most often in practice, it is necessary to know the predicted values of changes in the volume of demand for labor in the context of individual industries. And in this case, in calculations, it is useful and informative to divide the total change in demand for labor in industries into a direct effect (directly related to an output change in industries) and an indirect effect (resulting from an output change in related industries). The magnitude of the indirect effect of changes in the demand for labor in industries can be calculated as the difference between the total and direct effects in these industries

$$P \times \widehat{\Delta X} - P \times \widehat{\Delta Y} = P(\widehat{\Delta X} - \widehat{\Delta Y}), \quad (6)$$

where $\widehat{\Delta X}$ and $\widehat{\Delta Y}$ are diagonal matrices, on the main diagonal of which are industry's changes in output and final demand, respectively.

The absolute values of the matrix of intersectoral labor inputs (Z) can be calculated based on the following ratio:

$$Z = \hat{T} \hat{L} \hat{Y}. \quad (7)$$

When the appropriate data are available, estimates of total labor input can be obtained in professional, sex, educational (by type of occupation) aspects. This requires information on the unit labor costs per unit

output in industries (i.e., labor intensity) with the appropriate breakdown. The classic work on calculating various multipliers, including employment multipliers, based on input–output tables is [5].

The coefficients of total labor input, or employment multipliers, divided into direct and indirect effects, together with the matrices of total labor input, are calculated on the basis of national IOBs by many countries and are widely used in world practice. Below, an overview of the world experience of their use for analyzing the consequences of various economic policies on national and regional labor markets is presented.

Use of total labor input in the modern economy. This section does not chronologize the development of calculation tools and the use of estimates of total labor input in the economy. However, one necessarily has to start with the founder of the approach to calculating total labor input in economics, the Russian economist-mathematician V.K. Dmitriev. The methodology for calculating total labor input was developed in line with the theory of production costs. The problem that Dmitriev solved was that the price of production was derived from other prices—the prices of goods consumed in the production process (i.e., one unknown was derived from other unknowns). Using a system of linear equations, Dmitriev proved that the price of production, being the sum of wages and profits, is expressed through the total amount of labor directly and indirectly put in the production of any product or service [6]. In fact, Dmitriev was the first to develop a static model of input–output balance in the form of a linear input–output system with technological coefficients *reduced to labor inputs as a primary factor (IOB labor model)*, and was the first to propose a method for calculating the total labor input per unit of output taking into account the input–output connections.

The modern history of calculating total labor input (employment multipliers) in individual countries is associated with the development and assessment of the impact made by economic policies on the employment sector and the labor market. Thus, the US Bureau of Labor Statistics (BLS) develops and officially publishes tables of total labor input, “Employment requirements tables.” At the moment, data for the period 1997–2018 are available on the organization's website⁴ calculated on the basis of official input–output tables⁵ both in current and in constant prices (2012) and broken down into 205 industries, taking into account the import component and without it. As indicated in the BLS description for these matrices [7], tables of total labor input are developed to analyze the impact of various economic inputs on employment. The tables provide information for assess-

³ Strictly speaking, the matrix of interindustry's labor inputs calculated in this way for a certain period (year) is an averaged estimate of the actual structure of intersectoral labor inputs for this period. The fact is that the products manufactured within the same industry are characterized by unequal labor intensity, which means that the matrix $\hat{T}$ is not actually diagonal. However, in the absence of data on different levels of labor intensity in the industry, the breakdown in the calculations uses the industry-averaged level of labor intensity. The availability of data on different levels of labor intensity in the production of products within industries (obtained, for example, as a result of special surveys) could improve the accuracy of assessing the calculated matrix of intersectoral labor inputs.

⁴ <https://stats.bls.gov/emp/data/emp-reauirements.htm>

⁵ Input-output tables are developed by U.S. Bureau of Economic Analysis, BEA.

ing the impact of changes in the final demand of the i th industry on employment not only in it, but also in other industries, taking into account all production chains. On their basis, it is possible to compare industries with each other by the number of jobs they can create in the economy as a result of spending the same amount of money on the final goods and services of various industries.

Thus, the tables of total labor input developed by BLS provide the richest material for analyzing changes in the structure of employment in the retro-prospective period under the influence of changes in the structure of production, volumes and sectoral structure of inputs in the economy. In particular, estimates of total labor input are regularly used by the US Congress to analyze the number of jobs created as a result of spending federal funds on specific activities⁶. Over periods of economic crises (e.g., in 2008–2009), when there is a need to support the demand for goods and services of certain industries with the help of federal spending to create jobs, estimates of total labor input become valuable and informative material for analyzing the impact of these measures on the labor market [8].

The tables of total labor input published in the United States are not only a tool for assessing the impact of economic policies on the labor market but also the basis for the annual national employment forecast developed by the Bureau of Labor Statistics for a ten-year period⁷. The results of these forecasts are also published on the Occupational Outlook Handbook (OOH)⁸. It contains information on the dynamics of demand for labor for a ten-year period broken down by industries, occupations (568 detailed occupations in 325 occupational profiles, which is especially valuable for high school graduates and prospective university and college students), as well as on the prospective dynamics of wages, requirements for education and training, etc.

Employment multipliers are also calculated by other countries. For instance, the website of the UK National Statistical Office⁹ publishes estimates of employment multipliers harmonized with national accounts data.

Regional employment multipliers. Employment multipliers are widely used not only at the national level but also at the level of individual regions. Such information is in demand from local authorities intending to substantiate the costs of economic development of territories and assess various economic effects brought about by the implementation of investment projects.

⁶ <https://www.everycrsreport.com>

⁷ The current forecast was published on September 4, 2019 and reflects the main trends in the field of employment for the period 2018–2028. Its release can be found on the US Bureau of Labor Statistics website Access Mode: <https://stats.hls.gov/news.release/pdf/ecopro.pdf>

⁸ www.hls.gov/ooh/

⁹ Office for National Statistics. Access mode: <https://www.ons.gov.uk>

Thus, the US Bureau of Economic Analysis based on Regional Input–Output Modeling System–RIMS II¹⁰ calculates the multipliers of output, value added, income, including employment multipliers to assess the impact of various projects on the regional economy. As for the national level, regional employment multipliers estimate the overall change in the number of jobs in the region, either per dollar of change in final demand in the industry, or per job in it [9].

There are also alternative models for calculating direct, indirect, and induced effects, including taking into account the employment parameters based on input–output tables. These models are developed by private firms, research centers, and trade union organizations both for individual industries (e.g., tobacco, textiles, and car manufacturers) and for the economy as a whole. With regard to the tobacco industry, assessments were made of the consequences of its disappearance for the entire US economy [10]. The model IMPLAN¹¹ calculates economic effects at the regional level. Interestingly, the development of this model started in 1978 by the United States Forest Service (USFS), in conjunction with the Federal Emergency Management Agency (FEMA), in response to the need to develop a five-year land administration plan and approaches to assessing socioeconomic impact on local areas.

Despite the wide use of employment multipliers, calculated based on input–output tables, some economists and agencies point out the shortcomings of this toolkit. For example, these multipliers are suitable for use in preliminary calculations of the impact of certain economic policies, i.e., before these measures were implemented. The multipliers do not take into account such effects as changes in prices by suppliers, limited resources, which can be very significant for real multiplier effects. Therefore, alternative approaches to measuring local employment multipliers are quite common. These approaches are based on econometric assessment of employment multipliers for individual local areas based on empirical data (see, for example, [11–15]).

Estimates of inter-country multiplicative employment effects. The processes of globalization and integration have led to the need for assessing the consequences of structural changes in world trade (taking into account the emergence of trade barriers), in value-added chains, climate regulation mechanisms, and the consequences of environmental policy for the global and national labor markets [16]. The input–output methodology provides significant opportunities for such research.

In order to assess the relevant effects, direct and indirect employment multipliers calculated by the national statistics offices are used. To assess indirect

¹⁰ <https://apps.bea.gov/regional/rims/rimsii/home.aspx>

¹¹ Impact analysis for PLANning. <https://implan.com>

Fig. 1. Dynamics of the average number of employees in the economy providing the production of a unit of final demand: ----- with an unchanged constant output structure of 2000; — actual situation.

effects on a global scale, employment multipliers are used, calculated on the basis of multiregional input–output table (MRIO). These tables allow us to assess how the change in the production volume of a particular sector in country i affects employment not only in this sector within the country but also in related industries in other countries. This approach is used in its research by the International Labor Organization (ILO).

Thus, there is a noticeable demand for assessments of the impact made by various environmental policies and the transition to a “green economy” on the employment sector and national labor markets through the transformation of the production structure of the world and national economies. According to ILO estimates, as a result of the gradual transition to a green economy six million jobs in the world will disappear, but at the same time 24 million jobs will be created [17].

The process of regulating greenhouse gas emissions aimed at attaining environmental sustainability involves the consideration of scenarios of increasing renewable sources in the structure of electricity generation. This logically entails the question of the impact which the change in the balance in favor of renewable energy sources may make on the number and sectoral structure of employment, both in individual countries and on a global scale [18].

The influence of international competition and changes in value-added chains on the dynamics of jobs in the EU space based on the global input–output model is studied, for example, in [19].

Assessment of total labor input in the Russian economy. Despite the fact that in a number of countries the analysis of employment multipliers is an integral part of assessing the effectiveness of implementing macro-economic or regional policies, in Russia total labor input is not calculated. Meanwhile, the application of the above methodology for assessing total labor input

by type of economic activity on the basis of symmetric input–output tables allows one to get an idea of the impact made by the input–output structure of the economy on the employment and labor market.

The relative influence of the change in Russia’s structure of production on the dynamics of employment can be demonstrated by the example of the average number of employed providing the production of a unit of final demand (in monetary terms) in the economy. This indicator is based on the average value of the total labor input by industry, weighted by the volume of the industry’s final demand.

Figure 1 shows the performance of this indicator for each year calculated in two versions: based on the actual structure of production and unchanged, fixed at the level of the base year¹².

Figure 1 reflects the impact of structural changes in the economy on the dynamics of employment and demonstrates the contribution of the structural component to the change in the average number of people employed in the economy. Estimates show that, firstly, in 2000–2015, the number of the employed people, averaged over industries, necessary for producing a unit of final product in the economy decreased by more than a third. Secondly, the contribution of the structural component was very small in comparison with those technological changes that took place at the intraindustry level (for example, due to the gradual introduction of labor-saving technologies).

At the same time, the average value always neutralizes the features that can be more or less manifested at the industry level. For example, in the intermediate consumption of industry i , as a result of technological changes, the products of one industry can be replaced by products of another industry. If the substitution effect has affected industries with a similar level of labor intensity, the total number of the employed in the economy will not change, but at the industry level, the consequences of changes in the structure of intermediate costs will affect employment in different ways, which should not be underestimated in forecasting. In general, an increase in the share of relatively less labor-intensive industries in total production, all other things being equal, will reduce the overall labor intensity of the economy and, therefore, reduce the demand for labor.

Estimates of total labor input for the consolidated industries of the economy, highlighting direct and indirect effects as of 2017 are shown in Fig. 2.

The coefficient of the industry’s direct labor intensity is the ratio of the number of people employed in the industry per unit of its final production. Indirect labor intensity reflects the number of people employed in

¹²The calculations were carried out on the basis of symmetric input–output tables developed at the Institute of Economic Forecasting of the Russian Academy of Sciences for the period 1980–2015.

Fig. 2. Characteristics of labor intensity of industries, 2017: □ indirect labor intensity; ▨ direct labor intensity; — multiplier coefficient of jobs in the economy per one job (right scale).

related industries that provide the production of final goods and services in the industry (in monetary terms). The column height is the coefficient of the total labor input. The multiplier coefficient for jobs shows how many jobs in the economy correspond to one job in the industry and is calculated as the ratio of indirect labor intensity to direct. The statistical basis for calculations of the total labor input is input–output balance (in basic prices for 2017 with the exclusion of the import component from intermediate and final consumption) and sectoral employment (the LFS data).

The most labor-intensive sectors in the Russian economy are the service and trade sectors. However, their indirect effect on related industries is minimal: for one hundred jobs, for example, in the education industry in 2017, there were only seven jobs in the economy. The indirect effect of the health care and social assistance industry is twice as large: there were 14 jobs in the economy per 100 jobs therein. For the hotel and catering industry, the corresponding figure was almost 30 jobs; for wholesale and retail trade, 44. It can be said that employment in most of the services and trade sectors depends on the output performance in these and related industries but the industries themselves have, in comparison with others, a small potential for multiplying jobs in the economy.

The largest indirect effect is produced by these industries: mining (175 jobs in related industries per

100 jobs in the industry), supply of electricity, gas, and steam (179), manufacturing (166), and real estate operations (129). In these industries, the magnitude of the indirect effect is higher than one, thus, these industries are built into the system of input–output connections and, with a low direct labor intensity relative to other industries, have a great influence on employment in related economic activities.

In addition to assessing the total value of the indirect effect, the employed toolkit allows studying its industry's structure based on matrices of total labor input in the economy. This analysis makes it possible to identify the sectors of the economy, in which employment is most affected by the production of other industries. The table shows the sectoral structure of total labor input for four industries with the largest indirect effect.

It can be seen from the table that of all those employed in sectors providing the output of the mining industry, less than half (41%) are employed in the industry itself, 18% work in transport and communications (which is due to the need to transport products from mining sites) and 10% in manufacturing industries. More than 50% of those employed in the economy providing the output of manufacturing industries are concentrated in the industry itself (52%), 10% in wholesale and retail trade, transportation and storage, and agriculture. The industry's

Table 1. Industry's structure of total labor input for four industries, % of total labor input, 2017

Industry	Mining	Manufacturing	Supply of electricity, gas and steam	Operations with real estate
Agriculture	2.2	10.7	1.4	1.9
Mining	41.1	2.8	3.5	0.9
Manufacturing	10.1	52.3	6.0	7.7
Supply of electricity, gas and steam	4.6	3.4	56.0	6.2
Water supply, collection and disposal of waste, removal of pollution	0.5	1.0	0.9	1.6
Construction	3.0	1.0	1.6	5.6
Wholesale and retail trade	7.5	10.2	14.9	8.2
Transportation and storage	17.9	9.8	6.3	7.5
Hotels and catering facilities	0.4	0.3	0.3	0.3
Information and communications	0.6	0.6	0.8	1.2
Finance and insurance	2.1	1.9	1.8	2.1
Operations with real estate	1.3	0.6	0.7	47.6
Professional, scientific, and technical activities	2.0	1.8	1.6	3.5
Administrative activities and related additional services	5.3	2.4	2.7	3.8
Public administration, military and social security	0.3	0.2	0.2	0.3
Education	0.4	0.3	0.3	0.3
Health care and social assistance	0.2	0.1	0.2	0.1
Culture, sports, organization of recreation and entertainment	0.0	0.0	0.0	0.0
Other services	0.7	0.6	0.8	1.2
Total:	100.0	100.0	100.0	100.0

structure of those engaged in providing the output of products in the supply of electricity, gas, and steam is characterized by the following proportions: 56% are employed in the industry itself, 15% in wholesale and retail trade, and 6% in the manufacturing industries. A high percentage of those employed in the economy providing the output of real estate operations are concentrated in wholesale and retail trade (8.2%) and transportation and storage (7.5%).

The high share of those employed in these industries in the structure of input–output connections reflects the large proportion of trade in the cost structure of these industries and the overall high level of trade margins in the Russian economy. However, as calculations show (see Fig. 2), the effect of job multiplication by these industries (wholesale and retail trade, transportation and storage) is not so great in comparison with other industries. Thus, employment in trade is more dependent on other industries (serves them) than employment produced by it in other industries.

Estimates of total and indirect labor inputs in the economy in a more detailed sectoral context have a high potential for practical use. They can be used as a

basis for assessing the impact made by implementing government programs aimed at the support various sectors in the economy as well as by large investment projects on employment and the labor market. Due to the fact that the industries are differentiated in terms of labor intensity, the degree of integration into the system of input–output connections and the qualification structure of the workers employed in them, the creation of jobs in the industries differently respond to the input–output structure of employment. Moreover, the corresponding effects can be calculated not only at the level of the entire economy but also using a number of hypotheses at the level of individual regions. Accordingly, such assessments are important both during the period of economic shocks as they enable developing informed solutions to support employment, and in routine economic policy aimed at ensuring the sustainability of socioeconomic development.

In addition, besides indirect multiplier effects, the scientific literature provides estimates of the induced effects of job creation in industries associated with additional costs for employees (due to an increase in their wages), the state (through tax increases), and business (due to increased profits). However, these estimates require the availability of consumption elas-

ticities of all three economic agents broken down into separate groups of goods and services, which is a separate in-depth study (the assessment of the induced effects is presented, for example, in [2, 4]).

As noted, the coefficients of total labor input can be used to predict the industry's structure of labor demand in the short and medium term. As part of a long-term forecast, scenarios related to modeling the impact of various changes in the structure of the economy on the parameters of labor demand can be considered.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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