Olena M. Koval *(National University of Life and Environmental Sciences of Ukraine, Kyiv, Ukraine)*

INPUT-OUTPUT MODEL IN NATIONAL ACCOUNTING SYSTEM

The article defines the key features of input-output model in the national accounting system, and the basic methods of its implementation in economic system research. The main ways of IO model use are the following: GDP analysis, defining the economic structure, establishing the cross-industry economic relations, national output, aggregate demand and supply planning, the accounting of investment economic potential, developing efficient subsidy and tax policies, the export and import impact on national economy.

Keywords: national accounting system; economic reproduction; input-output model; economic system structure; cross-industry balance.

Олена М. Коваль *(Національний університет біоресурсів і природокористування України, м. Київ, Україна)*

МОДЕЛЬ «ВИТРАТИ-ВИПУСК" У СИСТЕМІ НАЦІОНАЛЬНИХ РАХУНКІВ

У статті розкрито основні умови моделі «витрати-випуск» в системі національних рахунків, установлено основні способи використання даної моделі в дослідженнях економічної системи. Основними напрямами застосування моделі «витрати-випуск» визначено: аналіз ВВП, дослідження структури економіки, встановлення міжгалузевих економічних відносин, планування національного доходу, сукупного попиту і пропозиції, розрахунок інвестиційного потенціалу економіки, розробка ефективної політики субсидій та оподаткування, вплив експорту та імпорту на національну економіку.

Ключові слова: система національних рахунків, економічне відтворення, модель «витрати-випуск», структура економічної системи, міжгалузевий баланс.

Форм. 2. Літ. 14.

Елена Н. Коваль *(Национальный университет биоресурсов и природопользования Украины, г. Киев, Украина)*

МОДЕЛЬ «РАСХОДЫ-ВЫПУСК» В СИСТЕМЕ НАЦИОНАЛЬНЫХ СЧЕТОВ

В статье раскрываются основные условия модели «расходы-выпуск» в системе национальных счетов, установлены основные способы использования данной модели в исследованиях экономической системы. Основными направлениями использования модели «расходы-выпуск» определены: анализ ВВП, исследование структуры экономики, установление межотраслевых экономических отношений, планирование национального дохода, совокупного спроса и предложения, расчет инвестиционного потенциала экономики, разработка эффективной политики субсидий и налогов, влияние экспорта и импорта на национальную экономику.

Ключевые слова: система национальных счетов, экономическое воспроизводство, модель «расходы-выпуск», структура экономической системы, межотраслевой баланс.

Introduction. Modern economic science offers the two approaches to study the economic activity: economic reproduction and equilibrium economics. Economic reproduction refers to dynamic processes, whereas eqilibrium characterises the static ones. It deals with quantitative proportions between different economic activities or sectors. In Marx's view, economic reproduction in any society has 5 main features: replacing the production of reproducible products, maintaining or adding society's physical assets to the stock; the reproduction and growth of the total population; the

reproduction, enforcement and maintenance of social relations, in particular the relations of production which characterize the social hierarchy and property rights; the maintenance and reproduction of trading and distribution relations as the systems, institutions and organizations enabling market trade and non-market allocation of resources.

The basic concepts set by V. Leontiev in the 1940s have become the key components of many types of contemporary economic analysis and input-output analysis, which is one of the most widely used methods in economics. The former model is more often linked to classical theories of Quesnay's Economic Table and Marx's reproduction equations and is a numerical representation of the circular process of economic activity.

Analysis of latest researches and publications. The research of economic systems with the input-output model is popular allover the world. It was used in the Soviet National Economic Balance and in General Coordination of the National Services of Statistics and Informatics etc. V. Leontiev won a Nobel Prize in Economics in 1973 for the explanation of the economic use of his input-output model. In practice there are numerous examples of input-output models cross-industry application. The most popular one is for analyzing the GDP (Jensen, 2001), economic analysis (Ibatulin, 2003), planning of economic expansion (Yegorov, 2006), investment potential in economic system (Popova, 2007), modelling and optimization of economic structure (Aroche, 2006; Boychuk, 2009), identifying the structural changes (Hioki, Hewwings and Okamoto, 2009), convenient multisectoral policy control (Ciaschini, Pretaroli and Socci, 2009), creating efficient subsidy policies in regional economy (Andre and Cardenete, 2009), agrarian intersectorial regulation (Tkachuk and Ivanyuk, 2010), economic structure analysis (Kuzubov and Ovander, 2010).

Unresolved issues. Modern input-output model is a part of national accounting system. It will be better to use IO model for deeper industry analysis, for example agrarian economy, for testing international economy influence in globalization process, for research of capital accumulation, aggregate demand and supply in national economic system.

The aim of the research is to define the main features of input-output model and to use this analytic tool for the economic system research.

The research findings. The National Accounting System (NAS) is a macroeconomic analytical system, acknowledged by the Committee of European Joint Societies, International Monetary Fund, United Nation Organization, The Organization of Cooperation and Development and the World Bank. In 1993 NAS was introduced in Ukraine. Income-output (IO) model is a system, which was presented by V. Leontiev.

Leontiev's contribution laid in establishing the model that showed the way how to make computation feasible. He used a matrix representation of the national economy. The main idea of the model constryction is that an economy has n sectors. Each of them produces a single homogeneous good x_i. Assume that the i-th sector for producing one unit must use a_{ij} units from sector j. Each sector sells some of its output to another sector as intermediate output and some of its output to consumers as final output or final demand. The final demand in the i-th sector is called d_i. So, we have:

$$x_i = a_{1i}x_1 + a_{2i}x_2 + \ldots + a_{ni}x_n + d_i. \tag{1}$$

It means that total output equals intermediate output plus final use. If the coefficients a_{ij} are indicated as the matrix A, the vector of total output mark as $\vec{x}$ and the vector of final demand will be $\vec{d}$, then the expression for the economy becomes:

$$\vec{x} = A\vec{x} + \vec{d}. \tag{2}$$

As a result we have obtained that $\vec{d} = \vec{x} - A\vec{x}$. This means that our demand is equal to our total production minus the production needed by other industries as inputs, where total production $\vec{x}$ is the cumulative product made by each industry. Forecasting is based on the technology matrix A, which determines the demand. Any matrix multiplied by an identity matrix is equal to itself $(I - A)\vec{x} = \vec{d}$. In order to determine x we multiply by $(I - A)^{-1}$ and get $x = (I - A)^{-1}d$. For practical purpose it might be challenging to compute the inverse matrix.

There are two application of Leontiev's model: a closed model, which deals only with the income of each industry, and the open one, which finds the amount of production needs to satisfy the increase of demand. The most useful application of input-output analysis for an economist or a common broker is the ability to see how the change of demand in one industry affects the entire economy (Jensen, 2001).

The structure of an economy in the framework of the IO model is defined by the set of industries, together with the set of existing links between them, which are determined by the demand and supply of goods exerted by the producers. This structure can be characterized by a subset of the connections between industries, regarded as the essential substructure, whose analysis allows to learn some of the fundamental features of the system at large. Results of Fidel Aroche's research assign structural positions to each sector in each system and describe the way how industries influence each other within the United States and Mexico economies. Those results confirm that these economies are structurally different, despite the existing similarities (Aroche, 2006).

Ukrainian scientist V.V. Popova uses the IO model for determination of the following parameters: cross-industry structure dynamics, correlation between gross income and gross capital accumulation, input-output balance and the priorities of interindustry structure policy (Popova, 2007). Comparing the gross income and gross capital accumulation in agriculture of Ukraine we achieved the tendency of capital accumulation decrease that means underinvestment in this field.

The main goal of M. Boichuk and N. Shmurygina's research is to find the optimum development of intersectoral economy with the delay. Using the IO model, optimization methods, programming and differential equation theory they have come to the decision: it is an optimum trajectory and management conducted that matter (Boichuk and Shmurygina, 2009).

The main purpose of Sh.I. Ibatulin's scientific work with IO model is to determine the economical terms for constant economic growth in agriculture. The results of agrarian gross domestic product distribution among different branches of economy represent the low level of the agro-industrial integration and insufficient level of food processing industry in Ukraine (Ibatulin, 2003).

P.Y. Tkachuk and I.V. Ivanyuk came to the conclusion that IO model is an analytic tool for economic analysis of price disparity among different brunches of econ-

omy. Scientists calculated the features of income distribution in agrarian economy and established the following facts. It is necessary to use the state requlation on minimal and maximal prices for agrarian goods and materials which are used as resources in accordance with IO model (Tkachuk and Ivanuk, 2007).

Macroeconomic level in economic policy is useful for planning and programming the national economy. But there is an unresolved task of using the IO model for regional management. This question is investigated by D. Yegorov and A. Yegorova. As a result, the scientists have got a model of strategic planning on the regional economic level. They calculate a cross-industry balance in different prices: word and internal (Yegorov and Yegorova, 2006). This approach allows to explore regional economic development in proper perspective within the globalization process.

Ukrainian scientists M.V. Kuzubov and N.L. Ovander demonstrated the dynamics of the Ukraine's economy structure which is analyzed with the "input-output" tables. They compare the national economy structure with the structure of other countries and ofter the following optimal gross added value structure: agriculture — 5.0%, industry — 24.4%, building — 3.2%, transport and trade — 25.2%, financial and insurance services — 23.1%, other services — 18.7% (Kuzubov and Ovander, 2010).

Statistic calculation of national IO model in 2010 revealed the high level of import resources used in agriculture — 5.83%, in food industry, beverages and tobacco production — 8.19%, in fish industry — 63.1%, in light industry — 2.4%, in forestry — 0.76%, in woodworking, pulp and paper industry and polygraphy — 24.55%. Average ratio of import and aggregate resources supply is 17%. At the same time resources export account in agriculture is 13.25%, in forestry 39.6%, in food industry, beverages and tobacco production — 13.7%, in woodworking, pulp and paper industry and polygraphy — 19.2%.

Conclusions. According to this research we have achieved the following outcomes:

1. Modern economic science offers the two approaches to study the economic activity: economic reproduction and equilibrium economics. Economic reproduction refers to dynamic processes, whereas eqiulibrium characterises the static ones. It deals with quantitative proportions between different economic activities or sectors. In Marx's view, economic reproduction in any society has 5 main features: replacing the production of reproducible products, maintaining or adding society's physical assets to the stock; the reproduction and growth of the total population; the reproduction, enforcement and maintenance of social relations, in particular the relations of production which characterize the social hierarchy and property rights; the maintenance and reproduction of trading and distribution relations as the systems, institutions and organizations enabling market trade and non-market allocation of resources.

2. Leontiev's model is a good tool for economic system analysis. It consists of independent but interrelated industries producing commodities by means of commodities, including service factors provided by households. The kernel of the model is a double entry matrix based upon the circular independence of production and demand: productive units purchase inputs in order to carry out production. By means of those transactions firms and households receive income, which in turn is used to purchase goods supplied by the producers. In the model distribution is taken for

granted and is focussed on the productive processes. It is assumed that homogeneous technologies produce homogeneous goods.

3. It is necessary to improve the applied research with input-output model to obtain further advanced knowledge in the field of input-output study, which includes improvements in basic data, theoretical insights and modelling, applications of input-output techniques, both traditional and modern. Theoretical and practical unification is the way to expand the national and the world economy towards sustainability and well-being.

References:

Про впровадження системи національних рахунків: Постанова Кабінету Міністрів України від 28.12.1992 №727 // zakon.rada.gov.ua.

Бойчук М., Шмуригіна Н. Моделювання і оптимізація статичного міжгалузевого балансу із запізненням // Вісник ТДТУ.— 2009.— Т.14, №1. — С. 190—200.

Егоров Д., Егорова А. Планирование развития на основе межотраслевого баланса (на примере Мурманской области) // Экономист.— 2006.— №1. — С. 43—51.

Ібатулін Ш.І. Міжгалузевий баланс та паритет в АПК // Науковий вісник НАУ.— 2003.— №6. — С. 36—43.

Кузубов М.В., Овандер Н.Л. Оцінка структурних зрушень в економіці України та їх оптимізація // Актуальні проблеми економіки.— 2010.— №9. — С. 66—75.

Національні рахунки України за 2011 рік: Статистичний бюлетень. — К., 2012. — 57 с.

Попова В.В. Методологія системного моніторингу міжгалузевого інвестиційного потенціалу // Фінанси України.— 2007.— №5. — С. 65—74.

Таблиця «витрати-випуск» України за 2010 рік в цінах споживачів: Статистичний збірник. — К., 2012. — 47 с.

Ткачук П.Ю., Иванюк И.В. Проблемы межотраслевого регулирования агропромышленного комплекса // Науковий вісник ЛНАУ.— 2010.— №17 // archive.nbu.gov.ua.

Andre, F.J., Cardenete, M.A. (2009). Designing Efficient Subsidy Polices in a Regional Economy. A Multicriterion Decision Making (MCDM) and Computable General Equilibrium (CGE) Approach. Regional Studies, 43(8): 1035—1046.

Aroche, F. (2006). Trees or the Essential Economics Structures: A Qualitative Input-Output Methods. Journal of Regional Science, 46(2): 333—353.

Ciaschini, M., Pretaroli, R., Socci, C. (2009). A Convenient Multisectoral Policy Control for ICT in the US Economy. Metroeconomica, 60(4): 660—685.

Hioki, S., Hewwings, G.J.D., Okamoto, N. (2009). Identifying the structural changes of China's spatial production linkages using a qualitative input-output analysis. Journal of Econometric Studies of Northeast Asia, 6(2): 25—48.

Jensen, I. (2001). The Leontief Open Production Model or Input-Output Analysis // online.redwoods.ec.us.

Стаття надійшла до редакції 29.01.2013.