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The structuring of components of the net domestic product according to the innovation criterion

Abstract

The article studies the additional multiplier effects, which the economic system can receive from the realization of a sound innovation policy, which should be considered during the assessment of microeconomic indicators of the economic growth. The methodology for the structuring of the NDP components by the criterion of innovation receives further development, which makes it possible to prove the importance of the innovative orientation in the components of consumer expenditures and availability of different tendencies in the consumption of traditional and innovative goods and services; to carry out the structuring of state expenditures by the criterion of innovation; to develop the mechanism of innovative orientation assessment of the net export; to research the factors of demand formation for innovatively and traditionally-oriented investments; to prove the existence of a cyclic feedback between the volume of every kind of investment and certain factors forming the demand; to define the conceptual areas of innovation components during the calculation of NDP.

Keywords: NDP, innovation criterion, innovation- and traditionally-oriented investments.

Introduction

In the recent years the development of the national economy has experienced a number of negative trends (loss of competitiveness, rapid shifting to the raw materials periphery of the global market, the reduction in the internal potential for independent development, etc.), when relatively good macroeconomic indicators were achieved not because of, but contrary to the government policies, often characterized by the lack of ideas and initiatives and the blind following to the recommendations of international financial organizations. It is impossible to eliminate most of these negative trends without raising the level of theoretical and practical orientation of macroeconomic investigations, in particular those connected with the study of such major categories as gross domestic product (GDP) and net domestic product (NDP), with the modernization of the structure and optimization of proportions of their reproduction.

In our opinion, one of the conditions for the formation of the concept of innovative development is the correct reflection of innovative orientation of certain types of expenditures in the calculation of macroeconomic indicators of economic development, in particular – NDP. It is traditionally understood as the value of the GDP excluding one of its parts, which was used to reimburse the capital consumed in the production. It is calculated as the sum of consumers' spending, net domestic private investments, government spending and the net export. The improvement of the theoretical bases of the formation of the structural elements of the NDP is essential in establishing the normal level of taxation burden in the country, the level of government spending (consumer and investment), optimizing the exports and imports ratios, which should contribute to the stabilization of the Ukrainian economy.

1. Literature review

The research of the economic nature of the net product as a complex economic category is the subject of debates as it is essential for the normal development and functioning of the market economy. The founders of the theory of the net product are the representatives of the classical political economy as: F. Kene, A. Smith, D. Ricardo, J.B. Say, K. Marx, A. Marshall, A. Pigou and others who have studied the problem of the formation and the use of the net product in the pure capitalist economy. The contemporary researchers (J. Keynes, P. Davidson, S. Weintraub, R. Harrod, P. Sraffa, M. Kaletsky, M. Friedman, F. Modigliani, V. Leontiev, P. Samuelson, W. Nordhaus, and others) developed the classical theory of the net product and studied some of its elements from the positions of practical application in the mixed (regulated) market economy.

In the scientific literature the problem of the complex research of the NDP category as a functional form of the net product has not been given a proper methodological justification as well as theoretical and practical solution. A number of problems remain unsolved, including: the use of the reproductive approach to the study of formation, distribution and use of NDP; the formation of optimal proportions of its distribution between the factors of production and functional forms; the specific forms of NDP in transitional economy, determination of the rational proportions of NDP distribution between the state and private businesses, the structuring of NDP and its individual components according to innovation criteria.

The economic science has developed a considerable number of models, which determine the interdependence between macroeconomic indicators and the relevant factors (primarily capital and labor resources). It should be necessary to emphasize the contribution to the research of this problem of such prominent scien-

tists as: A. Marshall, L. Walras, C. Cobb and P. Douglas (production function), J.M. Keynes (models of investment determinants, investment and employment multiplier), A. Pigou (model of initial impulses and the distribution of cyclic movements), J. Hicks and H. Hansen (model of the correlation of commodity, money and labor markets), M. Friedman (model of permanent and nominal income), R. Harrod and E. Domar (dynamic models taking into account the change of investment determinants) and others.

However, despite the significant interest in the study of innovative component of the economic growth, a number of theoretical aspects remain underdeveloped. In particular, there is a need in the further development of the complex of issues associated with the development of effective mechanisms of investment process innovativeness to be considered during the formation of the system of macroeconomic indicators of economic development, critical assessment of the impact of innovations on NDP as one of the key macroeconomic indicators of economic development.

2. Results

According to the conventional approach NDP is calculated as the sum of consumer expenditures, net domestic private investments, state spending and net exports. In the formalized form its calculation can be presented as follows:

$$NDP = C + I_n + G + X_n, \quad (1)$$

where C is the consumption expenditures; I_n is the net domestic private investments; G is the state spending; X_n is the net exports.

All these types of expenditures can be divided into two categories: innovation- and traditionally-oriented.

Therefore, in the structure of *aggregate net investments* we offer to distinguish: *innovation-oriented investments* $I_{n\text{ inn}}$, that is, the expenses for purchasing any (traditional or innovative) production factors with the purpose of their use for the creation of innovative products (innovative factors of production, innovative products, innovative services) and introducing them to the market; as well as *traditionally-oriented investments* $I_{n\text{ to}}$, that is, expenses for purchasing any production factors with the purpose of their use for creating and introducing traditional products. Based on the fact that in our study NDP is as an integral criterion of economic system's efficiency, we take into account not the gross, but the net investments (that is the difference between the volume of gross investments and so-called depreciation, which in this case is the value of loss in invested capital in the process of production of final goods).

Now let's consider the features of demand formation for innovation- and traditionally-oriented in-

vestments. It should be noted that the formation of this demand is influenced by the real interest rate and a set of factors that determine the amount of net investments.

At first we will consider the impact of the real interest rate on the formation of demand for the types of investments under investigation. It is universally recognized that in the existing conditions of the market economy's functioning the demand for investment is one of the components of the total demand for money. This is primarily connected with the transaction demand for money, which is caused by the necessity to carry out operations of buying and selling goods and services, and directly depends on the volume of current consumption over a specified period and the speed of money turnover in the economy. To ensure the investment processes it is necessary to make the money owners not use the money in the current period, but save it with the further transformation into investment resources.

The only economically justified and essential factor of influence on the rationally conditioned behavior of the national product's consumers concerning the reduction in the volumes of the current consumption for the sake of future investments is the income which should be provided by entrepreneurs – consumers of investment resources – to the owners of money resources, that is, the value of money. In economic theory this value is called the real interest rate. The higher the value of the money is offered by businesses to consumers, the more customers refrain from the current consumption and save larger amounts of money resources. Therefore, there is the potential opportunity for the growth of investments into the economy.

In its turn, the demand for investment is formed depending on the real interest rate, which is payable on the capital, and the expected net profit rate on the invested resources. With the rising of interest rates (the price of investment resources), the number and the scope of investment projects, which can satisfy investors' requirements to the profitability of their investments, decline.

If consumers offer higher prices on their savings, it is obvious that the demand from businesses realizing investment projects decreases. This is caused by the fact that there is a decrease in the number of projects, the profitability of which exceeds the real interest rate on the resources used for their implementation. As the number of enterprises wishing to use expensive investment resources declines, it can be argued that due to the fall of the real return on investment the amount of investment decreases.

Such behavior is typical both for innovation- and for traditionally-oriented investments; meanwhile the level of dependence of demand for each of them from the

real rates may differ. In the formalized models characterizing the dependence of each of the studied types of investment from the real interest rate, this difference will be presented by various values of coefficients that reflect the close functional relationship between these macroeconomic categories. If we can present it graphically in a simplified form (Figure 1), we can see that different degrees of demand's dependability for each of the selected types of investment from the real rates is reflected by different angles of demand curves. If all the conditions of the market functioning (except interest rates) remain unchanged, it can be maintained that for purposes of our analysis specific values of angles of these curves are not critical.

Shifts in the curves of investment demand to the right or left depend on the factors that affect the expected net rate of profit from investment.

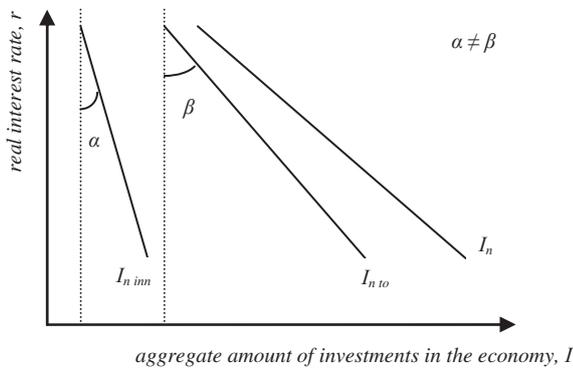


Fig. 1. Interdependence of the demands for net innovation-oriented ($I_{n\ inn}$), net traditionally-oriented ($I_{n\ to}$) and aggregate net investments (I_n)

The most important factors to be considered: the level of taxation; investor expectations; the pace of technological changes; the level of equipment depreciation and the cost of its maintenance; provision of industries with manufacturing capacities; staff qualifications; provision of manufacturing processes with the work force; the level of wages; infrastructure of investment environment; openness of economy; provision of manufacturing processes with natural resources; state support for investment and innovation processes; general level of savings in the economy, etc.

We can say that while these factors generally affect the total volume of net investment, the impact of each of them on the specific studied type will vary in size and character. In some cases, the areas of influence may even be different. Moreover, when one considers the researched processes in dynamics, it appears that some of the factors that affect the amount of investments in the current period, in the following period are directly dependent on the size of these investments. Therefore, *the feedback is formed*. The analysis of the researched processes in dynamics makes it possible to suggest the *cyclicity* of this process.

Now let us study the mentioned feedback by using the example of such factor as the provision with

fixed capital. We can say that the provision with fixed capital is higher in the traditionally oriented economy (in industries producing traditional goods and services) than in innovation-oriented economy (in high-tech industries producing innovative products and services). However, it is necessary to note that the process of attracting innovation-oriented investments aimed at the formation of the fixed capital in the high-tech sector causes a gradual increase of its provision in this economic segment in the absence of significant variations of the factors that determine the required size of the fixed capital.

Under the conditions of invariance of other factors the dependence of net investment amount from the fixed capital provision in a simplified form is defined as:

$$I_n = f(P_{FC}), \tag{2}$$

where P_{FC} is the level of provision with the fixed capital in the economy:

$$P_{FC} = \frac{P_R}{P_N}, \tag{3}$$

where P_R is the real (available) volume of the fixed capital in the economy, P_N is the amount of the fixed capital needed to achieve the target growth rate of integrated macroeconomic indicators, which is selected as the target criterion (for example, NDP). P_N depends on the capitalization ratio of production, forecast production volumes and others.

The hypothesis about the different levels of provision with the fixed capital in the traditionally- and innovation-oriented (hi-tech) sectors can be formalized as follows:

$$P_{FC_{to_t}} > P_{FC_{inn_t}}, \tag{4}$$

$$P_{FC_{to_t}} = \frac{FC_{R_{to_t}}}{FC_{N_{to_t}}}, \tag{5}$$

$$P_{FC_{inn_t}} = \frac{FC_{R_{inn_t}}}{FC_{N_{inn_t}}}, \tag{6}$$

where $P_{FC_{to_t}}$, $P_{FC_{inn_t}}$ are the levels of economy's provision with the fixed capital respectively in the traditionally- and innovation-oriented sectors of the economy in a period t ; $FC_{R_{to_t}}$, $FC_{R_{inn_t}}$ are the real (available) amounts of the fixed capital respectively in traditionally- and innovation-oriented sectors of the economy in a period t ; $FC_{N_{to_t}}$, $FC_{N_{inn_t}}$ are the volumes of the fixed capital needed to achieve the target growth rate of NDP respectively in traditionally- and innovation-oriented sectors of the economy in a period t .

In order to make the preliminary conclusions about the availability of a feedback, we can take the amount of capital needed to achieve the target growth rate of NDP as a constant (it only reduces the number of options that should be considered, but doesn't contradict the main idea).

Considering the investigated processes in dynamics, we can note that scientific interest in this case is not only in the existing level of fixed capital provision in the economy, but also its growth over a certain period of time, which we propose to define as ΔP_{FC} and calculate as:

$$\Delta P_{FC} = P_{FC_{t+1}} - P_{FC_t} \quad (7)$$

It is essential for the analysis to use the value of the growth rate ($GR = \frac{P_{FC_{t+1}}}{P_{FC_t}}$) and increase rate

$$GR = \frac{\Delta P_{FC}}{P_{FC_t}} = \frac{P_{FC_{t+1}} - P_{FC_t}}{P_{FC_t}} = \frac{\left(\frac{FC_{R_{t+1}}}{FC_N} - \frac{FC_{R_t}}{FC_N} \right)}{\frac{FC_{R_t}}{FC_N}} = \frac{(FC_{R_{t+1}} - FC_{R_t}) \cdot FC_N}{FC_N \cdot FC_{R_t}} = \frac{FC_{R_{t+1}} - FC_{R_t}}{FC_{R_t}} \quad (9)$$

Clearly, the growth of the fixed capital over a certain period of time is equal to the amount of net investments in the fixed capital, that is:

$$FC_{R_{t+1}} - FC_{R_t} = I_{nFC_t}$$

Accordingly, the ratio (8) can be written as:

$$\frac{I_{nFC_{to_t}}}{FC_{R_{to_t}}} \neq \frac{I_{nFC_{im_t}}}{FC_{R_{im_t}}} \quad (10)$$

where $I_{nFC_{to_t}}$, $I_{nFC_{im_t}}$ are the net investments in the fixed capital respectively in traditionally- and innovation-oriented sectors of the economy in the studied period of time, and the absolute value $I_{nFC_{to_t}}$ can greatly exceed $I_{nFC_{im_t}}$.

Let's make the analysis also in relation to the increase rate of the fixed capital provision to confirm the suggested hypothesis about the presence of a feedback between the level of the fixed capital provision and the volume of net investments.

The increase of the fixed capital from net investments will result in the increase of its provision in traditionally- and innovation-oriented sectors, but the paces of this growth may differ in size, that is:

$$FC_{R_{to_{t+1}}} = FC_{R_{to_t}} + I_{FC_{to_t}} \quad (11)$$

$$FC_{R_{im_{t+1}}} = FC_{R_{im_t}} + I_{FC_{im_t}} \quad (12)$$

($IR = \frac{\Delta P_{FC}}{P_{FC_t}}$) of the level of the fixed capital provision in the whole economy and investigated sectors separately.

Firstly, let's analyze the index growth rate of the level of fixed capital provision. In our opinion, in most cases the growth rates of the level of the fixed capital provision in innovation- and traditionally-oriented sectors of the economy are not identical, that is:

$$GR_{to} \neq GR_{im} \quad (8)$$

We determine the calculation of the growth rate level of the fixed capital provision in more detail:

$$P_{FC_{to_{t+1}}} = \frac{FC_{R_{to_{t+1}}}}{FC_{N_{to_{t+1}}}} \quad (13)$$

$$P_{FC_{im_{t+1}}} = \frac{FC_{R_{im_{t+1}}}}{FC_{N_{im_{t+1}}}} \quad (14)$$

$$\frac{P_{FC_{to_{t+1}}}}{P_{FC_{to_t}}} \neq \frac{P_{FC_{im_{t+1}}}}{P_{FC_{im_t}}} \quad (15)$$

where $FC_{R_{to_{t+1}}}$, $FC_{R_{im_{t+1}}}$ are the real (available) amounts of the fixed capital respectively in traditionally- and innovation-oriented sectors of the economy in a period following the period t ; $FC_{N_{to_{t+1}}}$, $FC_{N_{im_{t+1}}}$ are the amounts of the fixed capital needed to achieve the target growth rate of NDP respectively in traditionally- and innovation-oriented sectors of the economy in a period following the period t ; $P_{FC_{to_{t+1}}}$, $P_{FC_{im_{t+1}}}$ are the levels of economy's provision with the fixed capital respectively in traditionally- and innovation-oriented sectors of the economy in a period following the period t .

Schematically, the increase of the real amount of the fixed capital from net investments is illustrated in Figure 2.

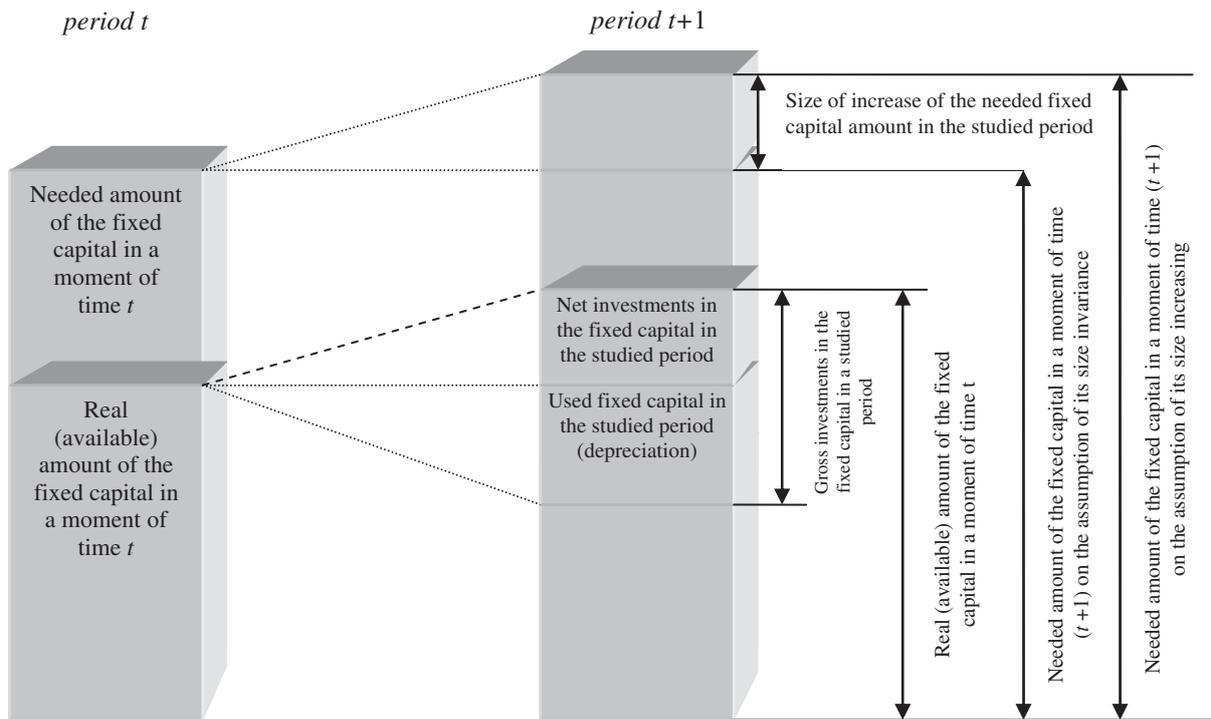


Fig. 2. The increase of the real amount of the fixed capital from net investments

Therefore, it can be argued that the formation of a dependence of investments volumes from the provision of fixed capital in the current period is based on the feedback between the fixed capital's provision and the level of investments in the previous period, that is:

$$I_{n_{FC_{inn_{t+1}}}} = f(P_{FC_{inn_{t+1}}}) = f(I_{n_{FC_{inn_t}}}), \quad (16)$$

$$I_{n_{FC_{io_{t+1}}}} = f(P_{FC_{io_{t+1}}}) = f(I_{n_{FC_{io_t}}}). \quad (17)$$

This confirms the hypothesis about the existing feedback between the level of the fixed capital's provision of the economy and the volume of net investments.

It is necessary to indicate that the assumptions we have made about the sustainability of the required size of the fixed capital does not significantly affect the conclusion about the feedback between the level of the fixed capital's provision and the amount of investments. Therefore, the only possibility to maintain the fixed capital's provision in the innovation- and traditionally-oriented sectors at sustainable levels is the increase of the required sizes of the fixed capital in these sectors by an amount which is equal to the ratio of the net investments in these sectors and the appropriate levels of the fixed capital provision.

At the same time, for the description of economic development the dynamics of the required size of the fixed capital is a matter of principle. The focus on the innovation of this development will lead to the growth of the required size of fixed capital in the innovation-oriented sector of the economy. The speed of this growth can significantly exceed the same indi-

cator for traditionally-oriented sector. On this assumption we can conclude that the reduction of the fixed capital's provision will likely be caused by an increasing demand for fixed capital rather than by small volumes of investment.

Next let's consider the effect of individual factors on the formation of investment demand. In our opinion, all factors of influence on the investment demand may be divided into three groups depending on how they affect the demand for each of the studied types of investments in their interaction. *The first group of factors* includes those that simultaneously affect the demand for traditionally- and innovation-oriented investments, accordingly changing the aggregate investment demand (Figure 3a). *The second group of factors* includes those that affect the demand for one of the studied types of investments, simultaneously changing the aggregate investment demand (Figure 3b). *The third group of factors* includes those that simultaneously affect the demand for each of the studied types of investment, while not affecting the aggregate investment demand (that is changing the specific structure of the investment demand) (Figure 3c).

To demonstrate the impact of each group of factors on the investment demand we will consider the impact of some instruments of state regulation.

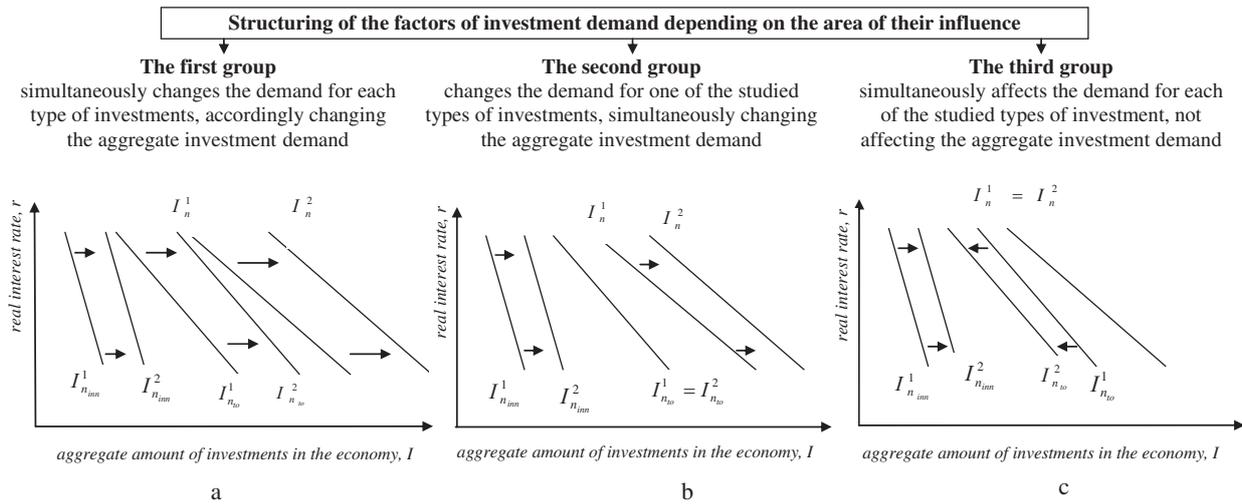
We will analyze the first group of factors using the example of such method of state regulation as tax incentives. Let's suppose that for the improvement of the investment climate the state may reduce the tax burden for all businesses that invest money in the fixed capital (regardless of the sector they work in).

This will increase the expected rate of profit and, consequently, the demand curves for traditionally- and innovation-oriented investments will move to the right (upwards from $I_{n_{inn}}^1$ to $I_{n_{inn}}^2$, from $I_{n_{to}}^1$ to $I_{n_{to}}^2$, from I_n^1 to I_n^2 , as we can see from Figure 3a). As the aggregate net investments are equal to the sum of net traditionally- and innovation-oriented investments, we can conclude that the overall change in net investments is equal to the aggregate change in the

net investments of the investigated types:

$$\Delta I_n = \Delta I_{n_{to}} + \Delta I_{n_{inn}} . \tag{18}$$

We will analyze the second group of factors using the example of such method of state regulation as tax incentives. Let's suppose that tax remissions will be levied by the segments (that is separately for traditionally- and innovation-oriented sectors). In this case the change in demand for net investments will also take place only in a particular sector of the economy.



The stimulation of innovative investment by providing tax remissions for innovatively active enterprises will lead to the shifting of the demand curve for net innovation-oriented investments. In a graphical display it is illustrated as the shifting of the demand curve for net innovation-oriented investments from $I_{n_{inn}}^1$ to $I_{n_{inn}}^2$, while the demand for net traditionally-oriented investments ($I_{n_{to}}^1$) remains stable, and the aggregate demand for net investments will increase by an amount equal to the change in net innovation-oriented investments (I_n^1 moves to I_n^2), as it is illustrated in the Figure 3b.

crease of innovation-oriented investments will not lead to the increase of the aggregate net investments, because it does not directly affect the real interest rate.

We will analyze the third group of factors using the example of such method of state regulation as state guarantees. Studying the peculiarities of innovation investment it is important to emphasize that the investment environment is characterized by extremely high competition. The basic rule of investors' behavior is the choice of the highest expected net profit rate, which is decisive for any kind of investment. It should be noted that in this case we focus not on the intraspecific (within one of the investments' types that we studied), but on interspecific competition (that is between traditionally- and innovation-oriented investments). Such division of the investment market according to different types makes it possible to investigate some factors influencing them. For example, the provision of state guarantees for stimulating the in-

But it should be noted that it increases the demand for innovation-oriented investments by reducing the demand for traditionally-oriented investments. Graphically it is illustrated by the shifting of demand curves for net innovation-oriented investments to the right and upward from $I_{n_{inn}}^1$ to $I_{n_{inn}}^2$, while the demand curve for the net traditionally-oriented investments will move to the left and down from $I_{n_{to}}^1$ to $I_{n_{to}}^2$, and the aggregate demand for net investments will remain stable (I_n^1), as it is illustrated in the Figure 3c.

Now let's consider the impact of investments on NDP based on the proposed structuring. The dependence of the volumes of all types of investments we investigated from DNP is presented in Figure 4.

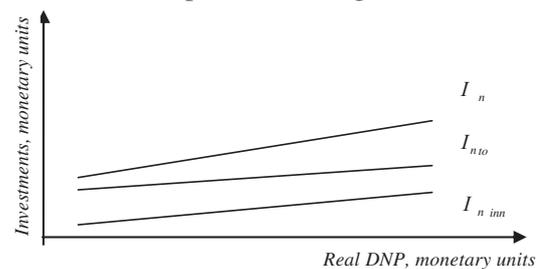


Fig. 4. Dependence of investments volume (according to types) from NDP

It should be noted that we consider investments as partially dependent from NDP:

$$I_{n_{to}} = I_{n_{to0}} + k_{I_{to}} * NDP, \quad (19)$$

$$I_{n_{inn}} = I_{n_{inn0}} + k_{I_{inn}} * NDP, \quad (20)$$

$$I_n = I_{n_0} + k_I * NDP, \quad (21)$$

$$I_{n_0} = I_{n_{to0}} + I_{n_{inn0}}, \quad (22)$$

$$k_I = k_{I_{to}} + k_{I_{inn}}, \quad (23)$$

where $I_{n_{to0}}$, $I_{n_{inn0}}$, I_{n_0} are respectively net traditionally- and innovation-oriented investments, and also aggregate investments that don't depend on NDP volumes; $k_{I_{to}}$, $k_{I_{inn}}$, k_I are the coefficients of dependence respectively of the net traditionally- and innovation-oriented investments, and also the aggregate investments from NDP, which can be considered as a *propensity to certain types of investments*.

Let's consider the particularities of the structuring of consumption expenditures as a component of NDP by the criteria of innovation. Since these costs are formed on the market of goods and services, it can be divided into two segments: traditional and innovative. For the purpose of selection of the innovative component in the NDP structure the element of consumer spending can also be divided into two parts, the first of which will characterize the performance in the traditional segment of investigated market and the second one – in the innovative segment. On this basis, the aggregate consumption expenditures (C_{agg}) will be:

$$C_{agg} = C_{to} + C_{inn}, \quad (24)$$

where C_{to} , C_{inn} are respectively consumption expenditures for traditional and innovative goods and services.

The decisive importance in our research is the characteristics of not only the absolute values of consumption expenditures for traditional and innovative products and services, but their share in aggregate consumption expenditures:

$$S_{C_{agg}^{inn}} = \frac{C_{inn}}{C_{agg}}, \quad (25)$$

$$S_{C_{agg}^{to}} = \frac{C_{to}}{C_{agg}}, \quad (26)$$

where $S_{C_{agg}^{inn}}$, $S_{C_{agg}^{to}}$ are respectively the shares of consumption expenditures for traditional and innovative products and services in aggregate consumption expenditures for products and services.

It should be noted that consumption expenditures can be presented as a function of income after taxes. It is necessary to take into consideration the division of the total consumer spending into consumption expenditures for traditional and innovative products and services that is:

$$C_{to} = C_{to0} + k_{C_{to}} * IAT, \quad (27)$$

$$C_{inn} = C_{inn0} + k_{C_{inn}} * IAT, \quad (28)$$

where C_{to} , C_{inn} are the consumption expenditures respectively for traditional and innovative goods and services; C_{to0} , C_{inn0} are the consumption expenditures respectively for traditional and innovative goods and services that don't depend on the income after taxes; $k_{C_{to}}$, $k_{C_{inn}}$ are the coefficients that characterize the propensity of people to consumption of respectively traditional and innovative goods and services, which we will call the average propensity to consumption of the respective types of goods and services; IAT is the income after taxes.

With regard to the above-mentioned relations the equation (24) is transformed into:

$$C_{agg} = C_{to0} + C_{inn0} + (k_{C_{to}} + k_{C_{inn}}) * IAT. \quad (29)$$

In a simplified form (without regard to the state participation in the economic processes) the income after taxes is equal to NDP.

Therefore, in order to correctly reflect the transformational changes occurring in the transition of the national economy to an innovative model of development, it would be advisable in macroeconomic researches to consider separately the consumption expenditures for respectively traditional and innovative products and services, and also to take into account the presence of different levels of consumers' propensity to the purchasing of each type of goods and services.

Now let's consider the next component, which forms NDP state expenditures. In our opinion, one can distinguish four main items of interest to us in terms of innovation, which may be related to the considered types in the structure of *state consumption expenditures*: state consumption expenditures on traditional and innovative products and services, in the structure of *state investment expenditures*: state traditionally- and innovation-oriented investment expenditures.

Regarding the latter, it should be important to emphasize that the investment policy must be formed at the state level, which would support science, promote high-tech industries' development, provide privileges to investment projects at the early stages of their implementation. It is particularly important to form a sound investment policy for the economy

in transition, with high risks, when it is difficult to correctly determine the return on investment or even impossible to quantify the relationship of current investments with future benefits. In other words, state investments should not lead to additional competition on the investment market but support its development, including the infrastructure, especially of those elements, which are unable to grow enough in the conditions of a fierce financial competition, but they are essential to ensure the competitiveness of the state on the global market.

In our opinion, the main and the most essential distinction of state expenditures is their regulation, dependence on the priorities of the state policy. The structure of the state spending is explained by the goals of the government in a certain period. In a formalized form the components of the state spending can be presented as follows:

$$G = G_{C_{to}} + G_{C_{inn}} + G_{I_{to}} + G_{I_{inn}}, \quad (30)$$

where $G_{C_{to}}$, $G_{C_{inn}}$ are the state expenditures for respectively traditional and innovation goods and services; $G_{I_{to}}$, $G_{I_{inn}}$ are respectively state traditionally- and innovation-oriented investments.

It should be noted that transfer payments made by the state are not included in the resultant indicator (in this case, to aggregate state expenditures and, as a result, to NDP) because they don't reflect the increase of the current production. But they form the personal income after taxes, which were discussed when considering the consumption expenditures of the population. So, to avoid the simplification that income after tax is equal to NDP, we must take into account the existing tax burden (which is formed from the tax burden imposed by the state) on the ultimate consumers and manufacturers of products and services, income recipients and property owners, as well as the transfer payments going backwards:

$$IAT = NDP * (1 + P_{TP}) * (1 - P_{TB}), \quad (31)$$

where P_{TB} is the average level of tax burden on NDP considering the transfer payments; P_{TP} is the average level of state transfer payments in NDP, which is calculated with the following formula:

$$P_{TP} = \frac{TP}{NDP}, \quad (32)$$

where TP is the aggregate transfer payments in a certain period.

Now let's examine the next component of NDP net exports. It should be noted that it is the difference between the expenditures of foreign counterparts on the goods and services produced in the country and

expenditures of domestic agents on goods and services produced abroad, in other words, it is the difference between exports and imports. Net exports may be represented by the sum of net export values for certain groups of respective expenditures:

$$X_n = X_{n_{C_{to}}} + X_{n_{C_{inn}}} + X_{n_{I_{to}}} + X_{n_{I_{inn}}}, \quad (33)$$

where $X_{n_{C_{to}}}$, $X_{n_{C_{inn}}}$ are the net exports respectively of traditional and innovative goods and services; $X_{n_{I_{to}}}$, $X_{n_{I_{inn}}}$ are the net exports respectively of traditionally- and innovation-oriented investments.

It should be emphasized that a crucial importance for the research of the level of economic system innovativeness in the context of export-import business activity belongs not so much to the identification of the net exports as to the ratio of the absolute values of its basic components (exports and imports) for the specified types. In our opinion, the increase of our country's participation in the trade with the innovative factors of production on the international market can be an indicator of innovation orientation of the national economy. The growth of domestic exports as such, and their share in the total world exports are a positive sign of economic development. As one of the export's components is the export of production factors, which causes the increase in the investment expenditures of foreign counterparts in our country, then an important feature of innovation orientation of the economic system will be the increase in exports of innovative production factors compared with the traditional. Therefore, the country can abandon the existing practice of exporting metal, raw materials, coal, wood, etc. and position itself in the world market as a country that takes an active part in the global technology exchange. In our opinion, the export of innovative products for the final consumption abroad is fundamentally more important than exports of innovative production factors, because in this case one can talk about supporting domestic producers, the replenishment of state budget, employment of domestic workers and others. Besides the necessity of increasing the prevalence of innovative products' export intended for the final consumption abroad over the export of innovative production factors, we consider it necessary to emphasize the need in increasing the share of the finished products in the structure of total exports that will help stimulate domestic production. It should be mentioned that in terms of supporting domestic producers, replenishment of the state budget and employment of domestic workers the increase in the volume of import factors is fundamentally more important compared with the import of goods and services for final consumption. These conclusions regarding the priorities of innovative

component in the structure of imports and exports do not exclude the necessity to develop the traditional exports and imports operations.

Let's define the mechanism of criteria assessment of the impact of changes of these expenditure types on NDP as one of the key macroeconomic indicators, on the assumption of the existing functional dependencies between different types of expenditures and NDP, taking into account their division by the criteria of innovation.

At first let's consider the main components of NDP – consumption expenditures and net investments – excluding the state expenditures and export-import operations. Graphically, the equilibrium level of the real NDP according to the method of “aggregate expenditures – production volumes” is presented in Figure 5. The curves reflecting the dependence of consumption expenditures and the sum of consumption expenditures and investment spending from NDP are not parallel. The state of equilibrium can be presented as the equality of savings and investments.

$$NDP = (C_{to_0} + C_{im_0}) + (k_{C_{to}} + k_{C_{im}}) * NDP + (I_{n_{to_0}} + I_{n_{im_0}}) + (k_{I_{to}} + k_{I_{im}}) * NDP. \quad (34)$$

On this assumption we can determine the multiplier of NDP growth:

$$M_{NDP} = \frac{1}{1 - k_{C_{to}} - k_{C_{im}} - k_{I_{to}} - k_{I_{im}}}.$$

In this context, one should use marginal categories which characterize the dependency of the function change from the argument change. But, as we have chosen the linear dependency for determining the relationship between consumption expenditures, investments and NDP, the average propensity to consumption and investment is formally equal to the marginal propensity. Therefore, it would be better to present the studied relationships as follows:

$$M_{NDP} = \frac{1}{1 - k_{mp_{C_{to}}} - k_{mp_{C_{im}}} - k_{mp_{I_{to}}} - k_{mp_{I_{im}}}}, \quad (35)$$

where $k_{mp_{C_{to}}}$, $k_{mp_{C_{im}}}$ are the coefficients that characterize the marginal propensity of people to the consumption of respectively traditional and innovative goods and services (*marginal propensity to the consumption of certain types of goods and services*); $k_{mp_{I_{to}}}$, $k_{mp_{I_{im}}}$ are the coefficients that characterize the marginal dependency of respectively traditionally- and innovation-oriented investments from NDP (*marginal propensity to certain types of investments*).

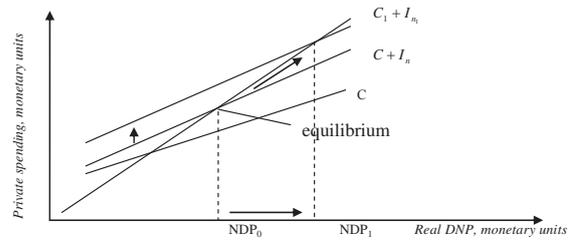


Fig. 5. The equilibrium of NDP according to the method “aggregate expenditures – production volume”

It should be noted that the propensity to traditionally- and innovation-oriented investments may differ significantly. The introduction of the appropriate coefficients makes it possible to estimate the value of the multiplier effect, that is the ratio of the change in NDP (shifting from NDP_1 to NDP_2 in Figure 5) to the initial change in investment (shifting of the curve $C + I_n$ to $C_1 + I_{n_1}$ in Figure 5) which caused the change in the real NDP on the basis of a simplified model of its calculation.

Taking into account the fact that we study consumption expenditures and net investments as partially dependent from NDP, we have:

These marginal categories are determined by the ratio of certain changes of indicators to the change of argument:

$$K_{mp_{C_{to}}} = \frac{\Delta C_{to}}{\Delta NDP}, \quad (36)$$

where ΔC_{to} is a change in the expenditures for the consumption of traditional goods and services, which is caused by a certain change in the value of NDP; ΔNDP is a change in the value of NDP, or deviation in NDP value from its basic value. The basic level of NDP is the level for which the marginal propensity to the consumption of traditional goods and services is calculated.

On this assumption we have:

$$\Delta C_{to} = C_{to_2} - C_{to_1}, \quad (37)$$

$$C_{to_1} = f(NDP_1), \quad (38)$$

$$C_{to_2} = f(NDP_2), \quad (39)$$

$$\Delta NDP = NDP_2 - NDP_1, \quad (40)$$

where C_{to_1} , C_{to_2} are the consumption expenditures on the respectively traditional and innovative goods and services for a basic (NDP_1) and other levels of NDP (NDP_2); NDP_1 , NDP_2 are respectively the basic and the predicted levels of NDP, while the predicted level must be as close to the basic as possible.

Let's calculate the marginal propensity to the consumption of traditional goods and services:

$$k_{mp_{C_{to}NDP_1}} = \frac{C_{to_2} - C_{to_1}}{NDP_2 - NDP_1}, \quad (41)$$

where $k_{mp_{C_{to}NDP_1}}$ is a coefficient of the marginal propensity to consumption of traditional goods and services for a certain basic level of NDP (NDP_1).

Mathematically, with certain functional relationship between the studied categories such value of the marginal propensity to the consumption of traditional goods and services will be determined by the derived function, which reflects the dependence of these expenditures from the value of NDP. The marginal propensity will be the following:

$$k_{mp_{C_{to}}} = \frac{\partial C_{to}(NDP)}{\partial NDP}. \quad (42)$$

Similarly one can present other marginal categories:

$$k_{mp_{C_{inn}}} = \frac{\partial C_{inn}(NDP)}{\partial NDP}, \quad (43)$$

$$M_{NDP} = \frac{1}{1 - k_{C_{to}}(1 + P_{TP})(1 - P_{TB}) - k_{C_{inn}}(1 + P_{TP})(1 - P_{TB}) - k_{I_{to}} - k_{I_{inn}}}, \quad (47)$$

It should be noted that the levels of tax burden and state transfer payments may also depend on the volume of NDP in accordance with the areas of the state policy. Therefore, it is necessary to consider the margin levels of state transfer payments and tax burden:

$$P_{TP_{mp}} = \frac{\partial TP(NDP)}{\partial NDP}, \quad (48)$$

$$P_{TB_{mp}} = \frac{\partial TB(NDP)}{\partial NDP}. \quad (49)$$

The introduction into the calculation of the categories of marginal levels of state transfer payments and tax burden makes it possible to modify the model for the calculation of the marginal propensity to consumption of traditional goods and services in the following way:

$$K_{mp_{C_{to}}} = \frac{\partial C_{to}(NDP, P_{TP_{mp}}, P_{TB_{mp}})}{\partial NDP}. \quad (50)$$

Similarly one can carry out the calculation of the marginal propensity to consumption of innovative products and services:

$$K_{mp_{C_{inn}}} = \frac{\partial C_{inn}(NDP, P_{TP_{mp}}, P_{TB_{mp}})}{\partial NDP}. \quad (51)$$

Further research requires the consideration of the net exports as a component of NDP. Taking in account the state and export-import expenditures the mechanism of

$$k_{mp_{I_{to}}} = \frac{\partial I_{to}(NDP)}{\partial NDP}, \quad (44)$$

$$k_{mp_{I_{inn}}} = \frac{\partial I_{inn}(NDP)}{\partial NDP}. \quad (45)$$

Under such conditions it becomes obvious that with the linear dependence (only in the case of the linear dependence) between the studied categories, which was chosen by us as the basis, the average and marginal values of certain propensities will be equal to each other.

Considering the state expenditures in the calculation of consumption expenditures it is necessary to correct the NDP to the average level of tax burden and the average level of state transfer payments into the NDP. In this case the functional dependence (33) will have a different form:

$$NDP = (C_{to_0} + C_{inn_0}) + (k_{C_{to}} + k_{C_{inn}}) * NDP * (1 + P_{TP}) * (1 - P_{TB}) + (I_{to_0} + I_{inn_0}) + (k_{I_{to}} + k_{I_{inn}}) * NDP, \quad (46)$$

A simplified calculation of the NDP multiplier on the assumption of the equality of average and marginal values of the propensity to consumption and investment would be conducted in the following way:

formation of the NDP equilibrium value takes a somewhat different form as illustrated in Figure 6.

The reflection of state expenditures (G) in the investigated model shifts the equilibrium value of net domestic product from NDP_1 to NDP_2 . In turn, the consideration of net exports (X_n) also affects the equilibrium amount of net domestic product, shifting it from NDP_2 to NDP_3 .

It should be noted that the state and export-import expenditures may, in turn, depend on NDP. In this case, one can't talk about the parallel curves, which reflect:

- ◆ consumption expenditures and net domestic private investments ($C + I_n$);
- ◆ consumption expenditures, net domestic private investments and state spending ($C + I_n + G$);
- ◆ consumption expenditures, net domestic private investments, the state spending and net exports ($C + I_n + G + X_n$).

The total number of factors which will affect the aggregate values of the state and export-import expenditures due to the influence of the regulatory impact and international factors may exceed their number for the consumer and domestic private investment expenditures, but the use of the marginal categories will also be essential for the purposes of our research.

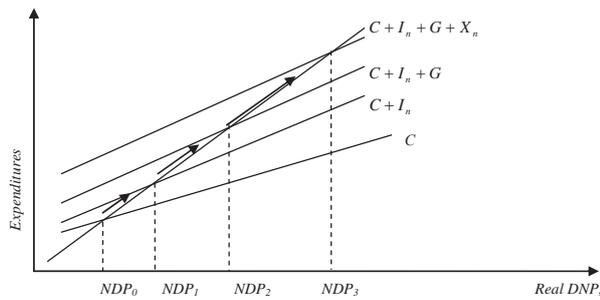


Fig. 6. Equilibrium NDP according to the method “aggregate expenditures – production volume”, which takes into consideration state expenditures and net exports

Let’s determine (according to the accepted classification) the marginal indicators of the dependence of state expenditures from NDP:

$$k_{mpG_{C_{to}}} = \frac{\partial G_{C_{to}}(NDP)}{\partial NDP}, \quad (52)$$

$$k_{mpG_{C_{inn}}} = \frac{\partial G_{C_{inn}}(NDP)}{\partial NDP}, \quad (53)$$

$$k_{mpG_{I_{to}}} = \frac{\partial G_{I_{to}}(NDP)}{\partial NDP}, \quad (54)$$

$$k_{mpG_{I_{inn}}} = \frac{\partial G_{I_{inn}}(NDP)}{\partial NDP}, \quad (55)$$

where $k_{mpG_{C_{to}}}$, $k_{mpG_{C_{inn}}}$ are the coefficients that reflect the impact of a change in the value of NDP on the amount of state consumption expenditures respectively on the traditional and innovative goods and services (*marginal propensity to state consumption expenditures of certain types of goods and services*); $k_{mpG_{I_{to}}}$, $k_{mpG_{I_{inn}}}$ are the coefficients that reflect the impact of a change in the value of NDP on the volume of the state traditionally- and innovation-oriented investments (*marginal propensity to state investments in certain areas*).

Let’s define the similar indicators for export-import expenditures according to the classification of their components by the criteria of innovation:

$$k_{mpX_{nC_{to}}} = \frac{\partial X_{nC_{to}}(NDP)}{\partial NDP}, \quad (56)$$

$$k_{mpX_{nC_{inn}}} = \frac{\partial X_{nC_{inn}}(NDP)}{\partial NDP}, \quad (57)$$

$$k_{mpX_{nI_{to}}} = \frac{\partial X_{nI_{to}}(NDP)}{\partial NDP}, \quad (58)$$

$$k_{mpX_{nI_{inn}}} = \frac{\partial X_{nI_{inn}}(NDP)}{\partial NDP}, \quad (59)$$

where $k_{mpX_{nC_{to}}}$, $k_{mpX_{nC_{inn}}}$ are the coefficients that reflect the impact of a change in the value of NDP on the amount of the net exports respectively of the traditional and innovative goods and services (*marginal propensity to the net exports of certain types of goods and services*); $k_{mpX_{nI_{to}}}$, $k_{mpX_{nI_{inn}}}$ are the coefficients that reflect the impact of a change in the value of NDP on the volume of the net exports respectively of the traditionally- and innovation-oriented investments (*marginal propensity to net exports by certain types of investment expenditures*).

We can group the defined marginal indicators according to their belonging to the traditional and innovative consumption expenditures, as well as traditionally- and innovation-oriented investments:

$$K_{mp}^{C_{to}} = k_{mpC_{to}} + k_{mpG_{C_{to}}} + k_{mpX_{nC_{to}}}, \quad (60)$$

$$K_{mp}^{C_{inn}} = k_{mpC_{inn}} + k_{mpG_{C_{inn}}} + k_{mpX_{nC_{inn}}}, \quad (61)$$

$$K_{mp}^{I_{to}} = k_{mpI_{to}} + k_{mpG_{I_{to}}} + k_{mpX_{nI_{to}}}, \quad (62)$$

$$K_{mp}^{I_{inn}} = k_{mpI_{inn}} + k_{mpG_{I_{inn}}} + k_{mpX_{nI_{inn}}}, \quad (63)$$

where $K_{mp}^{C_{to}}$, $K_{mp}^{C_{inn}}$ are the coefficients that reflect the impact of a change in the value of NDP on the amount of aggregate consumption expenditures respectively of the traditional and innovative goods and services (in our research we take into account the net exports of goods and services, and therefore the term “aggregate” should be understood with this amendment); $K_{mp}^{I_{to}}$, $K_{mp}^{I_{inn}}$ are the coefficients that reflect the impact of a change in the value of NDP on the amount of respectively the traditionally- and innovation-oriented investments.

In a general form the NDP multiplier can be determined as follows:

$$M_{NDP} = \frac{1}{1 - K_{mp}^{C_{to}} - K_{mp}^{C_{inn}} - K_{mp}^{I_{to}} - K_{mp}^{I_{inn}}}. \quad (64)$$

The research we have conducted makes it possible to draw the conclusion that the assessment of the influence of changes in the certain types of expenditures of NDP is based on the marginal analysis of the relationship between these expenditures’ volumes and the value of NDP. At the same time, there is a possibility to separate (in the aggregate expenditures) the innovation-oriented investments and consumption expenditures on innovative products and services as well as identify their direct influence on the NDP value with the help of the coefficients of marginal propensity to certain expenditures.

Conclusions

Positive changes in the economy are impossible without the formation of a state regulation policy focused on the innovative factor of economic growth. This task requires, among other things, the implementation of a qualitatively new investment policy, which, in turn, requires the improvement of the methodology of macroeconomic investment analysis. Such analysis should take into account the process of innovations' creation and implementation, its scope, influence of the innovation factor on the production dynamics. For the comprehensive analysis of the impact of innovation and investment factors on the macroeconomic performance criteria of the economic system (particularly on NDP) innovation- and traditionally-oriented components are singled out in every element of expenditures that form this index. The results of the research presented in this article made it possible to determine the consumption expenditures on traditional and innovative products and services in the structure of consumption expenditures as an element of NDP, to prove the different propensity of consumers to purchase each of them, to modify the quantitative representation of the aggregate consumption expenditures as a function of income after tax taking into account the traditional and innovative orientation of their components. The state expenditures in the structure of NDP are divided into state consumption expenditures on the traditional and innovative products and services, as well as the state traditionally- and innovation-oriented investment expenditures; their correlation is strictly regulated. The research of the net exports as a component NDP makes it possible to determine the net exports of traditional and innovative products and services, as well as

traditionally- and innovation-oriented investments, to determine the criteria of export's innovativeness.

It is crucial for the study of the innovation level of the economic system in the context of export-import activity to assess not only the volume of net exports, but the ratio of the absolute values of its basic components, structured according to the criteria of innovation.

In conditions of the economy's transition to the innovative type of development there is problem of discrepancy of the mechanisms for the assessment of the global economic performance to the realities of post-industrial society. Unfortunately, the additional multiplier effects, which the economic system can receive from the sales of innovative products and services, the provision of targeted financial assistance to innovation companies, implementation of innovation-oriented investments in the private sector and realization of import-export innovative operations are not thoroughly investigated by researchers. That is why this research has a great potential for further development. Obviously, a sound macroeconomic analysis of the role of innovations factors in the formation of the economic growth indicators, and on this basis – the development of an appropriate innovative, export-import, investment policy requires the development of an appropriate information base. This circumstance determines the need for innovation statistics in a separate branch of statistical observation. With the appropriate correction in the statistical accounting, an interesting area for the further research can be the quantitative assessment of dependence of macroeconomic indicators for the domestic economy's development from the marginal propensity to certain types of expenditures, structured by the criterion of innovation.

References

1. Marshall A. Principles of Economics (Revised Edition ed.) // Marshall Alfred. – London: Macmillan and Co., 1920. – 770 p.
2. Walras L. Elements of Pure Economics // Translated and annotated by William Jaffe, Walras Leon. – London: Allen and Unwin, 1954. – 620 p.
3. Cobb C.A. Theory of Production // Cobb C.W., Doudlas P.H., Amer. Econ. Rev. Suppl. – 1928. – Vol. 18. – pp. 139-165.
4. Keynes J.M. General Theory of Employment, Interest and Money // Keynes John Maynard. – London: Palgrave Macmillan, 1936. – 472 p.
5. Pigou A.C. The Economics of Welfare // Pigou Arthur Cecil. – London: Macmillan and Co., 1932. – 840 p.
6. Hicks J.R. Value and Capital: an Inquiry into some Fundamental Principles of Economic Theory // Hicks John Richard. – Oxford: Clarendon, 1939. – 480 p.
7. Hansen A. Business Cycles and National Income // Hansen Alvin. – New York: Norton & Co., 1964. – 540 p.
8. Friedman M. Freedom of Choose // Friedman Milton. – Cincinnati: South-Western Publishing Go, 1980. – 560 p.
9. Harrod R.F. Towards a Dynamic Economics. Some Recent Developments of Economic Theory and Their Application to Policy // Harrod Roy Forbes. – London: Macmillan and Co., 1956. – 184 p.
10. Domar E.D. Essays in the theory of economic growth // E.D. Domar. – N.Y., 1957. – 387 p.