The Estimation of Interindustry Exchange Equivalence in the Ukrainian Economy

Oleksandr Chebanov

Institute of Industrial Economics of NAS of Ukraine, 77 Universitetska Street, Donetsk, 83048, Ukraine, e-mail: alexandr_chebanov@yahoo.com

Abstract. In this paper we obtain and analyze estimations of values of comparative resource output for types of economic activity in Ukraine for the period of time from 2000 till 2004. We reveal main tendencies of interindustry changes in the resource and price structures that took place in Ukrainian economy over this period.

1. Introduction

The formation of the market economic system which would be socially-oriented and competitively strengthened is a common problem for majority of countries with transition economy. At the present stage of transformation processes taking place in these countries, the comparison of actual values of parameters characterizing economic system development to their possible optimal values can be used to propose rational practical solutions to this problem.

In this paper the degree of interindustry exchange equivalence (DIEE) is chosen as the indicator of the national economy development, which allows one to compare actual and optimal values of parameters. The exchange between branches is considered to be equivalent (distribution - to be equitable), if there is no appropriation (by individual branches) of economic benefit *de facto* created by other economy branches.

An estimation of DIEE can be obtained on the basis of results of different theories of economic thought. We connect optimal parameters of economic development with Neoclassical conditions of competitive equilibrium. Therefore, DIEE estimation is done in two stages. At the first stage, we estimate the values of parameters of economic benefit distribution between production factors under conditions of competitive equilibrium. To achieve this goal, we use the deterministic model of Cobb-Douglas production function and statistic data containing information on employment, capital assets, and gross value added at factor costs for the period of time from 2000 till 2004. At the second stage, we calculate prices corresponding to the values of interindustry distribution structure of gross value added (computed by applying the Input-Output model and the Input-Output Tables that can be found in the official publications of the State Statistics Committee of Ukraine) and compare their values with the actual prices.

The results of our computations are given in terms of the aggregate resource structure, comparative resource output values, and ratios of output estimations (in the actual and calculated prices) for separate types of economic activity of Ukrainian economy. Indices of these types' fractions in capital assets and employment and their grouping by dynamics of fractions in labor, capital, aggregate resource, and gross value added at factor costs in 2000-2004 are also shown.

The analysis we have conducted in the paper clearly reveals some tendencies in the structural changes of Ukrainian economy that can be useful for correction of industrial, structural, investment, financial, credit and income policy to ensure formation of stable and economically efficient proportions of the resource structure, the income structure, and the price structure of the national economy.

2. The degree of interindustry exchange equivalence as one of the indicators of the national economy development

In economic theory, the optimal parameters of economic system are frequently connected with competitive situation which is characterized by free movement of labor and capital providing the most effective distribution of available production factors.

According to A. Smith, the whole of the advantages and disadvantages of the different employments of labor and stock must be either perfectly equal or continually tending to equality. “If in the same neighborhood, there was any employment evidently either more or less advantageous than the rest, so many people would crowd into it in the one case, and so many would desert it in the other, that its advantages would soon return to the level of other employments.” (Smith, 1904).

It should be noted that, under conditions of the functioning of competitive pricing mechanisms, the market prices of commodities normally tend to so-called “natural”, “normal” or “production” prices whose purpose is to express stable, non-accidental and permanent forces conducted by the economic system.

A. Smith defined the natural prices in his Wealth of Nations: “When the price of any commodity is neither more nor less than what is sufficient to pay the rent of the land, the wages of the labour, and the profits of the stock employed in raising, preparing, and bringing it to market, according to their natural rates, the commodity is then sold for what may be called its natural price.”

He also pointed out that “the natural price, therefore, is, as it were, the central price, to which the prices of all commodities are continually gravitating. Different accidents may sometimes keep them suspended a good deal above it, and sometimes force them down even somewhat below it. But whatever may be the obstacles which

hinder them from settling in this center of repose and continuance, they are constantly tending towards it." (Smith, 1904).

D. Ricardo wrote in his Principles that "it is then the desire, which every capitalist has, of diverting his funds from a less to a more profitable employment, that prevents the market price of commodities from continuing for any length of time either much above, or much below their natural price." (Ricardo, 1821).

K. Marx used production prices in his Capital and noted that "It is really what Adam Smith calls natural price, Ricardo calls price of production, or cost of production, and the physiocrats call prix necessaire, because in the long run it is a prerequisite of supply, of the reproduction of commodities in every individual sphere." (Marx, 1959).

Great attention to natural, normal and/or production prices is given in works of scholars representing Neoclassical (J. Clark, A. Marshall, L. Walras and others), Neo-Ricardian (P. Sraffa, L. Pasinetti, H. Kurz and others) and other schools of economic thought. It is essential to remark that, although there are different approaches to define and interpret these prices, most of the economic theorists consider them as the base of formation of the market prices.

The development of the market prices is a result of an exchange by commodities. The equality of the market prices to natural or production prices means the equivalent exchange by commodities.

It is known that, under conditions of the competitive equilibrium at the macroeconomic level, the equivalent exchange between the economy branches takes place. It provides the equitable distribution of economic benefit. The exchange between branches is considered to be equivalent (distribution - to be equitable), if there is no appropriation (by individual branches) of economic benefit *de facto* created by other

economy branches.

The DIEE can be chosen as one of the indicators of the national economy development. For such an approach, the following premise is initial: the interindustry relations should be based on the principle of economically equitable distribution of the cumulative economic benefit. Namely, the distribution should be fulfilled in accordance with the interindustry ratios of the production factors (resources). The economic sense of this principle is the providing of an equal output of the factor's unit (no matter what is the branch (sphere of usage) it corresponds), which is a premise for the balance of sectoral processes of reproduction. The normative magnitudes of an output (specific factor effect) are determined as the averaged ratio, which is stipulated by a level of development of so-called community technology at each historical instant, of benefit (effect) and factor costs for economy (branch). (It can be also interpreted as socially necessary conditions of reproduction).

The equivalence of interindustry relations (of exchange), as it is understood in such context, can be evaluated for each individual factor of production as well as for a cumulative resource, depending on the purposes and priorities of each stage of economy development.

In a real economic system, the equivalence of the interindustry exchange can be broken due to deviations of sectoral market prices from the economically proved level. Economic and institutional conditions for functioning of sectoral productions and markets (e.g., degree of monopolization, elasticity of demand on product, technological level, stage of a life cycle of branch and/or product, macroenvironment, etc.) play the key role in this process. As the result, there is a redistribution of factor costs with the applicable appropriation of the unearned effect (benefit) by the individual agents of

market exchange. Thus, the redistribution processes occurring under interindustry exchange and final use reflect peculiar properties of the exchange-distributive relations in the national economy.

The observable violations of the equivalence can have different magnitudes on duration, intensity, depth (scale) and other characteristics. These estimations can be very useful to analyze general tendencies of the national economic system development, develop programs and choose instruments for the state regulation of the transition economy.

3. Algorithm for DIEE estimation

Scholars representing various schools of economic thought describe the competitive market conditions in different ways. They use different mathematical instrument set for this purpose. Since the general principles of interindustry exchange equivalence analysis, stated in Section 2, belong to no specific economic school, the further study of the equivalence can be based on approaches of different schools. In this paper, we apply the results of the marginal productivity theory to estimate the DIEE.

The main statements of the marginal productivity theory are stated in (Clark, 1908). In this theory, prices are considered as signals of economic defecit (for producers) and social utility (for consumers). Then, due to the principle of equality of marginal values, the competetive pricing mechanism makes it possible to produce the best set of commodities by means of the resources and technologies available. In addition, the prices of commodities and prices of production factors are determined mutually and simultaneously. Under conditions of competitive equilibrium, every factor of production receives part of income in accordance with its marginal product and "prices are at their natural level when labor and capital in one industry produce as much

and get as much as they do in any other. Normal prices mean equalized wages and equalized interest." (Clark, 1908).

In modern economic theory, the production function provides one of the most adapted and well-developed tools for analysis and quantitative estimation of parameters of the economic benefit distribution between production factors obtained from empirical data. This function was first applied by C. Cobb and P. Douglas to estimate the ratio between incomes of production factors in American economy. It was further developed by scientists representing Neoclassical approach (R. Solow, B. Minhas, H. Chenery, J. de Cani, M. Brown and others).

For the case of two production factors, the Cobb-Douglas production function can be written as follows:

$$Y = AL^{\alpha}K^{\beta}, \tag{1}$$

where Y is an output, L is a measure of labor, K is a measure of capital, A, α, β – are constants whose values can be found from the empirical data. Note that, according to Neoclassical interpretation of Cobb-Douglas production function, parameters α and β have the following meaning: they represent the shares of production factors in the case when income is distributed under conditions of competitive equilibrium.

The following procedure describes how production function (1) is traditionally used for finding the values of parameters of the economic benefit distribution (see, for example, (Blaug, 2001) or (Brown, 1971)). First, values of α and β are estimated from equation (1) by means of regression analysis and statistical information about indicators of economic benefit and resources used for production of this benefit in economy. These estimations of production function parameters are then compared with

statistical data reflecting actual distribution of economic benefit between production factors. If econometric estimations of α and β match corresponding shares that the production factors actually receive while the economic benefit is distributed, then conclusion about payment for production factors according to their marginal products is drawn.

The above interpretation of the production function is based on the assumption that the community technology attains the largest output of products for each combination of the production factors (Brown, 1971). It is also assumed that well comparable dynamic series of data are available for a long period of time. All of the above makes it quite difficult to get the adequate description of transition economy. Hence, alternative deterministic methods for empirical estimation of the production function parameters are required. One of such methods, presented in (Grebennikov and Suvorov, 1998), is developed on the following premises: (1) the relative fraction contributed by individual economy branches into the cumulative resources is equal to the mean between the shares contributed by those branches into the capital and employment assets; (2) the unit loss for one of the production factors is equivalent to the unit gain of other factor.

In (Grebennikov and Suvorov, 1998), the CRO is selected as indicator characterizing economic benefit distribution. It is obtained by multiplying the branch resource output (i.e., the ratio of branch gross domestic product to branch aggregate resource) by the resource intensity averaged for economy. It should be noted that this indicator is helpful for interindustry exchange equivalence analysis. However, from our point of view, the approach for calculating of CRO indicator should be modified so that

the proposed method of estimation of economic benefit distribution parameters according to marginal productivity would be adapted to available statistical data.

It is known that the value of branch gross domestic product is an indicator characterizing final result of branch activity. According to the methodology of System of National Accounts (SNA), gross domestic product consists of compensation of employees, gross operation surplus, mixed income and taxes (less subsidies) on production and imports. Since, according to the method described in (Grebennikov and Suvorov, 1998), the value of aggregate resource (AR) consists of two production factors – labor and capital, the value of economic benefit should be free from taxes and subsidies on production and imports for most adequate reflection of the result of branch activity. According to the methodology of SNA, difference between gross domestic product and taxes (less subsidies) on production and imports equals to "gross value added at factor costs". (System…, 1993) That is why, from our point of view, the usage of value of gross value added at factor costs as indicator of economic benefit for estimation of CRO values seems to be more reasonable.

Below we describe our modification of the deterministic method (Grebennikov and Suvorov, 1998).

In further discussion, the economy is presented by *m* branches (types of economic activity) and two production factors (labor and capital). Let $x(i) = X(i)/X$, $c(i) = C(i)/C$ and $n(i) = N(i)/N$ be relative weights (shares) of separate economy branch *i* in gross value added at factor costs (*X*), capital assets (*C*), and employment (*N*), respectively. Then, $r(i) = \min(c(i), n(i))^{\lambda} \max(c(i), n(i))^{1-\lambda}$ is the share of branch *i* in aggregate resource which is determined as aggregate from capital and labor, and $q(i) = x(i)/r(i)$ is the value of comparative resource output of branch *i*.

By definition,

$$\sum r(i) = 1 . \tag{2}$$

Solving equation (2) for λ makes it possible to define the values of *r(i)* and, consequently, the values of *q(i)* for every branch *i*.

Next, we take the square root of the conditional moment of the second order distribution *M1* (here the deviations of *q(i)* are determined with respect to the unity) and consider its value as an integral estimation of the discrepancy between the actual and equitable distribution of economic benefit for each type of economic activity. Similarly, we use the square root of the conditional moment of the second order distribution *M2* as an integral characteristic of the discrepancy between the actual and equitable distribution of economic benefit in the national economy.

For separate economy branch *i*, the marginal rate of substitution of labor by capital (*MRS (i)*) is defined by the formula:

$$MRS(i) = \begin{cases} \dfrac{C(i)}{N(i)} \cdot \dfrac{\lambda}{1-\lambda}, \; if \; c(i) = \max(c(i), n(i)), \\ \dfrac{C(i)}{N(i)} \cdot \dfrac{1-\lambda}{\lambda}, \; if \; c(i) = \min(c(i), n(i)). \end{cases} \tag{3}$$

Therefore, in our case, the *MRS* for the whole economy is calculated as averaged value over industrial values:

$$MRS = \sum MRS(i) \cdot r(i) . \tag{4}$$

The values of elasticities of AR to capital and labor, denoted δ_C and δ_N, respectively, can be determined for the whole economy from (5)-(6), assuming that their sum equals to one.

$$MRS = \frac{C}{N} \cdot \frac{1-\delta_C}{\delta_C}, \tag{5}$$

$$\delta_N = 1 - \delta_C . \tag{6}$$

Let us assume that the CRO doesn't depend on the scale of AR, i.e. $\frac{\partial X}{\partial R} = \frac{X}{R}$.

Then, in our case, the marginal products of labor and capital are defined as follows:

$$\frac{\partial X}{\partial N} = \frac{X}{N}\delta_N , \tag{7}$$

$$\frac{\partial X}{\partial C} = \frac{X}{C}\delta_C . \tag{8}$$

Thus, under the assumption on independence of CRO from scale of AR, indicators δ_N and δ_C also represent elasticities of gross value added to labor and capital, respectively. Therefore, the ratio of these indicators characterizes the economic benefit distribution between production factors according to their marginal productivity in economy.

We use the Input-Output model, proposed by W. Leontief, to find equilibrium prices that correspond to the computed distribution parameters of economic benefit. According to many scholars (see, for example, (Kuboniwa, 1991), (Kurz and Salvadori, 2004), (Leontief, 1966), (Schatteles, 1975) etc.), this model is the most adapted one for the quantitative analysis of structural changes on the basis of empirical data.

In this paper we apply the Input-Output model as follows. First, we define the values of gross value added at factor costs corresponding to marginal products of labor and capital for separate branch *i*:

$$X^m(i) = \frac{\partial X}{\partial N} \cdot N(i) + \frac{\partial X}{\partial C} \cdot C(i) . \tag{9}$$

Then, the values of product outputs at factor costs for every branch *i*, which corresponds to the calculated value of $X^m(i)$, can be obtained from the next equality:

$$\overline{V}^{m} = \overline{X}^{m} \cdot (I - B)^{-1}, \tag{10}$$

where $\overline{V}^{m}$ is the vector of industrial product outputs estimations at factor costs, $\overline{X}^{m}$ is vector of industrial gross value added estimations at factor costs, I – is the identity matrix, B – is matrix of coefficients of production use (i.e. $B = \|b_{ij}\|$, $b_{ij} = \frac{V_{ij}}{V_i}$, V_i is product output of branch i, V_{ij} is flow of product from branch i to branch j).

Thus, the ratio between branch product outputs in the actual and calculated prices characterizing the DIEE can be computed as follows:

$$k(i) = \frac{V(i)}{V^{m}(i)}, \tag{11}$$

where $V(i)$ is the actual value of product output at factor costs for branch i, $V^{m}(i)$ is calculated value of product output for branch i from equation (10).

Next, we take the square root of the conditional moment of the second order distribution M3 (here the deviations of $k(i)$ are determined with respect to the unity) and consider its value as an integral estimation of the discrepancy between the actual and calculated prices for each type of economic activity. Similarly, we use the square root of the conditional moment of the second order distribution M4 as an integral characteristic of the discrepancy between the actual and calculated prices in the national market.

4. Statistic data for DIEE estimation

The statistic data regarding employment, capital assets (in comparable prices of 2000 year) and gross value added for the period of time from 2000 till 2004, which is contained in the official publications of the State Statistics Committee of Ukraine (see, (Labor…, 2005) and (Fixed Assets…, 2005)), has been used as the information base for

the estimation of AR structure and the CRO values in the national economy. The Ukrainian Input-Output Tables (see, for example, (Ukraine's Input–Output Table…, 2006)) for the period of time from 2000 till 2004 has been used for computation of ratio between branch product outputs in the actual and calculated prices and for the state estimation and the tendency determination of the DIEE in the national market.

To calculate the values of estimations for the AR, CRO and ratio between branch product outputs in the actual and computed prices we have used the data in the context of types of economic activity for 26 types (such as agriculture, forestry, fishery, production of energy materials, production of non-energy materials, food-processing industries, textile and leather industry, woodworking, pulp and paper industry, publishing, manufacture of coke products, petroleum refinement and processing of nuclear fuel, manufacture of chemicals, rubber and plastic products, manufacture of other non-metallic mineral products, metallurgy and metal processing, manufacture of machinery and equipment, other production, electric energy, gas supply and water supply, construction, trade, hotels and restaurants, transport, post and telecommunications, financial intermediation, real estate transactions, renting and services to legal entities, public administration, education, health care and social assistance, community, social and personal service activities, other activities). To analyze the dynamics of estimations for the DIEE we have presented results of our computations for some types of economic activity in Tables 1-6.

5. Analysis of estimation of AR structure and CRO values for Ukrainian economy

In this section, we analyze changes in both AR and CRO that took place in Ukrainian economy for the period of time from 2000 till 2004. We derived these

quantities from statistic data containing information on employment, capital assets and gross value added at factor costs during this period of time.

The results of our computations of AR fractional values that are found as a solution of equation (2) are given in Table 1. As can be seen from the table, fractions of production of energy materials, manufacture of coke products, petroleum refinement and processing of nuclear fuel, trade, transport, post and telecommunications, financial intermediation, real estate transactions, renting and services to legal entities, education, health care and social assistance, community, social and personal service activities had stable growth in AR of Ukrainian economy. At the same time, one can see that the growth of the fractional values for food-processing industries and public administration was alternated by their reduction. Fractions of hotels and restaurants, woodworking, pulp and paper industry, publishing, metallurgy and metal processing have almost same values. Fluctuations of fractions in aggregate resource with tendency to reduction can be observed for manufacture of chemicals, rubber and plastic products, manufacture of machinery and equipment. We also note stable reduction of this indicator for agriculture, production of non-energy materials, textile and leather industry, manufacture of other non-metallic mineral products, electric energy, gas supply and water supply. The differences between growth rates of AR fractions of various types of economic activity are stipulated by different dynamics of their shares in capital assets and employment (see Table 2 and 3).

Analysis of our computations evidences the reduction of employment and growth of capital that simultaneously happened in both the whole Ukrainian economy and separate types of economic activity, such as agriculture, production of energy materials, food-processing industries, manufacture of coke products, petroleum

refinement and processing of nuclear fuel, construction, trade, hotels and restaurants, real estate transactions, renting and services to legal entities, financial intermediation, transport, post and telecommunications, public administration, health care and social assistance, community, social and personal service activities. Thus, the shifts of the resource structure in Ukrainian economy have occurred on the basis of displacement of labor by capital. This fact, in turn, led to the growth of the capital-labor ratio.

Our estimations of CRO values are shown in Table 4. Clearly, the increase of these indicator values was stable only for manufacture of coke products, petroleum refinement and processing of nuclear fuel for the period of time under consideration. A few years of the CRO increase were alternated by its decrease for agriculture, production of non-energy materials, food-processing industries, textile and leather industry, woodworking, pulp and paper industry, publishing, manufacture of chemicals, rubber and plastic products, manufacture of machinery and equipment, manufacture of other non-metallic mineral products, construction, trade, hotels and restaurants, financial intermediation, real estate transactions, renting and services to legal entities, health care and social assistance, community, social and personal service activities. Fluctuations of this indicator with tendency to reduction were observed for production of energy materials, metallurgy and metal processing, transport, post and telecommunications, public administration, education. Stable decrease of CRO can be noticed only for electric energy, gas supply and water supply.

It should be noted that manufacture of machinery and equipment and service branches (such as public administration, education, health care and social assistance, community, social and personal service activities) had unsatisfactory CRO values. Calculated values of this indicator for real estate transactions, renting and services to

legal entities are questionable. Comparing these values with analytical data characterizing growth rate, price dynamics and income dynamics of this type of economic activity, it is reasonable to assume that the factor of shadow corrects our estimations, decreasing their values. Most likely, this assumption can be also used for hotels and restaurants too. Relatively low value of CRO for manufacture of coke products, petroleum refinement and processing of nuclear fuel in 2000 year is stipulated by considerable loss of this type of economic activity.

As follows from Table 5, the difference in changes of CRO values for separate types of economic activity are stipulated by different growth rates of their fractions in the gross value added at factor costs and in the AR. We also note that CRO values for approximately half of types of economic activity were greater than the averaged value for the whole economy in both 2000 and 2004. In addition, agriculture, food-processing industries, woodworking, pulp and paper industry, publishing, manufacture of chemicals, rubber and plastic products, metallurgy and metal processing, construction, trade, transport, post and telecommunications belong to the group of types of economic activity having relatively high values of CRO during the period of time under consideration. Public administration and electric energy left this group in 2001, followed by gas supply and water supply in 2004. Manufacture of coke products, petroleum refinement and processing of nuclear fuel and financial intermediation took their place in 2001.

The discrepancy between the values of CRO and its averaged level for the whole economy appeared to be the most substantial for trade and financial intermediation. At the same time, it had almost no influence on agriculture and manufacture of chemicals, rubber and plastic products (by indicator *M1*). Financial intermediation was the first

among the types of economic activity by the CRO indicator in 2004 (compared with its 14th place in 2000).

The results of our computations testify that the structure of Ukrainian economy became worse due to the increase of specific weights of branches having relatively low values of the resource output during 2000-2004 (the value of indicator *M2* increased by 16,4%). The largest discrepancy between the CRO values is observed for the year of 2004. The structure of economic benefit distribution between the types of economic activity was close to the structure of aggregate resource distribution (by indicator *M2*) in 2002. So, structural changes didn't have stable nature.

6. Analysis of ratio of product output estimations of economic activity types for Ukrainian economy

To analyze the formation and dynamics of market prices for individual segments of the national market, we have calculated the estimations of DIEE for different branches as solution of equation (11). The results of our computations are presented in Tables 6 in the form of ratio between economy activity types product outputs in the actual and calculated factor costs. The ratio is positive, if the actual prices of branch products are overstated in comparison with the branch prices under conditions of competitive equilibrium. It testifies about favorable price situation, which is formed inside of the individual branch markets for the time period of interest. As our analysis shows, the branch structure of the production factors varies unessentially from year to year. Therefore, the changes of structural proportions of the Ukrainian economy were primarily defined by the market conditions during this time interval.

The discrepancy between supply and demand in the branch markets is the main source of the deviations of actual prices from calculated values that arise under the

market economy conditions. So, the ratio will be more than unity, if demand is more than supply, and less than it, otherwise. Therefore, the ratio of branch product output estimations (in the actual and calculated prices) is also indirect description of annual supply and demand equilibrium in the corresponding market segments. Its dynamics characterizes stability of this equilibrium in the individual branch markets from year to year.

The analysis of estimations for the product output (in the actual and calculated factor costs) computed for different types of economic activity (see Table 6) shows that the price conditions were favourable for agriculture, production of non-energy materials, food-processing industries, textile and leather industry, woodworking, pulp and paper industry, publishing, manufacture of chemicals, rubber and plastic products, manufacture of other non-metallic mineral products, manufacture of machinery and equipment, construction, trade, hotels and restaurants, financial intermediation, real estate transactions, renting and services to legal entities, public administration in 2000-2004. The price conditions became more favorable for financial intermediation (ratio between the product outputs in the actual and calculated prices has increased from 0,855 to 1,916). The opposite change of the ratio was fixed for electric energy, gas supply and water supply (decrease from 1,185 to 0,900).

The situation in electric energy, gas supply and water supply deserves a special attention. The decrease of the price ratio reflects the process of a gradual movement of the branch prices towards their "natural" level (within the framework of the acting technology) which was obviously artificially overstated.

The ratio for food-processing industries supports the argument regarding its high survival. At the same time, it is possible to suppose that the branch "is obliged" by its

relative benefits to the domestic inhabitants who are the main consumers of its products.

It should be noted that the ratio for manufacture of machinery and equipment increased by 20,2 percent. This fact can be considered as an indirect estimation of increased level of price competitiveness for domestic manufacture of machinery and equipment in the domestic market and as the indicator of way out from reproduction collapse in economy. Thus, this branch, oriented on the market filling by investment and innovation products, had the price stimulus (signals) for increase in production.

We also note that, at the time of the market relation formation, the deviations of the actual prices from the calculated prices (computed at the average for an industry) had the tendency to increase (from 0,247 in 2000 to 0,324 in 2004), but their dynamics was not stable. The least gap between the actual and calculated factor costs took place in 2002. Dynamics of an analyzable magnitude reveals that the degree of interindustry exchange equivalence and stability of ratio between supply and demand has decreased in the Ukrainian economy towards the end of the considered period in comparison with its beginning.

During the time interval under consideration, the branch dynamics of price fluctuations have been more intensive in comparison with the averaged for whole economy. The average amplitude of deviations of the actual prices from the calculated ones was the largest for a trade (64,0 percent from the calculated level under conditions of competitive equilibrium) and the smallest for hotels and restaurants (3,9 percent from a calculated level) for the period of time from 2000 till 2004.

The branches, for which the actual prices were overstated in comparison with the calculated prices for this period, should be considered as "recipients" in the sense that they have received more economic benefit than they "have earned" (with respect to

their calculated factor costs under conditions of competitive equilibrium) during an exchange. At the same time, branches, for which the price conditions were unfavorable, should be thought as "donors" of the economic benefit, since they have not received the effect they had to earn according to socially necessary conditions of reproduction in the full volume.

The branch-recipient group had consisted of 12 types of economic activity in 2000. In addition, agriculture, food-processing industries, woodworking, pulp and paper industry, publishing, manufacture of coke products, petroleum refinement and processing of nuclear fuel, manufacture of chemicals, rubber and plastic products, metallurgy and metal processing, construction, trade, transport, post and telecommunications were in this group during the analyzable period. The production of energy materials, electric energy, gas supply and water supply had become donors of economic benefit in 2003 and 2004, respectively. At the same time, textile and leather industry, manufacture of other non-metallic mineral products, financial intermediation had entered the branch-recipient group in 2001. This group had been added by manufacture of machinery and equipment, hotels and restaurants in 2003. Thus, the branch-recipient group had consisted of 15 types of economic activity by 2004.

It should be noted that real estate transactions, renting and services to legal entities, public administration, education, health care and social assistance, community, social and personal service activities were in the branch-donor group during 2000-2004.

7. Conclusions

The analysis of Ukrainian economy during 2000-2004 we have conducted in this paper testifies about motion of AR from types of economic activity producing commodity (such as agriculture, production of non-energy materials, textile and leather

industry, manufacture of chemicals, rubber and plastic products, manufacture of machinery and equipment, manufacture of other non-metallic mineral products, electric energy, gas supply and water supply, construction) to types rendering services (such as trade, transport, post and telecommunications, financial intermediation, real estate transactions, renting and services to legal entities, public administration, education, health care and social assistance, community, social and personal service activities). Concentration of the greater part of resources in the service sector is one of the indications of postindustrial stage of economic development that can be seen in well-developed countries of the world. In Ukrainian economy, however, the presence of fixed tendencies of structural changes in the branch distribution of AR does not mean the entrance to a qualitatively new stage of development, since they are caused by advanced reduction of production sphere. Moreover, the level of technology used and the level of quality services remain, as early, sufficiently low.

It should be noted that CRO was greater than the averaged value for those types of economic activity (e.g., agriculture, manufacture of chemicals, rubber and plastic products, construction) losing AR during 2000-2004. At the same time, the branches (such as production of energy materials, real estate transactions, renting and services to legal entities, public administration, education, health care and social assistance, community, social and personal service activities), whose CRO was less than the averaged level, have accumulated AR in relative measurement. Thus, AR has moved from relatively efficient types of economic activity to relatively inefficient ones. Probably, this fact is stipulated by non-market factors having substantial influence on the development of Ukrainian economy.

The growth of the capital-labor ratio and substitution of labor by capital have occurred in Ukrainian economy during 2000-2004. Interindustry structural changes have not had stable nature and been inefficient from the point of view of both the economically equitable distribution of economic benefit and the equivalence of interindustry exchange. Thus, the conditions of balanced structural development of economy have not been created in Ukraine.

The different concepts of modern economic theory and the experience of foreign countries with developed market economy support the thesis about the necessity of direct participation of state institutions in the process of formation of the basic tendencies of the national market development. The analysis of state and tendencies of the interindustry exchange equivalence on the Ukrainian market shows that an effective state intervention is the important factor at the present stage of transforming processes in Ukraine. Therefore, scientifically substantiated state influence on redistribution processes and interindustry exchange by means of all the (possible in market conditions) instruments (first of all, by regular improvement of fiscal and monetary policy) is needed for permanent reduction of the difference between interindustry and equivalent exchanges and further effective development of the national market. It should be based on estimations of deviations between actual and optimal parameters of the economic system development (computed in accordance with contributions of different schools of economic theory), quantitative analysis of factors causing these deviations and forecasting of dynamics of the main structural proportions.

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Table 1. The AR structure (by type of economic activity) for the economy of Ukraine in 2000-2004

Type of economic activity	r(i)				
	2000	2001	2002	2003	2004
Agriculture	0,150	0,142	0,132	0,119	0,106
Production of energy materials	0,044	0,045	0,046	0,046	0,046
Production of non-energy materials	0,015	0,014	0,013	0,013	0,013
Food-processing industries	0,034	0,034	0,033	0,033	0,034
Textile and leather industry	0,013	0,012	0,010	0,009	0,009
Woodworking, pulp and paper industry, publishing	0,007	0,007	0,007	0,007	0,007
Manufacture of coke products, petroleum refinement and processing of nuclear fuel	0,005	0,006	0,006	0,007	0,007
Manufacture of chemicals, rubber and plastic products	0,019	0,016	0,016	0,017	0,017
Manufacture of other non-metallic mineral products	0,014	0,013	0,012	0,011	0,011
Metallurgy and metal processing	0,033	0,033	0,033	0,033	0,034
Manufacture of machinery and equipment	0,066	0,063	0,059	0,055	0,056
Electric energy, gas supply and water supply	0,057	0,056	0,051	0,049	0,049
Construction	0,032	0,031	0,030	0,030	0,031
Trade	0,036	0,037	0,038	0,041	0,044
Hotels and restaurants	0,007	0,007	0,007	0,007	0,007
Transport, post and telecommunications	0,101	0,103	0,107	0,111	0,112
Financial intermediation	0,010	0,011	0,013	0,015	0,017
Real estate transactions, renting and services to legal entities	0,130	0,135	0,138	0,140	0,142
Public administration	0,043	0,046	0,050	0,054	0,047
Education	0,088	0,093	0,097	0,100	0,102
Health care and social assistance	0,061	0,063	0,066	0,068	0,070
Community, social and personal service activities	0,024	0,025	0,026	0,026	0,027

Table 2. Indices of fractions in capital assets and employment (by type of economic activity) in 2000-2004, in percentages to the year of 2000

Type of economic activity	In capital assets				In employment			
	2001	2002	2003	2004	2001	2002	2003	2004
Agriculture	99,6	100,1	99,1	94,8	90,8	81,0	68,5	58,0
Production of energy materials	102,7	107,0	105,6	103,9	98,4	98,3	98,7	100,7
Production of non-energy materials	89,0	86,5	79,2	77,9	102,5	102,4	104,6	111,7
Food-processing industries	100,6	91,6	96,2	94,6	98,8	100,0	100,2	105,3
Textile and leather industry	95,0	81,7	73,5	72,2	92,9	79,5	69,8	69,2
Woodworking, pulp and paper industry, publishing	83,8	75,7	84,6	83,2	102,6	103,2	104,8	114,9
Manufacture of coke products, petroleum refinement and processing of nuclear fuel	107,3	114,3	114,3	112,4	107,7	118,8	126,3	130,9
Manufacture of chemicals, rubber and plastic products	74,7	75,9	78,6	77,3	101,6	106,3	104,2	106,9
Manufacture of other non-metallic mineral products	88,8	76,9	69,0	67,8	94,5	87,3	85,0	88,0
Metallurgy and metal processing	94,9	90,7	87,5	86,0	105,3	108,6	111,0	116,6
Manufacture of machinery and equipment	95,1	88,1	76,5	75,2	95,6	91,4	89,2	90,4
Electric energy, gas supply and water supply	94,7	78,7	71,7	70,5	104,8	111,2	116,4	120,2
Construction	101,9	105,6	109,7	109,5	94,8	86,3	85,7	90,8
Trade	105,7	114,5	125,5	130,5	100,4	101,0	104,0	112,8
Hotels and restaurants	108,0	112,4	115,4	116,9	96,8	97,4	95,4	95,2
Transport, post and telecommunications	103,9	108,5	113,0	111,7	100,2	102,5	105,0	107,2
Financial intermediation	117,2	151,0	174,5	187,8	109,4	119,1	135,5	156,2
Real estate transactions, renting and services to legal entities	102,0	104,2	104,9	103,0	104,9	106,2	109,3	109,9
Public administration	102,4	105,2	107,3	106,1	110,8	123,9	136,1	110,5
Education	101,9	102,4	102,4	97,7	106,7	113,6	119,3	124,5
Health care and social assistance	102,8	104,7	105,6	101,9	104,4	109,7	114,4	117,6
Community, social and personal service activities	102,9	105,6	106,4	104,6	103,1	105,9	108,1	112,0

Table 3. Grouping of types of economic activity by dynamics of fraction in labor, capital and aggregate resource in 2000-2004

Type of economic activity by dynamics group	Change of fraction in factor resource	
	capital assets	employment
I. Increase (*r*)		
Production of energy materials	(+)	(+)
Food-processing industries	(–)	(+)
Woodworking, pulp and paper industry, publishing	(–)	(+)
Manufacture of coke products, petroleum refinement and processing of nuclear fuel	(+)	(+)
Metallurgy and metal processing	(–)	(+)
Trade	(+)	(+)
Hotels and restaurants	(+)	(–)
Transport, post and telecommunications	(+)	(+)
Financial intermediation	(+)	(+)
Real estate transactions, renting and services to legal entities	(+)	(+)
Public administration	(+)	(+)
Education	(–)	(+)
Health care and social assistance	(+)	(+)
Community, social and personal service activities	(+)	(+)
II. Decrease (*r*)		
Agriculture	(–)	(–)
Production of non-energy materials	(–)	(+)
Textile and leather industry	(–)	(–)
Manufacture of chemicals, rubber and plastic products	(–)	(+)
Manufacture of other non-metallic mineral products	(–)	(–)
Manufacture of machinery and equipment	(–)	(–)
Electric energy, gas supply and water supply	(–)	(+)
Construction	(+)	(–)

Table 4. The CRO values (by type of economic activity) for Ukrainian economy in 2000-2004

Type of economic activity	2000	2001	2002	2003	2004	M1
Agriculture	1,098	1,144	1,085	1,010	1,124	0,103
Production of energy materials	0,958	0,966	0,906	0,757	0,619	0,208
Production of non-energy materials	1,025	0,660	0,963	1,101	1,124	0,169
Food-processing industries	1,278	1,347	1,436	1,488	1,158	0,361
Textile and leather industry	0,670	0,759	1,040	1,065	0,950	0,187
Woodworking, pulp and paper industry, publishing	1,461	1,721	1,808	1,644	1,663	0,669
Manufacture of coke products, petroleum refinement and processing of nuclear fuel	0,289	1,001	1,083	1,637	1,893	0,586
Manufacture of chemicals, rubber and plastic products	1,131	1,083	1,037	1,113	1,129	0,105
Manufacture of other non-metallic mineral products	0,546	0,799	0,815	0,828	0,798	0,265
Metallurgy and metal processing	2,004	1,340	1,298	1,341	1,527	0,567
Manufacture of machinery and equipment	0,643	0,740	0,793	0,804	0,784	0,254
Electric energy, gas supply and water supply	1,301	1,136	1,124	1,056	0,834	0,176
Construction	1,247	1,294	1,284	1,419	1,467	0,353
Trade	2,712	3,190	3,092	3,163	2,945	2,028
Hotels and restaurants	0,842	0,883	0,839	0,902	0,959	0,123
Transport, post and telecommunications	1,366	1,307	1,279	1,319	1,215	0,301
Financial intermediation	0,803	1,204	1,138	1,399	3,010	0,927
Real estate transactions, renting and services to legal entities	0,439	0,522	0,541	0,499	0,529	0,496
Public administration	1,066	0,908	0,886	0,803	0,971	0,115
Education	0,573	0,541	0,562	0,579	0,512	0,447
Health care and social assistance	0,490	0,534	0,564	0,565	0,506	0,469
Community, social and personal service activities	0,475	0,467	0,645	0,613	0,499	0,466
M2	0,579	0,549	0,524	0,554	0,674	

Table 5. Grouping of types of economic activity by dynamics and factors of CRO changes in 2000-2004

Type of economic activity by dynamics group	Change of fraction	
	in gross value added at factor costs	in aggregate resource
I. Increase (*q*)		
Agriculture	(–)	(–)
Production of non-energy materials	(–)	(–)
Textile and leather industry	(+)	(–)
Woodworking, pulp and paper industry, publishing	(+)	(+)
Manufacture of coke products, petroleum refinement and processing of nuclear fuel	(+)	(+)
Manufacture of other non-metallic mineral products	(+)	(–)
Manufacture of machinery and equipment	(+)	(–)
Construction	(+)	(–)
Trade	(+)	(+)
Hotels and restaurants	(+)	(+)
Financial intermediation	(+)	(+)
Real estate transactions, renting and services to legal entities	(+)	(+)
Health care and social assistance	(+)	(+)
Community, social and personal service activities	(+)	(+)
II. Decrease (*q*)		
Production of energy materials	(–)	(+)
Food-processing industries	(–)	(+)
Manufacture of chemicals, rubber and plastic products	(–)	(–)
Metallurgy and metal processing	(–)	(+)
Electric energy, gas supply and water supply	(–)	(–)
Transport, post and telecommunications	(–)	(+)
Public administration	(–)	(+)
Education	(+)	(+)

Table 6. The values of ratio of product output estimations of economic activity types (in the actual and calculated factor costs) in 2000-2004

Type of economic activity	2000	2001	2002	2003	2004	M3
Agriculture	1,100	1,145	1,100	1,061	1,151	0,116
Production of energy materials	1,068	0,938	1,065	1,111	1,084	0,080
Production of non-energy materials	1,204	1,262	1,235	1,244	1,240	0,238
Food-processing industries	0,946	1,042	1,188	1,225	1,183	0,158
Textile and leather industry	1,283	1,361	1,326	1,304	1,305	0,317
Woodworking, pulp and paper industry, publishing	1,082	1,137	1,103	1,107	1,014	0,098
Manufacture of coke products, petroleum refinement and processing of nuclear fuel	1,161	1,150	1,130	1,139	1,132	0,143
Manufacture of chemicals, rubber and plastic products	0,897	1,029	1,059	1,081	1,052	0,070
Manufacture of other non-metallic mineral products	1,283	1,139	1,136	1,136	1,140	0,176
Metallurgy and metal processing	0,867	0,936	0,999	1,019	1,042	0,069
Manufacture of machinery and equipment	1,243	1,103	1,068	1,127	1,090	0,140
Electric energy, gas supply and water supply	1,086	1,114	1,142	1,189	1,196	0,151
Construction	1,457	1,651	1,632	1,641	1,775	0,640
Trade	0,944	0,991	0,954	1,014	1,047	0,039
Hotels and restaurants	1,243	1,232	1,200	1,228	1,188	0,219
Transport, post and telecommunications	0,855	1,038	1,013	1,124	1,916	0,419
Financial intermediation	0,528	0,599	0,612	0,593	0,656	0,404
Real estate transactions, renting and services to legal entities	0,989	0,913	0,893	0,868	0,997	0,086
Public administration	0,653	0,604	0,612	0,626	0,556	0,391
Education	0,605	0,608	0,620	0,625	0,566	0,396
Health care and social assistance	0,625	0,610	0,710	0,703	0,624	0,348
Community, social and personal service activities	2,588	2,788	2,586	3,078	0,628	1,593
M4	0,247	0,245	0,236	0,244	0,324	