The Theory of Economic Nonequilibrium in Application to the Regional Disparities Problems: The Impact of Coronacrisis

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***Abstract*—This the article considers the main postulates of the theory in relation to the regional economic space. Based on statistical data, the author confirms the hypothesis that different regions of the Russian Federation are in a state of recession and inflation gaps. For recession gap price level is stable above the equilibrium, for inflation, on the contrary, the price level stable below the equilibrium.**

Keywords—regional differentiation, clusterization, price dynamics, recessionary gap, inflationary gap, coronacrisis

I. Introduction

For several years, the global economy has been experiencing crisis phenomena, which are systemic properties of models of continuous expansion of sales markets to a significant extent. The models are focused on maximizing profits, therefore one of the basic properties is the splitting of circulation processes, when the monetary circulation process breaks away from the process of product circulation and begins to follow its own mechanism. During the increase in this gap periodically forming financial "bubbles", which provoking economic crises.

Now the reverse side of the vast global market benefits and universal trade exchange is becoming apparent even for the main beneficiaries - European and American societies. Obviously that additional benifits are disproportionately distributed to the diferrent segments of the population, but are concentrated in certain circles. Against this background, in some States is developing the crisis of public administration [1].

The crisis that unfolded at the beginning of 2020, related to a new coronavirus infection (coronacrisis), only aggravate the previously existing contradictions. The coronacrisis has made arrest (in essence, confiscate) or outbid of medical equipment and personal protective equipment intended for another country a sustain practice of international relations. This policy, however, is at odds with the possibility of long-term positive joint inter-country interaction after this crisis will passed.

For this reason, regionalization of the economic space and national protectionism are becoming an important tool for protecting the national economy and reducing inequality, balancing the distribution of income received at the level of the world market. In this context, the high dependence of any business or industry on the condition on the international market can be considered as a threat to national security [6], which was clearly demonstrated by the coronacrisis. In this sense, a much more promising principles for the functioning of the economic system of any State is to focus not on profit maximization, due to its close connection with the global market, but on the strategic, long-term stability and reproducibility of the economic system of a particular country.

II. Theory

The dominance of scientific concepts related to profit maximization in the regional economic field has led to the fact that Western economic theory has been filled by research that does not explicitly take into account the territory, and often the economy was considered as a whole at the national level [4]. In particular, national-level factors have taken a leading position in explaining the regional economies dynamics [5]. Also, external demand began to be considered as the main force of regional economic growth [8], and trade models (e.g., models of increasing returns, comparative competitive advantages) have taken a leading place in explaining the reason for the concentration of economic activity.

This policy of trade-based economic growth has generally aggravated problems of regional inequality and productivity deficits. However, after the 2008 crisis, alternative views began to develop, for example, were revised the assumptions of traditional economic theories, such as a priori equilibrium and the automatic tendency to balance of economic systems, no longer describe the real situation. In life experience self-replicating and increasing imbalances are observed (more on this in [7]). Therefore, the main focus of the new concept should be on the study and understanding of the fundamental factors of heterogeneity of the socio-economic space.

In the Russian and Soviet economic school, which goes back to the ideas of Karl Marx's theory of reproduction. This scientific school was carried out the development of economic concepts, in which the territory and economic space were one of the key elements. On this basis, various criteria for the effectiveness of economic development were developed and justified, which was used for real programmers for the

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development and formation of production complexes in Siberia and the Far East (the reproduction process was organized).

The reproduction process is understood as a continuous process of renewal of the forces of production and relations of production necessary for production activity. K. Marx identified: "...just as society cannot stop consuming, it cannot stop producing. Therefore, every social process of production, considered in a constant connection and in a continuous stream of its renewal..." [3]. At the same time, the regional reproduction process is the basis for self-maintenance and self-development of the region, and V. I. Belyaev [9] notes that with the destruction of the reproductive process in a certain territory, it ceases to be a region in the socio-economic sense and turns into a region in the geographical sense (another definition of this phenomenon is "investment desert"). This transformation does not happen at once, but nevertheless there are many examples when once economically developed and prosperous territories were abandoned (e.g., the Detroit, Flint, Duluth cities and the entire territory of the "rust belt" of the United States; a number of small and medium-sized cities in Russia, so-called mono-cities (single-industry cities), which had a city-forming enterprise in the military, mining, enrichment, electrical sphere, Industrial city (Komi Republic), Charonda city (Vologda region), Michurinsk city (Tambov region), Kydykchan city (Magadan region).

In the context of the reproductive approach, economic growth is considered in a broad sense, i.e., there should not be only an increase in socio-economic indicators, but rather an improvement in production, an increase in the technological level of forces of production, the development of social and economic relations for production and distribution. Here it is reasonable to give the difference in definition, which draw attention to Murua J. and Ferrero A. [2]. So "resilience" (resistance, fault-tolerance, viability) definitely corresponds to the reproductive approach, but it contradicts the widespread and well-established concept of "sustainability" (admissibility, acceptability), which is more related to the concept of profit maximization. That is, certain conditions (for example, the impoverishment of certain segments of the population associated with the growth of trade globalization) become acceptable and sustainable if they allow you to maximize profits. However, these same conditions lead to the fact that the economic system loses its resilience and viability.

In turn, the reproduction approach for each process in the region determines the proportions of production, distribution, redistribution and consumption of products and services in material and cost form. This creates the basis for organizing more efficient parameters of demand and income distribution, hence initiating new reproduction cycles and processes through investment. Increasing and strengthening relation of reproduction between and within regions makes protection from global economic volatility and, in general, can create conditions for import substitution due to the growth of production and improvement of the region's products.

III. The Methodology of Evaluation of Non-equilibrium States in the Economy

The predominance of concepts based on the primacy of trade in the practice of economic development management during the 1990s and 2000s led to an increase in disparities throughout the world. It can be observed that not all produced GRP is consumed here. This situation is typical for most developing countries. In other words, the growth of produced GRP will not always mean an increase in the level of income and economic development of these countries. In turn, the shrinking of revenue blocks the process of simple reproduction (the lowest level of capacity utilization). We can say that in developing countries, the complex of economic relations is reproduced and intensify in imperfect (suboptimal) proportions. The strengthening and fixation of these imperfect proportions is expressed in the fact that most countries are characterized by the outflow of investment, savings, population, and capital to countries where these proportions are more favorable. A similar polarization of economic space is typical for the level of a separate state, where there is an active metropolitan region and a number of other growth points that have proportions that promote rapid and intensive economic growth. At the same time, other territories of the country are experiencing decline and compression of the economic space.

Therefore, at the initial stage of the study it is important to group economic systems using clustering methods, which will divide observations into more homogeneous groups in terms of socio-economic development conditions. The potential and structure of the economy can be defined through indicators - GRP and employment in various industries. The addition of this data with parameters related to demographic, social status, and well-being assessments allows us to fully take into account the nature of not only economic but also social relations that have developed in the economic system.

Also in this stage were performed to check the possibility of joint use of all indicators. The hypothesis of collinearity of factors was tested by evaluating the correlation matrix. The criterion for recognizing two factors as collinear was the level of the correlation coefficient (r) equal to |0.7|. As a result of constructing a correlation matrix, the collinearity hypothesis was rejected, and we obtained a system of independent variables for further analysis.

At the next stage, search clusterization was performed using the Ward's method. Combining the two closest clusters at each step of Ward's algorithm leads to a minimal increase in the target function and allows you to get an understanding of the process of combining observations into groups and make assumptions about the substantiated number of clusters. This data generalized by the specific chart (the clusterization dendrogram).

When the number of clusters is determined, it is advisable to perform a refining clustering using the K-means method. It allows you to clarify the composition and evaluate the parameters of variables in each cluster. Also at this stage, a analysis of variance (ANOWA) is performed, which shows the significance of dividing observations into groups for each variable involved in clustering. This allows you to filter out

parameters for which clustering does not allow you to select groups that differ significantly from each other.

The next stage is the analysis of price levels, their dynamics and proportions that have developed for different groups (clusters). For this purpose, we used statistics for the period from 2000 to 2018. This period is selected because it includes two investment and industrial cycles and one crisis that shares this period in the middle (the crisis of 2008-2009). This allows us to assess not only general trends, but possible institutional changes that may have taken place in two different periods of economic boom.

IV. The Case of Russian Regions

The imperfections of the social relationships discussed above are also characteristic of the Russian regions. Only a small number of regions have a positive balance of population and capital inflows (Moscow, Moscow region, Khanty-Mansi Autonomous Area, Sverdlovsk region). Data on the socio-economic development of the Russian regions in 2018 was used as clustering parameters. A total of 28 indicators were used for clusterization.

To perform clusterization, you must scale the values of all 28 parameters and reduce them to the same unit of measurement. Here it is important to emphasize that in the case of our indicators, we have two types of values: those that take only positive values (most indicators, e.g., GRP, income, etc.); and indicators of growth rate, which take both positive and negative values. The latter include three indicators: the migration growth rate, and the increase (decrease) in financial assets and money in the population. Therefore, we used two approaches to normalize the parameters. We have normalized most of the parameters by the ratio to the maximum value of this parameter using (1):

$$x_i / x_{max} = z_i \quad (1)$$

where, z_i is the new normalized estimate of some parameter i, x_i is the initial data for some parameter i, and x_{max} is the maximum value of some parameter i. In other words, the final normalized estimates represent the degree of reached the maximum value of parameter i by different regions. Accordingly, the range of changes of new normalized parameters varies from 0 to 1.

For the three other parameters, the normalization method described above cannot be applied, since data have different signs, but equal in modulus, will get the same estimate which is not logical. Therefore, to normalize them, we used (2):

$$(2x_i - (x_{max} + x_{min})) / (x_{max} - x_{min}) = z_i \quad (2)$$

where, x_{min} is the minimum value of some parameter i. Equation (2) allows you to take into account the entire range of data that is between the maximum positive value and the minimum negative value, and to normalize relative to this range. In the end, the new estimates have a dimension ranging from -1 to 1. These operations allow you to prepare data for clusterization and performed it using the Ward's method (the dendrogram is shown in Fig. 1). It clearly shows the division into 3 clusters. If you want to make 4 clusters (marked with line 1 in Fig.1) that two groups are divided: metropolitan regions (Moscow, Saint Petersburg, Moscow region) and developed regions (Tyumen region without Autonomous Areas, Leningrad region, etc.). However, in this case fall into the same group National Republics (Ingushetia, Chechnya, etc.) and Autonomous Areas (AA) (Chukotka, Yamalo-Nenets, Nenets), which is not entirely substantiate, given the differences in the nature of settlement and the structure of the economy. Therefore, it was decided to divide 5 clusters, so that these regions were also divided into two separate groups. This corresponds to the division along line 2 in Fig. 1.

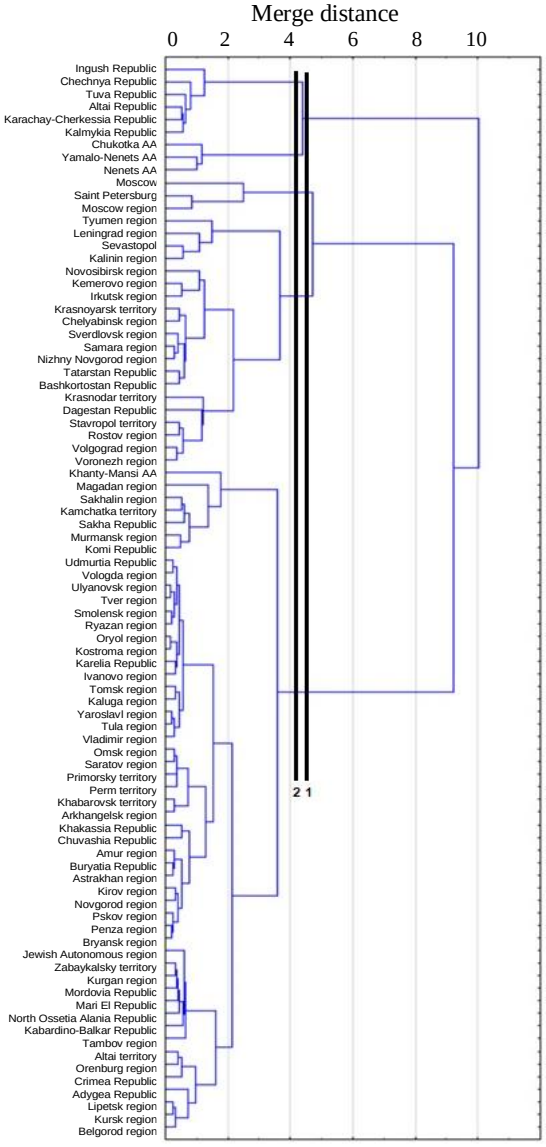

Fig. 1. The dendrogram of clustering by Ward's method for the regions of Russia.

Fig. 1 shows an uneven distribution across the group. Cluster 4 and cluster 2 are small groups of regions which accordingly have 5 and 3 regions. Cluster 4 have economic systems with high level of GRP and cluster 2 is a group of

regions with a high standard of living and quality of social environment. However, it should be noted that the regions located at the opposite pole in socio-economic space of Russia, i.e., with the lowest GRP and a high level of poverty, are also not numerous and are represented only by National Republics. This fact is probably due to the predominance of traditional methods of production. More representative groups of regions (clusters 1 and 5) are of particular interest for further more detailed research. They, in our opinion, will represent the core of regions with a recessionary and inflationary type of gaps. Next, we perform clustering using the K-means method to determine the correct composition and characteristics of clusters. A summary about the characteristics of typical regions (located as close as possible to the center of each cluster) is presented in table 1.

TABLE I. TYPICAL REGIONS OF THE FIVE CLUSTERS AND SOME OF THEIR CHARACTERISTICS

Typical regions	**Cluster Characteristics**		
	Number of regions	***GRP per capita, thsd rub.***	***Average monthly income per capita, thsd rub.***
Ulyanovsk region (cluster 1)	55	280.0	22.8
Saint Petersburg (cluster 2)	3	781.2	45.0
Karachay-Cherkess Republic (cluster 3)	6	165.4	18.1
Yamalo-Nenets AA (cluster 4)	5	5710.1	79.4
Voronezh region (cluster 5)	16	404.8	30.3

Table 1 shows a significant difference between the typical regions. In addition, the hypothesis of insignificant differences between clusters for all 28 parameters used in clustering was rejected in the framework of clustering using the K-means method through analysis of variance.

Cluster 2 – metropolitan regions that have relatively high GRP and income, but are particularly distinguished in a prosperous social situation, which is expressed in the lowest level of poverty. This is also confirmed by the high positive migration growth rate coefficient (CMR) per 10 thousand people, it is 90.3. Cluster 3 – the opposite of cluster 2 – National Republics, which are characterized by an extremely low level of economic development, low income and the highest percentage of the poor population, which provokes outflow (CMR -27.2). Cluster 4 is represented by sparsely populated regions with intensive outflow of population (CMR -56.2), but the predominance of mining industry makes the regions leaders in terms of income and wages. Therefore, the watch mode of work, the accumulation and export of money outside the borders of these regions prevails here. In other words, it is important to understand that wages that are generated in the regions of cluster 4 are spent mainly outside of this group of regions. If we talk about products produced in these regions, they are also mainly exported, which also turns these materials off from the reproduction process of cluster 4 regions, in particular, and the Russian Federation as a whole.

The most numerous clusters 1 and 5 show a fundamental difference. The regions of the first group are characterized by an intensive outflow of population (CMR is -26). There is a situation where a small amount of GRP is correlated with a small population. Cluster 5, on the contrary, has a positive balance of the population (CMR is 22.3), therefore, it can be understood that the economy of these regions has a greater potential, and the labor market can accept the influx of population and labor force. Roughly speaking, we can say that from the regions of cluster 1, the population tends to go to the regions of cluster 5 (and the regions of cluster 2, of course).

The next stage was the analysis of price levels, their dynamics and proportions that have developed for different clusters. Tables 2 below show the average annual rate of price growth in various fields of consumer relations.

TABLE II. THE AVERAGE ANNUAL RATE OF PRICE GROWTH IN VARIOUS SECTORS OF THE CONSUMER MARKET

Cluster	**The Stages of Economic Boom and Decline**		
	2000-2007, %	***2008-2009, %***	***2010-2018, %***
Consumer price index for food products			
cluster 1	15.2	10.4	8.4
cluster 2	13.5	12.7	8.6
cluster 3	14.3	10.9	7.9
cluster 4	11.6	15.6	8.5
cluster 5	13.2	12.4	8.2
Consumer price index for non-food products			
cluster 1	12.0	9.7	6.8
cluster 2	10.7	8.2	6.7
cluster 3	8.6	12.4	7.1
cluster 4	9.9	9.8	7.5
cluster 5	10.3	10.9	6.2
Consumer price index for services			
cluster 1	31.6	13.4	7.0
cluster 2	24.6	13.6	6.9
cluster 3	24.7	15.3	6.7
cluster 4	22.7	23.3	6.6
cluster 5	25.6	16.9	6.5
The price index on the secondary housing market			
cluster 1	31.0	-0.6	3.7
cluster 2	22.8	8.8	1.4
cluster 3	23.8	18.3	3.9
cluster 4	14.7	17.6	6.3
cluster 5	22.3	7.3	2.7

For this purpose, we used statistics for the period from 2000 to 2018. This period is selected because it includes two investment and industrial cycles and one crisis that separates this period in the middle (the crisis of 2008-2009).

Table 3 shows that during the period of the first economic boom, residents of cluster 1 regions were in the most unfavorable conditions, since the dynamics of consumer prices outstripped all other regions. Cluster 4, on the contrary, still had large-scale subsidized advantages associated with the northernness and remoteness of the regions of this group, the severity of natural and climatic conditions of living, which led to the lowest rates of growth in consumer prices. The subsequent crisis quickly changed the price proportions and brought cluster 4 regions to the top in terms of price growth for food products and services. That is, the most intensive growth was observed in those fields where it is impossible to limit or postpone consumption (food and housing and communal expenses). Here, the regions of the cluster 5 have an advantage due to densely populated and economically developed, which in turn leads to bigger size of the market and the development of the competitive. All this factors limit the growth of prices for all categories of goods except food. The period of the next economic boom in 2010-2018 is characterized by a significantly smaller scale in the average annual price growth themes, which allows us to formulate an assumption about public administration decisions aimed at smoothing the price differentiation of regions.

V. Assessments and Conclusions

Price dynamics shows that cluster 1 has the most unfavorable positions in the consumer sector, which is expressed in the highest rates of price growth, which cannot be compensated, since in the production sector, on the contrary, there is a backlog in price dynamics. So the production sector cannot make an increase of income of population in cluster 1. The most favorable price proportions are observed in the regions of clusters 2 and 5, which are densely populated and economically developed. Consumer prices here are growing most slowly, and production prices are more dynamic, which acts as an incentive to increase production. This confirms the assumption that there is a recessionary gap in cluster 5 regions and an inflationary gap in cluster 1 regions.

On this basis, we can make some conclusions about the nature of changes in consumer and production preferences against the unfolding coronacrisis. Thus, the cluster of regions with a lower-than-average level of development and income (cluster 1) and the cluster of National Republics (cluster 3) already have an optimized and simplified structure of the consumer market, due to low purchasing power, which leads to minor changes in consumer preferences during crisis periods. Due to the low propensity to consume, the food market is also optimized in regions 1 and 3 of clusters, however, intensive price growth may also encourage the formation of some food stocks. In turn, all regions with intensive dynamics in the food market (clusters 2, 4 and 5) may have significant changes in this area, since for certain segments of the population, food products may even become a substitute for money accumulation tools. There have already been waves of increased demand for products with a long shelf life. To a lesser extent, this applies to regions that are developing with the watch mode of working (cluster 4).

There may also be some changes in the segment of durable goods, as the intensive growth of prices for them may encourage the more affluent part of the population of cluster 3 and 5 to save money from inflation by purchasing a new car, TV, household appliances, etc. For cluster 1, this is irrelevant due to low purchasing power, and for cluster 4 due to the lack of demand for durable goods, so people prefer to invest in more significant things, such as improving housing conditions. For cluster 2, due to the overstocking of the market and favorable price dynamics, purchases of durable goods are also irrelevant, and the purchase of real estate is considered as an opportunity to generate additional income (i.e., buying an apartment for rent it out, and not for own relocation). In fact, real estate for cluster 2 is more of an investment tool, rather than a means of money accumulation. However, the cronacrisis has already raised the question of the relevance and expediency of people living in large metropolitan areas and megapolisies and it is likely that in the near future such trends will appear for smaller cities.

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