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Intersect oral Balance of Construction Complex as a Factor of Territory Development

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Abstract:*The article deals with studying the interconnection of industries associated with the construction complex. Construction is presented as a system comprising industries, which includes engineering industry, mineral resource industry, transport industry, metallurgy industry. Based on the model of intersectoral balance, the author establishes the impact of the change of productionmatrix on the ratio of components of vectors of the gross production and the final production.*

Key words: *construction, interconnection, intersectoral connections, territory development, system, construction complex.*

JEL Codes:E 21, M 11, O11, L74

I. Introduction

Construction complex refers to the state strategic objects by right, since it, firstly, realizes the basis of the economic development cycle; secondly, has tight connections to many basic industries of the economic complex; thirdly, is a backbone factor for the development of certain regions. Therefore, construction as a motive factor of economy, infrastructure, and territory development is of a special interest for research in contemporary conditions as well.

A significant progress in the research on the development of modern theoretical base of analysing territory development including the development of backbone industries achieved during the recent decade. Despite these developments, the study of the practice of territory development indicates retention of the issue of inequality of allocation and development of manufacture and consumption in the space that brings the role of the structural and institutional processes up to date.

II. Analysis of the reference data and problem statement.

Representatives of the neoclassical theories of growth G. H. Borts, J. I. Stein (1964), T. Swan (1956), R. Barro, X. Sala-i-Martin (1990) [1-3] consider the territory development based on the factors that form manufacturing potential the main of which are labour, land, and capital. Factors of the spacial allocation are the additional motive powers.

Construction complex can be considered as a manufacturing system composed of several industries. Moreover, the interaction between the industries can be set by means of market relations.

Representatives of the neoclassical theory, namely Barro R. and Sala-i-Martin X. (1990)[3] pay significant attention to studying the issues of spacial allocation of the manufacture, construction directly that found its expression in substantiating efficient models of the economy regional differentiation.

Neoclassical theory develops in two trends in one trend, it is presented in aggregate models of the economic growth, in the other, and it is conveyed on the level of regional models and consists in the significance of the manufacture factors. For all that, researchers note that disproportion in the territory development are explained with the simplified correction in answer to the exogenous changes. There is a need in developing infrastructure for liquidation of the disproportions and contradictions in the territory development.

Followers of the cumulative theories (synthesis of neokeynesian, institutional, economic-geographical) studying economic territory development prefer the group of factors influencing the spacial territory development.

In his works [4, 5], G. Myrdal (1972) analyses peculiarities of economic growth in developing countries including consideration of the influence of territorial factors. The researcher argues the conclusion that the difficulties on the territory development relate to the social contradictions and the backwardness in all life areas. Therefore, the market economy tools do not work on the scheme of the orthodox theory.

The works of the Nobel prize winner P. Krugman(1995, 1997) [6-8] reveal an interesting regularity: the welfare of different territories is explained with the scale effect. It comes from the conclusion that it is reasonable to increase the specialisation level for the territory development. Moreover, the territory with bigger population receives position that is more advantageous.

In spite of the fact that the role of state gradually decreases in the conditions of the market economy, the functions of the state institutes remain determinative concerning the territory development. A. O. Kasych persists in this opinion in her research (2011) [9]. According to the conclusions in the research works [10, 11], the author substantiates the conclusion that the leading role in the base of the territory development should belong to the state. Realization of the efficient state policy can become a tool regulating strategic territory development. For all that, construction also need the state programs regulating and coordinating the territory development.

Construction as a dominant factor of the territory development requires revealing interference of industries associated with the construction complex. Considering the complicated structure of interconnections between the construction and other industries, there appears the issue of assessment and analysis of the manufacturing-construction system. In this case, the systems analysis provides opportunity for studying a wide range of the construction complex elements. Strengthening the target focus of all construction participants on the issue of the finished construction products requires unity of the performance of manufacturing-economic activities and all organizations of the construction complex. Elimination of the negative trends in the construction management requires transition from the empirical actions on the construction managing to the scientifically substantiated complex projecting of the construction organizational forms.

The main difficulty in the conduction of the quantitative research on the processes of the construction complex functioning is the lack of accurate, detailed and comparable data. Construction complex includes a group of productive and non-manufacturing industries, which are functionally united and provide material conditions for manufacturing processes, and the whole society vital activities.

In most cases, the analysis of the construction complex functioning duplicates the typical interrelations of the industries. Dispersion of the geographical types present the difficulty. Dependence of the construction on the labour, materials and equipment that are widely used in other industries and its relation to the numerous auxiliary industries complicate the accurate analysis and the dependence of the construction on the political and economic uncertainty worsens the dynamics.

III. Research aim and tasks.

The article aims at determining the interference of the elements of the intersectoral balance for the territory development.

The established aim is achieved due to the fulfilment of the following tasks:

– singling out the main industries relating to the construction;

– using the model of intersectoral balance with regard to the construction;

– analysing interference of the industries associated with the construction;

– determining the influence of the change of elements of the production matrix on the ratio of the components of the vector gross and final production.

IV. Research data and methods.

The author uses the model of intersectoral balance by V. V. Leontiev “expenses–production” [12] to resolve the tasks mentioned above.

V. Research results.

Inference between the subjects of the national economy requires agreement of the manufacture volumes and structure with the consumption volumes and structure. The general economic balance in construction can be determined in total, based on the solution of the simultaneous equations reflecting participation of the subjects in the main kinds of activities. I.e. based on the model.

The models describing the economic turnover are matrix or balance.

Presumably, the construction can be presented with n industries (Table 1).

Table 1Intersectoral flows

To After	Intersectoral flows, x_{nm}	Final production	Gross production
	1 2 . . .	y_i	X_i
1	x_{11} x_{12} . . . x_{1n}	y_1	X_1
2	x_{21} x_{22} . . . x_{2n}	y_2	X_2
. . .	. . . . .	. . .	. . .
n	X_{n1} x_{n2} . . . x_{nm}	y_3	X_n

Where *n*is a number of industries;

X_i is a gross cost of the production in the industry i, $i = 1, n$;

y_i is the final demand for the production of the i industry, $i = 1, n$;

x_{ij}isintersectoral flows, i.e. intermediate expenses of production of the i industry of the j industry, $i = \overline{1, n}, \; j = \overline{1, n}.$

Each industry *i*creates a gross cost of the product x_i that is applied as a raw product for its own manufacture x_{ii}, for manufacture of another industry $x_{ij}$and for meeting the final demand y_i.

$$\begin{aligned} X_1 &= x_{11} + x_{12} + \ldots + x_{1n} + y_1, \\ X_2 &= x_{21} + x_{22} + \ldots + x_{2n} + y_2, \\ &. \; . \; . \; . \; . \; . \; . \; . \; . \; . \\ X_n &= x_{n1} + x_{n2} + \ldots + x_{nn} + y_n, \end{aligned} \quad (1)$$

or in the contracted form

$$X_i = \sum_{j=1}^{n} x_{ij} + y_{i,} \; i = 1, 2, \ldots, n. \quad (2)$$

If the construction spends the gross production on its own needs, such system and its models are closed. If at least one kind of non-zero final production is manufactured, the system and its models are open.

Transition from the general diagram of the intersectoral “expenses–production” to the analysis of the volume and structure of the expenses in the country construction requires calculation of the coefficient of the factor cost:

$$a_{ij} = x_{ij} / \; X_{j.} (3)\backslash$$

i.e. the construction system is characterized with the production matrix $a = (a_{ij}), \quad i = \overline{1, n}$, $j = \overline{1, n},$

where the value $a_{ij}$is a quantity of products of the *i*industry that is spent on an item of the products of the *j* industry. Considering that manufacturing the gross product of all industries requires spending $X_i = \sum_{j=1}^{n} a_{ij} X_j$ units of products of the iindustry, vectors $X = (X_1, X_2, .., X_n)$ и $Y = (y_1, y_2, \ldots, y_n)$ are united with simultaneous equations:

$$\begin{aligned} X_1 - a_{11} X_1 - a_{12} X_2 - \ldots - a_{1n} X_n &= y_1, \\ X_2 - a_{21} X_1 - a_{22} X_2 - \ldots - a_{2n} X_n &= y_2, \\ . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \\ X_n - a_{n1} X_1 - a_{n2} X_2 - \ldots - a_{nn} X_n &= y_n, \end{aligned} \quad (4)$$

which can be contracted to:

$$x_i - \sum_{j=1}^{n} a_{ij} x_j = y_i, i = 1, 2, \ldots, n; \quad (5)$$

or in the form of matrix

$$(E - a) X = Y, \quad (6)$$

where*E* is a unity matrix.

The only solution of such equations is caused by the reverse matrix $A = (E - a)^{-1}$:

$$(E - a)^{-1} Y = AY. \quad (7)$$

In its content, the matrix $A = (A_{ij})$, $i = \overline{1, n}$, $j = \overline{1, m}$, is a coefficient matrix of full expenses as the economic sense of its elements is as follows:

elementA_{ij}reflects the need in the gross product of the *i* industry for manufacturing an item of the final product of the *j*industry.

As a result, A_{ij} is a multiplier reflecting the effect of spreading demand on the gross product *i* which primary source is the demand on the final *j* product.

Leontiev’s model can be applied for:

1. Determining the appropriate amount of the gross product of industries for manufacturing the final product on its established volumes;

2. Calculating the amount of the final product on the established level of manufacturing the gross

product;

3. Studying the impact of the change of technology on the manufacture, i.e. calculating how the change of the elements of the production matrix influence the ratio of the components of the vectors of the gross and final products.

The studied model “expenses–production” can be a basic one for more complex models. Resource limitations can be added to it. If one uses labour which expenses are limited with a value L, manufacture of a unit of the gross product $x_j$requires$t_j$units of labour expenses, where $t_j = L_j / X_j$, so the total number of labour resources used in the manufacture of the whole gross product equals $\Sigma t_j X_j$.

As a result, the limitation of the use of labour resources can be presented in the following form:

$$t_1 X_1 + t_2 X_2 + ... + t_n X_n \leq L. \qquad (8)$$

Thereby, balances of labour expenses such as basic production assets can be calculated together with the resource-cost balance.

Construction of the state can be presented as a system.

The tightest inferences are established on the industries due to the construction peculiarities:

1) with engineering industry;
2) with mineral resource industry;
3) with transport industry;
4) with metallurgy industry.

In the formed Table 2 there are intersectoral flows in the cost expression on the generalized data collected from open sources.

X_i is the product of the industry i, a $x_{ij}$is the cost of goods and services provided by the industry i to the industry j. Inner volumes of consumption are excluded in this case.

Table 2

Intersectoral flows (in billions of UAH)

From To	1	2	3	4	Total
1	—	$x_{12} = 16.4$	$x_{13} = 25.8$	$x_{14} = 76.9$	$X_1 = 119.1$
2	$x_{21} = 14.3$	—	—	$x_{24} = 11.6$	$X_2 = 25.9$
3	$x_{31} = 22.1$	$x_{32} = 0.7$	—	—	$X_3 = 22.8$
4	$x_{41} = 65.6$	$x_{42} = 5.6$	—	—	$X_4 = 81.2$
Total	102.0	32.7	25.8	88.5	249.0

According to the data in the Table 2 in the accounting year, the gross production of the first industry is 119.1 billion UAH. ($X_1 = 119.1$). $X_{12} = 16.4$ billion UAH of them were given to the second industry. The volume of $x_{13} = 25.8$ billion UAH was transferred to the third industry.

The volume of $x_{14} = 76.9$ billion UAH was transferred to the fourth industry.

In the same year, production of the second industry was $X_2 = 25.9$ billion UAH. $X_{21} = 14.3$ billion UAH of them went to the first industry. The volume of $x_{24} = 11.6$ billion UAH was transferred to the fourth industry.

The production of the thirds industry was $X_3 = 22.8$. $X_{31} = 22.1$ of them went to the first industry, $x_{32} = 0.7$ were the supply from the second industry.

The cost expression of the production of the fourth industry equals $X_4 = 81.2$. $X_{41} = 65.6$ of this sum went to the first industry in the form of works done there; $x_{42} = 15.6$ went to the second industry.

According to the above mentioned, the following ratio is true:

$$\begin{cases} x_{12} + x_{13} + x_{14} = X_1, \\ x_{21} + x_{23} + x_{24} = X_2, \\ x_{31} + x_{32} + x_{34} = X_3, \\ x_{41} + x_{42} + x_{43} = X_4. \end{cases} \qquad (9)$$

Sum of transition from one industry to the other industries equals the gross production of the industry.

These ratios have the following form in our model:

$$\begin{cases} 16,4 + 25,8 + 76,9 = 119,1, \\ 14,3 + 11,6 = 25,9, \\ 22,1 + 0,7 = 22,8, \\ 65,6 + 15,6 = 81,2. \end{cases} \quad (10)$$

Let us assume that there are continual manufacture coefficients or coefficients of direct expenses a_{ij}. We use the following ratio to calculate them:

$$a_{ij} = x_i / X_j \quad (11)$$

Intersectoral flows are written in the following way:

$x_{ij} = a_{ij} X_j$. (12)

Coefficients of direct expenses build a matrix:

$$a = \begin{pmatrix} 0 & 0,63320 & 1,13158 & 0,94704 \\ 0,12007 & 0 & 0 & 0,14286 \\ 0,18556 & 0,02703 & 0 & 0 \\ 0,55080 & 0,60232 & 0 & 0 \end{pmatrix}$$

Calculation of continual direct expenses (elements of the matrix a) has the following form:

$a_{12} = x_{12} / X_2 = 16.4 / 25.9 = 0.63320;$
$a_{13} = x_{13} / X_3 = 25.8 / 22.8 = 1.13158;$
$a_{14} = x_{14} / X_4 = 76.9 / 81.2 = 0.94704;$
$a_{21} = x_{21} / X_1 = 14.3 / 119.1 = 0.12007;$
$a_{24} = x_{24} / X_4 = 11.6 / 81.2 = 0.14286;$
$a_{31} = x_{31} / X_1 = 22.1 / 119.1 = 0.18556;$
$a_{32} = x_{32} / X_2 = 0.7 / 25.9 = 0.02703;$
$a_{41} = x_{41} / X_1 = 65.6 / 119.1 = 0.55080;$
$a_{42} = x_{42} / X_2 = 15.6 / 25.9 = 0.60232.$

To produce one additional hryvnia in the first industry in the accounting period, we need:
a_{21}= 0.12007 UAH fromthe second industry:
a_{31}= 0.18556 UAH from the third one and 0.55080 UAH from the fourth industry.
To receive the additional hryvnia in the second industry in the same period, we need:
a_{12} = 0.63320 UAH of supplies from the first industry;
a_{32} = 0.02703 UAH of supplies from the third industry;
a_{42} = 0.60232 UAH of supplies from the fourth industry;

To receive the additional hryvnia in the third industry, we need a_{13} = 1.13158 UAH from the first industry.

To receive the additional hryvnia in the fourth industry, we need a_{14} = 0.94704 UAH from the first industry and a_{24} = 0.14286 UAH from the second industry.

Leontiev's closed model has the form:

$$\begin{cases} X_1 - a_{21}X_2 - a_{13}X_3 - a_{14}X_4 = 0; \\ -a_{21}X_1 + X_2 + a_{23}X_3 - a_{24}X_4 = 0; \\ -a_{31}X_1 - a_{31}X_2 + X_3 - a_{34}X_4 = 0; \\ -a_{41}X_1 - a_{42}X_2 - a_{43}X_3 + X_4 = 0. \end{cases} \quad (13)$$

Since we discuss the homogeneous simultaneous equations, whose determinant equals zero, we cannot determine absolute values of the production volumes of the industries and we determine only their ratio X_i / X_j.

With the set coefficients of direct expenses, we receive:

$$\begin{aligned} X_1 - 0,63320X_2 - 1,13158X_3 - 0,94704X_4 = 0; \\ -0,12007X_1 + X_2 - 0,14286X_4 = 0; \\ -0,18556X_1 - 0,02703X_2 + X_3 = 0; \\ -0,55080X_1 - 0,60232X_2 + X_4 = 0. \end{aligned} \quad (14)$$

Having excluded the fourth industry and denominated its demand for the products of other industries through y_1, y_2, y_3, we receive the open model of "expenses–production":

$$\begin{cases} X_1 - a_{12}X_2 - a_{13}X_3 = y_1; \\ -a_{21}X_1 + X_2 - a_{23}X_3 = y_2; \\ -a_{31}X_1 - a_{32}X_2 + X_3 = y_3, \end{cases} \quad (15)$$

where$y_1$isan independent demand of the fourth industry the products of the first industry;
$y_2$isan independent demand of the fourth industry for the products of the second industry;
$y_3$isan independent demand for the products of the third industry;

The numerical model is presented in the form:

$$\begin{aligned} X_1 - 0{,}63320X_2 - 1{,}13158X_3 &= y_1; \\ -0{,}12007X_2 &= y_2; \\ -0{,}18556X_1 - 0{,}02703X_2 + X_3 &= y_3. \end{aligned} \quad (16)$$

The independent demand of the fourth industry in the closed system is noted as

$y_1 = x_{14}$; $y_2 = x_{24}$; $y_3 = x_{34}$.

If the demand of the fourth industry on the other unchanged conditions for the products of the first industry (y_1) increases on 1%, i.e. from 76.9 to 77.669 billion UAH, we receive the following data because of the system solution:

X_1 = 120.18347 (was 119.1) billion UAH
X_2 = 26.03050 (was 25.9) billion UAH,
X_3 = 23.00496 (was 22.8) billion UAH

Consequently, increasing demand of the fourth industry for the products of the first industry on 1% takes place due to the increase of the products on 0.91%, the second industry – on 0.50 % and the products of the third industry – on 0.90 %.

The calculations done with the help of the matrix of full resource expenses:

$$(E-a)^{-1} = \begin{bmatrix} 1 & -a_{12} & -a_{13} \\ -a_{21} & 1 & -a_{23} \\ -a_{31} & -a_{32} & 1 \end{bmatrix}^{-1} = \begin{bmatrix} 1{,}0000 & -0{,}63320 & -1{,}13158 \\ -0{,}12007 & 1{,}0000 & 0{,}0000 \\ -0{,}18556 & -0{,}02703 & 1{,}0000 \end{bmatrix} =$$

$$= \begin{bmatrix} 1{,}40781 & 0{,}93449 & 1{,}59306 \\ 0{,}16904 & 1{,}11221 & 0{,}19128 \\ 0{,}26580 & 0{,}20347 & 1{,}30078 \end{bmatrix} \quad (17)$$

The system solution (16) with the help of this matrix has the form:

$$X = (E-a)^{-1}.Y, \text{ or } \Delta X = (E-a)^{-1}\Delta Y. \quad (18)$$

Substituting the elements of the matrix of full expenses, we receive:

$$\begin{cases} X_1 = 1{,}40781y_1 + 0{,}93449y_2 + 1{,}59306y_3; \\ X_2 = 0{,}16904y_1 + 1{,}11221y_2 + 0{,}19128y_3; \\ X_3 = 0{,}26580y_1 + 0{,}20347y_2 + 1{,}30078y_3. \end{cases} \quad (19)$$

VI. Discussion of research results.

The interference of the industries on this model can be done due to the current data. If the demand of the fourth industry for the products of the first industry changes on 1 billion UAH with other conditions remaining unchanged, the products of the first industry increases on 1.40781 billion UAH, the second industry – on 0.169 billion UAH and the third industry – on 0.2658 billion UAH.

If the demand for the products of the second industry y_2 increases on 1 billion UAH with other conditions remaining unchanged, X_1 should increase on 0.93 billion UAH, products of the second industry X_2 – on 1.11 billion UAH and products of the third industry X_3 – on 0.2 billion UAH.

If the demand of the fourth industry increases for the products of the third industry on 1 billion UAH it will increase products on 1.59 billion UAH, products of the second industry X_2 – on 0.19 billion UAH and products of the third industry X_3 – on 1.3 billion UAH.

The model “expenses–production” is static, since it does not consider possible changes taking place as time goes by and is used for comparatively short periods. Models that are more complex should be used to consider dynamic changes.

Dynamic generalization of the model can be received if the fund volume f_{ij}, that equals the number of *i* production, is introduced. It is given on the fund gain of *j* industry divided on the growth of this industry ΔX_j (amortization is hereby included into the compensation fund). In this case, the model has the form of simultaneous equations:

$$X_i - \Sigma a_{ij} X_j - \Sigma f_{ij} \Delta X_j = Z_i, i = 1, 2, \dots, n, \qquad (20)$$

whereZ_i is the rest of the final product of *i* industry after covering compensation funds (amortization) and the development fund (investment) of the manufacture.

Export, stock growth, insurance funds can be included into Z_i together with consumption. Introducing the industry product growth rates $k_j = \Delta X_j / X_j$, the simultaneous equations have the form:

$$X_i - \Sigma в_{ij} X_j = Z_i \ , i = 1, 2, \dots, n, \qquad (21)$$

where$в_{ij} = a_{ij} + f_{ij} k_j$.

It approximates its form to the static model.

VII. Conclusions.

The conducted research allows revealing the following:

1. Construction industry needs improvement of the theoretic basis for developing, since it is very complex and varied from the point of view of inference of the constituents.

2. Complex approach to the analysis of construction determines the main trends of its perspective analysis of its elements' inference in the whole. The need in the complex approach is proved with the experience received by science and practice.

3. Construction is a system of the united complex of interfered elements; the system elements are subsystems of a lower rate, i.e. there is a unity of aims, resources, construction (structure).

The author determines the influence of the change of elements of the production matrix on the ratio of the components of the vector gross and final production.

The research suggests:

– studying construction as a system combining activity of the totality of industries characterized with resource unity;

– applying the model of intersectoral balance to reveal the industry interconnection of the construction complex influencing the territory development.

The research is a basis for further theoretical researches on managing construction complex development as a factor of the territory development.

References

[1.] Borts G. H., Stein J. I. Economic Growth in a Free Market. New York, London, 1964 – 333p.

[2.] Swan T. Economic Growth and Capital Accumulation // Economic Record, 1956, - Vol. 32, N. 2, p. 334-361.

[3.] Barro R. ,Sala-i-Martin X. Economic growth and convergenceacross the United States. NBER Working paper. 1990. 3419. - p. 272.

[4.] MyrdalG. Economic Theory Underdeveloped Regions. London: Duckworth, 1957. – 566 p.

[5.] Мюрдаль Г. Современные проблемы «третьего мира». Драма Азии : пер. с англ. /подобщ.ред. д.э.н., проф. Р.А. Ульяновского. М., Прогресс, 1972, - 767 с.

[6.] Krugman P. Increasing returns and economic geography //Journal of Political Economy, 99. 1991, - p. 483-499.

[7.] KrugmanR ,VenabiesA. Globalization and the inequality of nations// Quarterly of Economics, 1995, - 110 p.

[8.] KrugmanP. ,VenabiesA. The seamless word: a spatial model of international specialization and trade. Mineo, MIT, 1997. – 531p.

[9.] КасичА.О. Досвідформуваннянаціональнихінноваційнихсистем в країнах, щорозвиваються / А.О. Касич // Актуальніпроблемиекономіки. – 2013. – № 5 (143). – Р. 46-49.

[10.] КасичА.О. Теоретичніаспективпливупроцесівдецентралізаціїнаекономічнийрозвитоккраїни /А.О. Касич// Актуальніпроблемиекономіки. – 2016. – №8. – С. 16-21.

[11.] Касич А.О. Теоретичні і методичніосновианалізувнутрішніхджерел фінансуванняінвестиційноїдіяльності /А.О. Касич // Актуальніпроблемиекономіки. – 2011. – № 3(117). – С. 243–250.

[12.] Leontief W., jun. Die Bilanz der russischen Volkswirtschaft. Eine methodologische Untersuchung // Weltwirtschaftliches Archiv. — 1925. — Bd.22, H.2 (Oktober). — S. 338-344.