точников для успешной модернизации, выхода на новый уровень самоорганизации. Но это не значит, что модернизация в этих регионах невозможна. Необходимая неустойчивость для изменения текущей траектории развития может быть привнесена в них через национальные и региональные приоритеты, реализацию программ технологического и пространственного развития субъектов РФ и т. д. Предложенный подход к прогнозу развития региональных экономических систем сформировал новый, синергетический взгляд на их развитие. Этот взгляд позволяет оценить возможности развития, зависящие не только от специфики элементов и компонентов региональных экономических систем, но и от всего комплекса их свойств.

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INSTABILITY OF THE SOCIO-ECONOMIC SYSTEMS AS A FACTOR OF THEIR RECEPTIVITY TOWARDS CHANGES

The article underlines the phases of the socio-economic systems from stability / instability viewpoint, links the connection between the life phase and the degree of receptivity of the system's towards change. The socio-economic order parameters are offered, and the assessment methods through which instability is conveyed. The suggested methods have been used for solving the problem of assessing the degree of receptivity of the regional economic systems to the currents global crisis and the following modernization process.

We have overcome the sharp first phase of the economic crisis in Russia. From its very beginning the political and economic elite of the country regarded it as both a threat and a challenge. The crisis undoubtedly caused most extraordinary and urgent stabilizing measures though it made the situation absolutely evident how resources oriented Russian economy lacks the future, has no prospects. The crisis anyway gave a new impetus, a strong impulse for the acknowledgment of danger, the national awareness of the future and the mechanisms to its achievement. Last year international economic forum in June 2010 in St. Petersburg raised for discussion the topical problems "Crisis" and "Modernization" in an inseparable connection. The question hence comes up: the interdependence between crisis phenomena (like instability level) of the socio-economic systems and their receptivity toward changes is a single fact or regular occurrence. Does it possess some fundamental grounds beside psychological aspects? The article presented treats these bases as well as methods of their assessment.

Socio-economic systems are specific organisms of the material, energy and information interrelations between separate subjects, the groups and the communities. All these relations are characterized by its openness (environmental exchange), non linear structure (integrating the individuals and relations of various origin, generation and maturity level) [1].

Open and non-linear systems are capable of complex behaviour manifested through self organization and change of stability and instability periods. The higher is system's instability the higher is its receptivity towards changes [2]. The direction vector of the system's movement is of great importance in the instability period — from the stable position or towards the stable position. In view of all this and with regards to postclassical and synergy approach to study of the complex behaviour of the socio-economic systems, the change in the degree and the character of their receptive ability could be presented in the form of cyclic (partly cyclic) reiteration of the four life phases [3]:

1. **Stability**. Predominance of the negative feedback. Steadiness and stability, absence of possibility of realization of the useful and harmful changes, weak dependence on the impact. Suppression of any possible changes of itself. Lack of ability in the organization for self development, absence of its own sources for alteration and evolution. The current state of the system is determined by its past.

2. **Developing instability**. Intensification of the positive feedback. Instability growth. Actualization of the various internal sources of the system's development. The system becomes the source for itself, the extended environment and the subject. Growth of probability of realization of the new state. There is a probability of going out to the new level of self organization, new form of the system complexity. Its receptivity is increased towards minor changes and initial conditions. The receptivity concerns a wide range of effect. At the same time together with the source of internal development we acquire a risk of realization of the destructive changes of the system, the possibility of its breakup. The direction to change the system is determined by its past.

3. **Bifurcation**. Maximum instability state. Choice of the new stability state (attractor) is happening, the possibility of the way out to chaotic attractor. Availability of only some attractors. The new stability state might be either the system's evolution or its degradation. The options for administering the choice of attractors are rather limited and susceptible to minor fluctuations. The fact of the system going through the bifurcation point is defined not only by the change of the instability type (the system might fall down to the old attractor) but by the covering fact which accompanies the system to the way out to a new form of self

4. **Subsiding instability**. Increase of negative feedback action. The system is being unstable although it is within attraction of the new attractor and is moving towards the new stability state. Its sensitivity to change is weakened. The direction of its development is determined by its future — the form and content of the attractor chosen. The system starts self organizing in accordance with the perceived effect. Narrowing of the spectrum of the perceived effects is taken by the system as disturbance coinciding with the future attractor.

The system is locked by going onto the new stability status.

It is common knowledge that the degree and character of stability/instability of the system might be defined through the mathematical modeling with estimate of stability/instability indicators and through the order parameters [4]. Due to the fact that socio-economic system is perceptive to even minor disturbances during the instability period the number of factors considered under classical modeling would tend to go to infinity, and the model itself would expand the unmanageable size. The key to understanding the complex behaviour of the system are order parameters. It is the parameters that allow to radically diminish the complexity of the system studied and relatively easy describe the complex behaviour. The order parameters are most slowly relaxing instability characteristics of the system. The express the consensus fact between the separate parts and elements of the system, coordinate its behaviour during the instability period [5]. Macroscopic characteristics of the system capable of complex behaviour might be described through coordination and competition of the order parameters.

Another difficulty of modeling the complex behaviour of the socio-economic systems is rooted in choosing the basis for modeling. Best of all the complex behaviour is described by the fractal structure, i.e. via identification of the basic component (like isomorphic) in relation to all the elements and components of the modeled system. As an example of the socio-economic system which allows to form the fractal structure the concept of technology is used in its postnonclassic and post industrial interpretation, i.e. technology is defined as indirect (beyond the subject's) manner of transformation of one set of products into the others. The majority of the modern products are received as a result of utilization of the aggregated interrelated technologies made up in a "net". By analyzing each type of the link within the net there identified a comprehensive list of instability characteristics of the socio-economic system and established the following five order parameters:

— **Clustering level of links**. It presents the structure of the interrelations between the system's components from the point of view of their distribution smooth or clustering.

Table 1

Clustering level of GRP in the regional economic systems since 2005 to 2007

Region	2005	2006	2007	Indicator level, its trend
Republic of Bashkorstan	0,320	0,328	0,310	Clustering level below average. Uncertainty trend
Tatar Republic	0,387	0,379	0,358	Clustering level below average. **Descending trend**
Permskiy Kriy	0,384	0,351	0,357	Clustering level below average. Uncertainty trend
Kurgan oblast	0,314	0,308	0,308	Clustering level below average. Uncertainty trend
Sverdlovsk oblast	0,400	0,422	0,412	Clustering level a little below average. Uncertainty trend
Tyumen oblast	0,712	0,675	0,637	Clustering level above average. **Descending trend**
Chalyabinsk oblast	0,466	0,445	0,470	Clustering level a little below average. Uncertainty trend
Novosibirsk oblast	0,267	0,278	0,278	Clustering level much above average. Uncertainty trend

— **Informational level**. It presents the ability of the system's components to generate the new information on the basis of information/ knowledge [6].

— **Reflexivity level**. It reflects the depth of responsive image with the subject, the representativeness and the level of penetration of the subjects of the system into the reflexive images of each.

— **Variety links level**. It presents the number of mutual links between the system's components, their.

— **Value coordination level**. It reflects the presence or absence of the common movement vector, availability of the directing reference for self organization in the form of a list of agreed values.

There should be outlined the basic difference between the order parameters from the usual common manageable parameters: the latter are submitted by the subject from outside while the first are borne inside the system and by the system. The change of their state reflects its inner selforganisational dynamics of the system.

As an example of the specific methods of instability level assessment brought by the order parameters into the socio-economic operation there can be used both qualitative and quantitative methods including Shannon's relative informational enthropy, Spirman's method of rank correlation, the formula of potential variability of the system, etc. [3]. The order parameters assessment methods have been used for solving the practical problems, one of which is the problem of receptivity of the regional economic systems towards the current global crisis and the following modernization period.

The regional economic system is considered as a system of technologies for gross regional product production. The base for research chosen were eight regions in Privolzhje, Urals, Siberia: the Republic of Bashkorstan (RB), Tatar Republic (TR), Permskiy Kriy (PK), Kurgan oblast (KO), Sverdlovsk oblast (SO), Tyumen oblast (TO), Chalyabinsk oblast (CO), Novosibirsk oblast (NO). These areas are having a different structure and GRP (Gross Regional Product) size, different level of social and economic development. There is also the data — experts grades on GRP for 2009 and 2010 that would makes possible the preliminary estimate of the results forecast.

The analyses done showed that instability in the regional economic systems selected has been transported via the "clustering" order parameter. The higher clustering characteristics level is the higher the level of transported instability. The other order parameters were changing the content but never the level or instability transported.

The calculation of the level of clustering characteristics were more reliable when the system components are the data on the "ОКВЭД" Performance. The initial information came from federal statistics service. The calculation results of the level of clustering characteristics for the selected regions and the conclusion on the change trend over the previous three years before the crisis are done in table 1. The Shannon's formula or elative informational enthropy was laid in the basis of our calculation:

$$H_0 = \sum (S_i / n \log(S_i / n)) / \log(1/k)$$

where S_i is any performance contributing into GRP in the selected region (in percentage); n equals the sum of all S_i, i.e. 100; summing up comes with i from 1 to k; k equals 15 (quantity of the types of activity). The definition area of this indicator from 0 (maximum clustering) to 1 (minimum clustering). As it has been said above the clustering, in our case it characterizes the growth of the system's instability.

The information on the indicators trend will be used later in the paper to formulate the conclusion on the type of instability at pre-crisis period: developing or subsiding.

The degree of regional economic systems stability towards the current global economic crisis is assesses as the result of interaction of the two factors: stability

degree of the pre-crisis trend of development of the regional economies and the instability brought about by the global crisis. It was established that the development trend of the regional economic systems depends on a number of factors:

1. The level of the system's stability — under clearly defined stability the system is non perceptive or faintly perceptive to any disturbances.

2. The presence of a steady movement trend — the system is unstable but the steady movement allows to acquire immunity towards outside crisis disturbances.

3. The type of instability — under subsiding instability the spectrum of the perceived disturbances is narrowed.

The factors 1 and 2 are considered as рассмотрены mutually exclusive, i.e. the stability of the pre-crisis trend was assessed either via system's stability or via the stability of he system's movement. Factor 3 was considered as correcting, alternative factor for the previous 1 and 2. The stability degree of the regional economies development in the pre-crisis trend with the above mentioned factors is presented in Table 2.

Instability level is equal to clustering level in the last pre-crisis year (2007). Maximum instability correlates to zero clustering meaning. Stability/instability are considered dichotomy. Thus the stability level (factor 1) was calculated as «1 — instability level». If the meaning received is bigger than the dichotomy centre (= 0,5), we use the stability level for further calculations. If the stability meaning is less than 0,5, the system was studied for steady motion trend (e.g. Tyumen oblast). If it was revealed the stability level of the pre-crisis trend was estimated by instability system level (factor 2), in absence of the trend — the calculation process included the stability level. The factor under number 3 was identified by the presence of the trend in the clustering level of the regional GRP structure (table 1). Falling (descending) trend was considered as additional 0,2 point against the system's stability level and –0,2 against instability. The growing trend was considered with the reverse signs.

Stability level less than 0,5 was found in the Tyumen economy (0,363). Rate analysis of the GRP over 2005–2007 years revealed the steady dynamic motion towards decrease. In view of this the Tyumen oblast is apt for scenario "System's Stability Development". While the other regions there is another scenario "System's stability".

Out of 15 kinds of GRP forming activity in each region most crisis affected are «*D.* Wood Processing Industry» and «*F.* Building». Strong but short term influence has undergone «*C.* Natural Resources Extraction». Significant changes were marked in cargo transportation, production and distribution of energy. To register the instability brought into the system the GRP structure identified the types of activity, the sections responsible for 10 and more per cent of GRP, it was they determine the clustering level and make instability possible. Their aggregated contribution into the GRP was summed up and then the share of every one affected by the crisis was estimated. Estimation of the share sections «*D*» и «*F*» was considered with coefficient 1, sections «*I.* Transport and Communication» and «*E.* Production and Distribution of Energy, Gas and Water», because of their status of partly affected by impact coefficient was 0,5, section «*C.* Natural Resources Extraction» due to short term impact the coefficient was 0,25. The share estimated reflects the degree of instability caused by the crisis for independent types of activity, but in the modern economy the independence is not possible. Movement (instability) in one type of activity экономике influences the dynamics of development (instability) in another. The search for functional translation of the meaning instability for the independent variable was made with the help of the method of successive approximation. The results of the estimation made are presented in table 3.

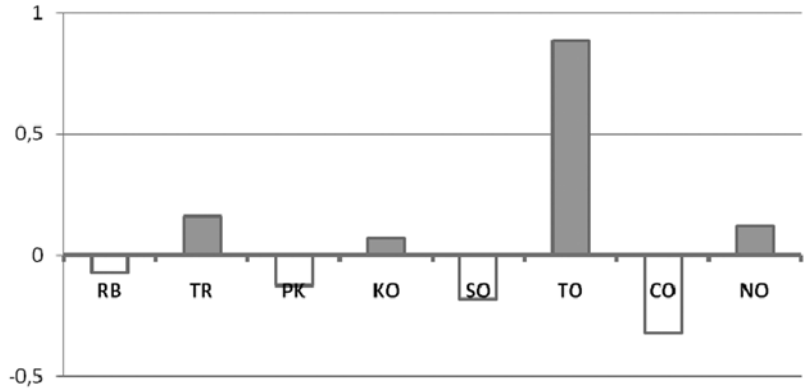
Correlation of the stability degree of the pre-crisis development and instability trend caused by the crisis might result from one of the three possible scenarios:

— Forces vectors oppose each other. In this case the indicators are summed up with different signs. For example, the degree of brought in instability is assigned «–».

— Forces vectors act in one direction, then the indicators are just summed up.

— Forces vectors interact angle-wise. In this case it is necessary to introduce the correlation coefficient and work out a specific mechanism of interaction estimate.

The studied case was estimated along simplified version — the acting forces stability/instability is either unidirectional, or opposing. The direction of the pre-crisis movement and the impact of the crisis were estimated through the GRP change rate over the period of 2004–2007. Decreasing direction or unidirectional movement with relation to the crisis impact was identified only in the Tyumen oblast. The simple mechanism of summing up was used. All other regions were having the pre-crisis movement opposite the crisis impact. The mechanism of summing up with opposite signs was used. Thanks to summation ability and deduction within 0 to 1, the total stability degree has the area of meanings from –1 to 2. The calculations and the meanings of the



Pic. *The regional economic systems' stability degree against current global crisis*

regional economic systems' stability degree before the global crisis are presented in table 4.

The data received are reflected in the chart for convenience (picture). Tyumen oblast demonstrates a high stability of its pre crisis development direction

The republics of Tatarstan, Kurgan and Novosobirsk oblast are characterized by less stability trend. The crisis undoubtedly affects their development in 2008 and 2009, but in 2010 and 2011 the trends are more liable for revival. The republic of Bashkorstan, Permskiy Kriy, Sverdlovsk and Chelyabinsc oblast also are tended to restoration trends but much later than the regions listed above. These regions are located under threat to their integrity. The resources and the potential of the regions would be routed to both the restoration of the development rate and the retention of regional economic system integrity. The experts' prognostic meanings for GRP in 2008 and 2010 support the anticipated hypothesis formulated before.

Table 2

The stability degree of the regional economies development trend in the pre-crisis years

	RB	TR	PK	KO	SO	TO	CO	NO
Stability level (factor 1)	0,69	0,642	0,643	0,692	0,588	0,363	0,53	0,722
Steady motion level (factor 2)	—	—	—	—	—	0,637	—	—
Corrected instability (factor 3)	—	0,2	—	—	—	–0,2	—	—
Total:	**0,69**	**0,84**	**0,643**	**0,692**	**0,588**	**0,437**	**0,53**	**0,722**

Table 3

The degree of the crisis brought in instability

Regions	Types of activity (sections) according "ОКВЭД"															The degree of the crisis brought in instability
	A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*K*	*K*	*M*	*N*	*O*	
	Coefficients taken for share estimate															
	—	—	0,25	1	0,5	1	—	—	0,5	—	—	—	—	—	—	
RB	8,8	0	12,2	27,2	3,7	6,9	12,4	1,2	10	0,1	6,2	3,4	3,2	3,4	1,3	0,76
TR	7,8	0	24,8	21,3	2,6	7,9	12,8	0,8	7,5	0,4	5,8	2,5	2,5	2,3	1	0,68
PK	2,9	0	13,9	30,3	3,8	5,5	12,3	0,9	9,3	0,1	9,3	4	2,8	4	0,9	0,77
KO	16	0	0,7	16,3	3,1	5,9	15,4	1,3	16,5	0	4,9	8,6	4,8	5,3	1,2	0,62
SO	3,4	0	3,6	32,8	3,3	4,8	22	1,1	9,1	0,2	8	3,7	2,8	4,1	1,1	0,77
TO	1	0	55,2	2,1	2	6,3	12,9	0,7	6,8	0,6	7,1	1,8	1,2	1,8	0,5	0,45
CO	6,5	0	1	40,5	2,6	5,9	16	0,7	9,3	0,2	6,3	3,8	2,6	3,6	1	0,85
NO	7,5	0	3,2	15	2,7	4,6	16,9	1	16,5	0,6	15,5	5,2	4,1	5,8	1,4	0,6

Table 4

Regional economic systems' stability degree before crisis

	RB	TR	PK	KO	SO	TO	CO	NO
Trend of pre crisis stability degree	0,69	0,84	0,643	0,692	0,588	0,437	0,53	0,722
Degree of brought in instability	–0,76	–0,68	–0,77	–0,62	–0,77	0,45	–0,85	–0,6
Total	**–0,07**	**0,16**	**–0,127**	**0,072**	**–0,182**	**0,887**	**–0,32**	**0,122**

For further verification of the data received it is important to make a model of interactivity of the current stability/instability of the regional economic systems and the instability brought in by and through global economy revival, the national and regional priorities, the realization programs of technological and spatial progress of the Russian Federation subjects and so on.

The research data allow to evaluate the internal readiness of the regional economies for modernization, change of technological setup. From this point of view the starting position is held by the regions with zero stability degree (Sverdlovsk, Permskiy Kriy, Republic of Bashkorstan, Tatarstan, Novosibirsc and Kurgan oblast). All the regions with the meaning above zero would first need to enforce the instability system, then pass on to modernization. But those regions with the meaning below zero would need spend the resources first for retaining the integrity, then turn to modernization process. Those regions with the meaning close to zero are having unique conditions. The global crisis brought about the instability to such an extent that they would need first to introduce the quality changes. The situation interpreted thus is just a potential and a necessary term. The results of the real modernization would depend on other terms, like ability to reroute the coming instability into the needed direction, the ability to preserve the sufficient security level for the whole system, etc.

The treatment of the complex behaviour of the regional economic systems allowed to see the opportunities and threats to their development, capability of self development and self organisation. The analysis of stability/instability through the order parameters allowed to forecast pre-crisis development trends restoration in the regional economies and their receptivity to modernization. Analysis of the factual data highlighted the complex and multimeaningful role of instability for stimulating the system to self organization and self development. On the one hand the instability transport destroys the system and requires additional resources to keep up integrity. On the other hand instability is a necessary term of system's receptivity of change such as innovation and modernization. The region itself can be a source of stability and instability can transport it from outside from other regions or upsystems. Some regions demonstrate so far lack of internal sources for successful modernization, way out to the new level of self organization. It does not mean however that modernization in these regions is impossible. The instability required for the change of the current development trajectory might be brought up through the national and regional priorities, realization of the programmes of technological and regional development of the subjects of the Russian federation, and so on. The approach suggested in the research to anticipated regional economic development has molded a new synergy view on their progress. This view allows to estimate the potential for development depending not only on specifics of elements and components of the regional economic systems, but on their characteristics as a complex integrity.

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