Spatial Matrix of Financial Flows: Tools of Formation and Experience of Application

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Abstract[1]

The article deals with the method of forming of the spatial matrix of financial flows (SMFF). The basis of the proposed method are the principles of formalization of social accounting matrices. These principles have been transformed by means of accounting a regional specific character of the distribution of financial flows on institutional sectors and levels of spatial hierarchy.

By the example of the Republic of Bashkortostan was realized a proposed scheme of the spatial distribution of financial flows. Were revealed high instrumental properties of the proposed matrix for the management by the territorial finances.

1. Introduction

Management by the territorial finances is a complex economic problem. The peculiarity of this management, first, is conditioned by the open nature of regional economic systems. Financial resources, circulating within them, is distributed between different sectors and levels of economic management. But a unified system of accounting spatial movement of financial resources in regions is absent. As a result there is an objective need to develop tools of spatial accounting of financial flows. As such tools may be proposed by the spatial matrix of financial flows. Scheme of data matrices should provide a comprehensive picture of the scale, structure and orientation of the spatial movement of financial resources.

Secondly, territorial formation do not have the consolidated information that fully describes the movement of financial resources. In the system of regional accounts is developed only account of the production. This account operates by the categories of gross issue, intermediate consumption and added value . Scheme of this account does not allow to identify the volume, structure and direction of the movement of financial resources that go through the stages of forming, primary and secondary distribution. As a result there is a problem of integrated accounting information about the movement of financial flows. This information is dispersed among different sources. The development of tools integrating these sources is a challenge that is presented in this paper.

Foregoing shows the relevance, scientific and practical importance of developing tools of movement financial flows over the levels of spatial hierarchy and sectors of economics in the region.

2. Spatial financial flows and their characteristics

In the traditional statement the financial flows are a directed movement of financial resources. These flows reflect the system of economic relations on the production, distribution, exchange and consumption of different kinds of resources, products and economic welfares. However, new realities necessitate the transformation of traditional submission of economic category "financial flow" and its characteristics. The basis of these changes are objective features of economic development in conditions of prepotency of the spatial approach.

These include lack of rigid connection of the economic resources to concrete territory, their high mobility and the increased demands of economic rationality and efficiency of their use.

Based on this definition, formalize the financial flow by vector $\vec{x}_{ij}(t)$, where i, j – segments of the economic space, the beginning and end of the financial flows. Given property of the aggregation, which inherent by the financial flows, this vector can be represented in the form of the expression:

$$\vec{x}_{ij}(t) = \sum_{k=1}^{K} \vec{x}_{ij}^{k}(t); \qquad (1)$$

where k - index of the element, a component of an aggregated financial flow, t - a unit of time.

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Among the main characteristics of financial flows should be allocated:

- value of the flow – $\left|\vec{x}_{ij}^{\,k}(t)\right|$ the absolute size of the financial flow, which move between individual segments of economic space;

$$\left|\vec{x}_{ij}(t)\right| = \sum_{k=1}^{K}\left|\vec{x}_{ij}^{k}(t)\right|; \quad (2)$$

- power of flow as the ratio of value of the flow to the GRP;

$$M\,x_{ij}(t) = \frac{\left|\vec{x}_{ij}(t)\right|}{GRP_t} = \frac{\sum_{k=1}^{K}\left|\vec{x}_{ij}^{k}(t)\right|}{GRP_t}; \quad (3)$$

- intensity of the flow $\Delta\vec{x}_{ij}(t)$, calculated as the value of flow per unit time (month, year, quarter):

$$\Delta\vec{x}_{ij}(t) = \frac{\partial\vec{x}_{ij}(t)}{\partial t} * \partial t; \quad (4)$$

- the structure of the flow $S_{ij}^{k}(t)$ as a proportion of individual elements and the flow as a whole:

$$S_{ij}^{k}(t) = \frac{\left|\vec{x}_{ij}^{k}(t)\right|}{\sum_{k=1}^{K}\left|\vec{x}_{ij}^{k}(t)\right|}; \quad (5)$$

Analysis of of financial flows, which was conducted according with the these characteristics revealed the flows, the most significant for regional management. Among them:

- money income households, which include expenditures of business on wages and social transfers from the state. The size of these revenues in 2008 year amounted to 696.1 billion rubles and for 1995 - 2008 years increased more than 4 times (average annual rate of growth – 11,3%).
- investment in fixed capital, formed from the gross mixed income, household savings and state investment. Theirs value amounted to 207.1 billion rubles or 25,8% of GRP of the republic. Total investments in 1995 – 2008 years (excluding inflation factor) increased more than 19 times, despite the default of 1998 and the crises of recent years;
- balanced financial result (profit – loss) of the business sector of the economy, amounting 89.3 billion rubles. This financial flow most depended from external conditions and domestic market. But its increase (nearly 8 – fold in 1995–2008 years) is a testament to the competitiveness economy of the Bashkortostan;
- Tax and non-tax income of the state, who are concentrated in the consolidated budget of the Republic of Bashkortostan. In 2008, the size of the budget increased to 116.5 billion rubles (or 10.7 times). Such a significant amount of the budget determines the growing importance of the sources of its formation and of the directions useing, as well as tools of spatial distribution of financial flows. The total consideration of these and other large financial flows can provide the total coverage of the financial resources of the region and the adequacy of schemes of their turnover to the realities of the economy.

The results of spatial analysis as the basis for the development of modified matrix of financial flows. These matrixes were formed by taking into account the spatial aspects of the movement of financial resources across sectors of economics and levels of spatial hierarchy.

3. The basic positions of forming of spatial matrices of financial flows

In the base of an integrated representation of spatial matrices of financial flows were used tool of social accounting matrices. Fundamentals of this tool have been proposed R. Stone and A. Brown conformably to the national level of management. Subsequently, the data bases have been adapted to different countries (see, for example, Waheed A., Ezaki M.) [1]. Currently, social accounting matrices actively is improved by the scientists from developed countries. These matrices were developed to sectors of the economy, for example, AgroSAM (Muller M., Dominguez I., Gay S.; Rocchi B., Romano D., Stefani G.) [2,3]; regions and interregional cooperation (Robinson D., Liu Z.) [4]; Eurozone (Jellema T., Keuning S., McAdam P., Mink R.) [5]; for the social and ecological spheres (modifications of the SAM - SESAM) (Keuning S.J.) [6] and etc.

Recent studies of the scope and structure of national economies with the use of social accounting matrices began to develop in the CIS countries - in the Kazakhstan (Hare P., Naumov A.) [7], Georgia (Mekantsishvili E.) [8], etc. The high efficiency of this tool guaranteed its use in economic analysis by statistical offices of various countries and international financial organizations.

In Russia, research of matrix of financial flows are conducted by A.S. Akopov and G.L. Beklaryan [9], A.R. Belousov and E.A. Abramova [10], N.B. Shugaley, E.B. Yershov [11], etc. It should be noted that the majority of Russian developments focused on the national level. This is understandable, since the Russian statistics more fully represented in the System of National Accounts of Russia and the tables «input – output». The similar official statistics on the regional and interregional levels (for example, at the level of economic regions and federal districts) exists in truncated form.

In this connexion, the primary principles of the spatial matrix of financial flows were transfered from the SAM tools and modified for this task. Among these principles:

1. Construction of the spatial scheme financial flows as a square matrix describing the movement of financial resources for various economic sectors and levels of spatial hierarchy;
2. The rows of the matrix represent the income various sectors of economics, grouped by sector (business - non-financial corporations, households, government, financial and credit institutions), and columns, respectively, their expenditures. Thus the scheme of financial flows shows the economic processes of formation, distribution and redistribution of income, as well as their transformation in the expenditures of the corresponding recipients;.
3. Sectors of economy divided on levels of the spatial hierarchy (the region, other regions, the federation, the rest of the world). As a result, everyone from the types of income, included in the consideration, represented in the unit or aggregated form depending of the composition of its elements;
4. Financial sector (along with the formation of their own income) acts as an intermediary in the distribution of income of other institutional sectors. This creates certain difficulties in the separation of functions and the sizes of financial flows. Therefore, the financial and credit institutions of the region in this version presented without detailed elaboration, which will be implemented in the subsequent variants of matrix;
5. Financial flows in the investment sphere of the region reflect the movement of financial resources of the investment character. These resources are mainly formed from the internal income (savings) of different sectors of the economy of the region. In addition, in the matrix are taken into account and investment income from external sources (investment programs of the federal center, inter-regional investment projects, foreign investment);
6. The aggregate amounts of rows and columns of the matrix represent the values of the integrated flows of financial resources, which are moving between individual segments of the economic space. On the economic content the sums of the rows of the matrix are the flows of income of the different sectors of the economics, which are analysed in relation with a concrete level of economic space. Accordingly, the sums of the columns of the matrix reflect the expenses of sectors and of hierarchical levels of economics, adopted for the analysis.
7. Matrix has the static character. Its construction is carried out in relation to a specific year. Depending on the problems solved in the framework of regional governance, the range of years of building these matrices can be expanded.

4. Model of Spatial matrix of financial flows

The above-mention principles can be formalized following structure of the spatial matrix of financial flows (Table 1).

Table 1. Model of Spatial matrix of financial flows [2]

		j					
		...	m	...	Fs	I	Σ
i	...				...		...
	l		M_{lm}				
	...				...		...
	Fs	...		...	$\left\vert \vec{x}^{\,k}_{ij}(t) \right\vert$	...	$\sum_j \left\vert \vec{x}^{\,k}_{ij}(t) \right\vert$
	I				...		
	Σ	...		...	$\sum_i \left\vert \vec{x}^{\,k}_{ij}(t) \right\vert$	...	

[2] Formalizing model of the Spatial matrix of financial flows was made with the participation of a senior researcher ISER USC RAS Ph.D. Cherednikova L.Y.

where i, j – income and expenses of participants of economic relations, grouped by sectors and levels of spatial hierarchy; l, m – sectors of economy, $l, m \in \{B, H, G\}$, where B – business; H – household; G – State; Fs – credit and financial institutions; I – investment sector of the economics; $a_{ij} = \left| x^{k}_{ij}(t) \right|$ – the elements of the matrix.

The core of the matrix is minor Mlm, which represents the matrix of fourth-order type (Table 2).

Table 2. Minor Spatial matrix of financial flows

		m – sectors of economy			
		R	R_f	F	R_w
l – sectors of economy	R		…		
	R_f	…	$\left\| \vec{x}^{k}_{ij}(t) \right\|$	…	
	F		…		
	R_w				

where $\left| \vec{x}^{k}_{ij}(t) \right|$ – the value of aggregate financial flow, which move between individual segments of economic space; $\{R, R_f, F, R_w\}$ – levels of spatial hierarchy: R – the region, R_f – other regions, F – the Federation, R_w – the rest of the world.

Each element of the matrix (except totals) is the values of the aggregate flow. Elements of the matrix, corresponding to the total amounts, are values integrated financial flows and is calculated from the expression $\sum_i \left| \vec{x}^{k}_{ij}(t) \right|$ or $\sum_j \left| \vec{x}^{k}_{ij}(t) \right|$.

At that, must fulfill a condition, that when $i = j$ is enforced equality $\sum_i \left| \vec{x}^{k}_{ij}(t) \right| = \sum_j \left| \vec{x}^{k}_{ij}(t) \right|$.

Formed model of the spatial matrix is a tool for accounting of financial flows. The properties of this matrix make it possible to calculate the values of integrated financial flows and their characteristics for use in the management of the regional economics.

5. Testing of the developed tools of Spatial matrix of financial flows

Testing of Spatial matrix of financial flows was carried out by the example of the Republic of Bashkortostan in 2008. Republic of Bashkortostan is one of the largest regions - subjects of Russia. The economic processes that are characteristic of this region, typical of the majority of territorial entities of Russia. Therefore, their adequate representation, is significant not only for this particular republic, but also for other areas.

As information sources for the construction of Spatial matrix of financial flows have been used materials of National Accounts of Bashkortostan (2008), the consolidated budget of the Republic, the official statistics of Bashkortostanstata, etc.

Eested of this tool permitted to establish that:

1. The truncated volume of official statistics not a serious obstacle to obtaining a complete picture of financial flows within the region. System description of these flows in the matrix allows the use of its capabilities for the analysis of the regional economy;
2. Matrix adequately describes the movement of financial flows within the region. Deviation of calculated values of integrated financial flows from their actual values in most cases does not exceed 5%. This characterization of the trustworthiness of proposed scheme of the motion of financial resources makes it possible to speak about the high potential of this instrument;
3. Aggregated performance of individual flows, which was taken at this stage of development, are a logical and correct from position of a phased development tools of Spatial matrix of financial flows. When the need arises, these flows can be disaggregated. This matrix should be the expanded to a size that meet the needs of analysis and management.

But problem of accounting for spatial flows is the starting point for the management of financial resources in the region. To fully realize this goal have been identified external and internal factors that determine the sizes of flows. These factors under the condition of their inclusion in the mechanism of management of financial flows may act as their economic regulators.

6. Conclusion

The main results are as follows:

- In conditions a truncated and fragmented information a problem of management by the financial flows consist in development of the tools of the account of financial resources.
- Development of such tools can be based on a system of social accounts. These accounts should be consolidated in a matrix form and cover most of the regional financial flows.
- Testing of the proposed model of the spatial matrix of financial flows was carried out by the example of the Republic of Bashkortostan and showed its high instrumental properties for the purpose of analysis of the volume, structure and direction of financial flows. Testing of the proposed model of the spatial matrix of financial flows was carried out by the example of the Republic of Bashkortostan and showed its high instrumental properties for the purpose of analysis of the volume, structure and direction of financial flows.

- The models control for each of the financial flows, included in the matrix, were developed. This allows to include in the matrix of financial flows tools of analysis and management.

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