

Chapter 40

Economic Systems: From Chaos to Order

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40.1 Introduction

In the contemporary world there are two kinds of extremes. On the one hand, it is an accurate and ordered changing of events in space and time, such as the planets movement, a regular knock of pendulum, movement of trains by schedule. On the other hand – a random motion of the ball on the roulette wheel, the Brownian motion, the occurrence of random turbulent eddies at high speed flows of water.

Until recently the task of any branch of engineering and any kind of industry was to organize an operating process of all vehicles and equipment in a stable steady way. Order, harmony and stability have always been considered the main technical advantages. Can't you not be afraid of external chaos, uncertainty, fragility, and the inevitable energy losses – these satellites of nonequilibrium? (Muchnik) Besides, disordered processes can also lead to disaster.

40.2 Economic Chaotic Systems: The Basic Characteristics

The chaotic processes happen often in the real world. According to the I.R. Prigodgin, the situation in the modern world is extremely unstable and non-equilibrium, and a man exists in the reality, in which the order does not dominate, but on the contrary, all the natural and social systems, in which the man is involved, are in a state of incessant change and chaos. Even a single change or unexpected combinations of social phenomena and processes are sometimes so strong that the previously active systems, within which occurs a change, cannot stand changeless

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and are destroyed. In other words, only the open systems, which develop on the basis of self-organization and internal order, can exist and interact with each other. On the edge of destruction of these systems it is impossible to predict the direction in which it will go further: will it be the chaos or it will move to a new and higher level (Prigogine and Stengers 1986).

Currently, the Russian economy has entered a new phase of development. As it proved in practice in contemporary conditions the system of classic economic theory and statistical methods based on linear models are not applicable to the Russian economy with her ups and downs. In the conditions of Russian reality, these methods have become unproductive and inadequate. This is due to the fact that the transition of Russian economic system from a planned one to a market is a kind of a jump or a bifurcation,¹ which involves many uncertainties and ambiguities (Zhdanov 2010).

The basic postulate characterizing the linear paradigm, which dominated in the 90 years of the 20th century in connection with the study of economic systems, is the following: every action causes a proportionate reaction. But experience shows that markets, in particular, labor markets, financial markets, ecological and economic relations, rarely follow this paradigm. It often occurs that in economic systems the inconsiderable leaps lead to wave-like and abrupt changes. It often happens that the exponential reaction appears at the initial impact. It means that classical approaches of statistic analysis in most economic processes are not efficient. In the late twentieth century the general patterns in nonlinear processes were actively studied. As a result a new science has appeared – synergetics.² Using mathematical modeling of different evolutionary systems, including economic ones, the researchers found that the behavior of these systems can be determined by a finite number of variables (parameters). Now we can talk about the origin of the economic synergy that studies the dynamic economic system. Economic synergetics makes its emphasis on the use of chaos theory; it considers that chaos lies at the initial stage of any economic dynamic system. This suggests that it is impossible to make precise economic predictions.

So, today the Russian economic system can be represented as follows.

First of all, it is a highly complex system, consisting of a large number of economic cells in close interaction with each other. Besides, it has a pronounced layered structure, in which a higher level integrates on certain rules (algorithms) with the information signals on lower level units and operates with aggregates. At the same time, the economic system itself acts as a subsystem to the community as a whole, since the existence of the community and its development are not limited by purely economic processes.

Second, it is considered to be the open system according to the degree of connection with the environment. The environment with which the economic system

¹Bifurcation – a kind of transition from quantitative to qualitative changes. The concept of bifurcation is a fundamental concept in chaos theory, or as it is called non-linear dynamics. (Author's note)

²The basic concept of synergy is subordination of the degrees of freedom of several major variables. (Author's note)

is in constant interaction represents a society with a social structure, political system, cultural potential and rules of morality. Interaction with the environment occurs in two directions: from the environment to the object and back, respectively, it is determined as the input and output of the system. The input parameters of the economic system are characterized by the totality of industrial, environmental, labor, technological methods, knowledge, etc. The public influence on the economic system is performed via the motives of the people involved in the production, which, in turn, are determined by economic interests, form of ownership and social structure of society.

The range of environmental conditions (factors) necessary for the existence of economic system is unstable, constantly changing for the quantitative characteristics and structure as well. Inside the environment there are different groups of objects which are considered in terms of the ability to manage their elemental composition. Accordingly, the environments have direct and indirect effects. The environment of direct impact includes the ability of direct influence on the aims of the system in a limited period of time. The environment of the indirect impact includes factors (physical, geographical, national, ethnic, socio-cultural, institutional, organizational, etc.), which have an impact, extended in time and indirectly through the direct effect.

Third, it is represented as a dynamic and non-equilibrium system with a plenty of possible modifications, which can have permanent and discrete changes. At the same time, the various components of society and the economy are developing at different rates. There are many striking examples of unbalanced development. Take any profile in economics – industrial, territorial, by ownership, by size of enterprise, – everywhere you will notice a significant difference in the rate and quality, and sometimes it is a decline. The balance between the subsystems of the economy is upset: innovations are far behind the production, growth of investment is behind the growth of savings, etc.

Fourth, the Russian economic system is a nonlinear system, as it is quite “sensitive” to some external factors. Its response to the external factors is not proportional to the force of the “disturbance effect” and is often unpredictable. Precisely this nonlinear system is chaotic. The behavior of a nonlinear system is difficult to predict – the system “reacts” to the disturbance of the condition in a very complex and usually ambiguous way. In general, only rigidly deterministic systems can be in a strictly steady state. It is interesting to note that in his time A. Bogdanov paid attention to the fact that “the stability of the complex depends on the minimum of the environmental effects or on the maximum of its own resistance.” (Bogdanov 2003)

Fifth, the Russian economic system is a self-organizing unified system, where the inner life and development should happen, first of all, and mainly on the basis of self-organization – spontaneous ordering (the transition from chaos to order.). The self-organizing system as a whole is the result of the movement and interaction of its elements and relationships. The main sign of the integrity of the system is the presence of integral properties not common for the individual elements of management, as well as the prevalence of stable internal relationships between these elements in the framework of the system above their external connections

(with other system elements) (Chelnokova 2009). In this situation the appearance of instability, uncertainty, the increased dynamic influence of the environment means that the economic system should constantly increase the number of different economic structures, which appear as a result of self-organization that can not only adapt to external living environment, but relying more on self-regulation, successfully solve their problems.

Note, that the capacity for self-organization have the only public, non-equilibrium and non-linear systems, in which the processes of self-acceleration can occur through positive feedback loops. Economic systems are indeed self-organizing systems. First, any economic system is a system of stream-type associated with the environment (natural, political, cultural) by flows of energy, matter and information. The state of equilibrium similar to the “heat death” cannot be reached for this system even in the stationary state, when nonzero flows pass through the system. Second, in any techno-economic paradigm the element of self-reproduction is originally laid in the form of manufacture of the means of production (Petraikov 2008).

The effect of competition is an important property of self-organizing systems. In fact, any ordered structure is the result of competition between unstable species. The surviving species suppresses other ones, and imposes the appropriate structure to the system. A new kind of species is the result of the dominant technology which is established as a result of the final selection – a new techno-economic paradigm with a specific institutional infrastructure.

The process of self-organization in the systems begins with random external influences (fluctuations) which in a nonequilibrium system are not suppressed, but rather are increased, and in the end, it led to the formation of a new dynamic structure. As a result of self-organization, based on the principle of negative feedback,³ the system establishes a new order, called spontaneous, because it does not arise under the influence of external forces, but as in a typical organization, and formed spontaneously due to internal reasons. A new equilibrium in the system is supported on the basis of the positive feedback (Dyatlov et al. 2007).

40.3 Economic Chaos in the Labor Market

Now we turn to the analysis of specific economic systems and try to consider how the order is generated out of chaos by the process of self-organization in such economic system, as the labor market.

³The principle of negative feedback shows how the spontaneously arising order is supported in the system, but does not reveal the mechanism of such an order, and the transition from one type of order or stage of development to another. For this it is necessary to use the principle of positive feedback, according to which the progressive changes that occur in the system, are not suppressed, but are accumulated and amplified. (Author’s note)

Labor market, acting as a self-organizing complex system with the diversity of its subjects and relationships, occurring inside them, has not been studied from the perspective of chaos theory.

The need of modern analysis of labor relations from the perspective of the theory of chaos has arisen due to the significant changes in contemporary society, both at the global level and at the level of individual countries. Development of information technology and the globalization of the economy have created fundamentally new conditions of functioning and development of public relations, giving rise to new and exacerbated old contradictions in such a vital area of human existence, as labor relations, particularly in times of economic crisis. Almost all social and economic conditions are reflected as if in the mirror of the labor market. Labor demand and supply, the unemployment rate depend on how well the economy operates, in which phase of the economic cycle it is, what is the behavior of the main actors of the market – the worker, the employer and the state.

In the labor market the economic order supposes that there is a system of elements at all levels of the labor market and these elements have stable, recurrent, regular links and economic relations. Economic order is achieved by the regulators of people and institutions designed to create good conditions for the development of social, labor and economic relations. The economic chaos appears as a set of economic elements between which there are no stable, recurrent relationships (they are intermittent), i.e. the chaos can be defined as a violation of the economic structure and the labor market in particular. The chaos in the labor market appears as violation of the norms of human behavior and activities in the organization, violation of labor discipline, as violation of sustainable economic performance, the fall of commodity-money relations, it leads to a conflict between supply and demand for goods, services, money, resources. The growth of chaos shows the existence of crisis in the society and the economy. During the chaos people are actively looking for different ways out of the crisis and are able personally to affect not only on the prospects of their lives, but also on the macro-processes in society. Therefore, chaos has a certain creative power, the ability to give rise to a new order.

The labor market is functioning as a system with a complex self organization and structure. Abueva E.L. considers the labor market is a complex and semi structured system (Abueva 2010). In fact, the labor market is a system with control and regulable process, and at the same time it is an abstract, open, active, dynamic and mixed organizational system. In some cases, the labor market is represented as the systems in the variety of systems: social and economic, economic and social, complex, very complex and super complex, well organized (structured), disorganized (semi structured) and self-organized. It is well known that the elements of the labor market are combined into “a whole” system due to the relations “purchase and sale” of labor between its owners and the owners of the means of production, as well as due to other interactions based on these relations. Structural basis of the labor market characterize the structure of the market, and include the most important of its elements and components ensuring the formation of the basic properties of the labor market. The main function is to maintain the structural integrity of the foundations of the labor market as a system. The basis for the

interaction of the main contractors of the labor market is the existence of economic relations, based on the laws and regularities. Ashmarov I.A. thoroughly classifies (Ashmarov 2009) basic laws, highlighting the universal laws of economics that are directly related to the labor market (the law of social differentiation of labor, the law of variation of labor, the law of labor saving, the law of distribution by labor according to productivity growth, the law of marginal productivity of labor or the law of diminishing returns, the law of marginal utility), general economic laws (the law of demand, supply, cost, unbalance, etc.), specific economic laws functioning in the labor market (Okun's law, the law of circulation of labor in the labor market, the law of correspondence prices to quality, competition law, etc.). The evolution in the labor market happens according to the above mentioned laws of development. The mutual transition of order to chaos results not only in a change of ties and relationships between the elements, but also in a selection of selective factors. That means that there occur new opportunities for building a new economic system in the labor market on the basis of transition "order-chaos-order." Some authors associate the transitional moments to the chaos with the crisis, instability, and other destabilizing factors.

Among the destabilizing factors that are the cause of chaos Kosals L. marks the instability in the economy: the closed nature and the disorganization of the federal government, the contradictions between the government and the regions, a growing number of disasters, accidents, the low level of protection of the population, deep stratification of the population, social instability (Kosals 1999). It would be logical to add such factors as shadow economy expansion in the labor market, hidden forms of employment, criminal spheres. The destabilizing factors affect the labor market, in particular and generate a response reaction for the formation of stabilizing factors working against the destabilizing effect, removing the social tension in society, and they do not let the society to go into a state of chaos. Such factors may include migration, increasing the social status, the right of free enterprise, the definition of the form of employment, the combination of the employment for population, distance-type employment, institutionalization (formal and informal) (Senokosova 2010).

V.G. Rodionov (2009) among other things pays attention to the growth in economic activity, leading to increased inertance of managed socio-economic systems according to the general rule: more weight – more inertia.

In this case, V.G. Rodionov notes that the increased frequency and strength of external destabilizing effects contribute to the rapid accumulation of internal conflicts leading to increased social and economic tensions, while the loss of stability is characterized as bifurcation and transition to a new trajectory of development. V.G. Rodionov notes one more destabilizing factor – globalization and scientific-technical progress, leading to a global reduction in the number of traditional jobs with continued worldwide growth in population. This is in the opinion of the author, is one of the most active factors shaping the global instability in the world in the form of a permanent reallocation of the number of jobs created and the surplus product. The most acute problems of this kind are in Russia. The excess supply of labor available in the country over the size of the labor force is the strong economic

factor to accelerate the growth of the population of Russia. Without solving this problem, we will not solve the pressing economic, social and political problems of the present and the future. As a result the parameter of employment becomes one of these “weak links.” Moreover, this imbalance leads directly to greater instability of social and economic systems. It is obvious that in the absence of jobs, economic and social system degrades and disintegrates.

In their tractates the representatives of the sociology K. Mannheim, T. Luckmann, P. Berger consider the value of social chaos in the context of the social disproportionality and the crisis of the rational forms of social life. The appearance of the lower social layers with the irrational claims of dominance increases social instability and leads to social chaos as an alternative to the rational organization of society. From this point of view the system of labor market can be destroyed from inside, so the elimination of social disproportionality and introduction the rational democratic planning in the community can minimize or neutralize the social chaos (not only the demolition of the order), and it can minimize the destabilizing factors affecting the social and labor relations generally. The perception of social chaos as a state of social life is determined by the choice of individual strategies to meet the basic necessities of life, or the realization of social and fixed positions, associated with conservation and transfer of social status, as well as development of their own codes of behavior. Social chaos in the labor market is legitimized through social uncertainty, the rejection of plans for the future, increasing the fears and anxieties of the society to the threat of unemployment. Although production and reproduction of social chaos are connected with social heritage and social and nostalgic syndrome, they are produced as a result of socio-structural disproportions, institutional defects of social life, the modifying of the crisis into regular “chaotic” practice, and into the distancing the majority of population from the state and into concentration of efforts on the social micro level. Also they are produced as a result of the lack of mechanisms of coordination the interests of social groups, the existence of marginal position, social uncertainty and lack of social perspectives of some part of population.

The intensive swinging of destabilizing factors in the labor market may lead for some time to a state of chaos that leads to system collapse. The main driving forces of this process are: a loss of a unifying idea of state development, as well as ethnic and religious differences, change in attitude to the means of production, natural and human resources, the differences in the ethical principles of social development, political beliefs, etc.

40.4 The Environmental Aspect of Chaos Theory

Analyzing the structure of the modern world we can suggest that the world is full of systems (financial, energy, trade, political, educational). Up to now, such systems were mainly within national states, but now they tend to merge into a single global system (Ilyinsky 2004). Here we can consider the trends of relations between a man and the environment.

Undoubtedly, alongside with the growth of the positive results in the development of the economy, there is a trend of growth in negative factors. An increase of human activity in the environment leads to the growth of pollution. Since the problem is not new, the economic system requires a structured system of elements that are designed to neutralize or minimize the results of economic human action.

But what is happening in reality is more like chaotic development, as the effectiveness of these elements of the system is under the question. So at the end of January 2013 Greenpeace (the international organization) published a report on “Point of No Return”,⁴ which presents 14 the most dangerous for the climate of industrial projects. These are the projects for the extraction of fossil fuel – as a source of energy for economic growth – the oil sands in Canada and Venezuela, deepwater drilling in Brazil and the Gulf of Mexico, the expansion of coal mining in the United States, Australia, Indonesia and the western provinces of China, shale gas production in the USA, expansion of oil and gas production in the Caspian sea, gas production in Africa, oil production in Iraq, launching of oil and gas production in the Arctic shelf. These projects are implemented by such companies as Shell, BHP Billiton, Peabody, Enbridge, Gazprom, Cairn Energy, Petrobras and BP, which are the industrial leaders in their states. And the focused actions of the economic policies of the state are directed primarily to create conditions for the development and maximizing the results of these companies, and in turn, lead to a synergistic negative effect of the economic system. It means (from the Greek. synergos – acting together) is a multiple effect, derived from combining parts into a unified system. Specifically, as a result of the desire of each country to reach the economic growth by 2020, the implementation of the 14 projects will increase carbon dioxide emissions into the atmosphere by 6.34 gigatons, that is by 20 % compared to current levels. This means that the governments will not be able to fulfill the undertaken commitments in the framework of the Kyoto Protocol in order to keep climate change within the 2 °C.

However, such an unstable state of the system – a necessary condition for its development. It may be noted that the elements of ecological and economic relations in industrialized countries have a more ordered structure. For example, to obtain the necessary energy in developed countries they use the rubbish and it has become a scarce resource long since. Swedish businessmen take trash as import goods from Germany and Norway for electricity production. In China they buy up the plastic and waste paper for recycling, and in Denmark and Sweden, – the raw material for waste utilization stations: so they produce so much energy that is sufficient for providing 17 % of homes. Annually in the world due to the waste conversion it becomes possible to produce 130 billion kilowatt-hours of electricity – about one sixth of the energy supply in Russia. From what is not burned they make packaging, bottles, clothes, mobile phones and much more. Only 6 % of household waste cannot

⁴http://www.greenpeace.org/russia/ru/news/22-01-2013_Davos-Tochka-Nevozvrata. Date of appeal: 5 Jan 2013.

be of use. This escalation in organizational system of the material world is the result of a new structure that brings an order which stands against chaos.

However, the energy that accumulates in other economies can break through the settled order at some moment, destroying the existing structure in whole or in part, and re-throwing the economic system into chaos. So according to the Federal Service for Supervision of Natural Resource Usage annually as a result of the livelihoods of people in Russia it is formed 35–40 million solid waste (200 million cu m.). At the same time in Russia less than 400 enterprises of sorting and recycling of solid waste are functioning, but the rate of accumulation of waste by 45 % higher than the power of these waste utilization stations, and about 18 million tons remain raw.

According to official data in Russia there are more than 13,000 of authorized dumping sites and more than 10,000 unauthorized. According to statistics, the majority of illegal dumps occupy land settlements. For example, in the Central Federal District (CFD), 68 % of illegal dumping sites (about one million) are located on the lands of settlements and cover an area of 250 hectares, 12 % (173 dumps by 14 hectares) – in water-conservation zones, 12 % (178 dumps by 103 hectares) – on agricultural lands, 8 % (123 dumps by 26 hectares) – on forest lands.

Today the country has 336 facilities for waste disposal. Among them there are 40 waste utilization stations for thermal treatment (incineration), 53 – for sorting purposes and 243 – for the sake of process industries. That is not enough. We do not have the industry itself. Moreover, the estimated capacity of existing enterprises is very low. To create a full-rate waste recycling industry, we need effective acts of state and investments of private investors.

The magnitude of the problem and the seriousness of the situation are obvious. And then there is the impendent transition of the economic system structure in the state of energy that can be the building blocks for the emergence of a new organized structure. The main thing is that the system should be able to eliminate the violation of stability, and irreversible processes, that fundamentally can change the system, would not lead to self-destruction of mankind.

40.5 Conclusion

Thus, any economic system in contemporary conditions is a complex, open to external influences, dynamically non-equilibrium and nonlinear system, consisting of a large number of interacting objects. The stationary state of such system is independent in time and is usually unstable: some deviations from these state conditions take place more often over time. In the instability conditions the small impact on the economic system can cause significant changes. The economic system is able to produce the order out of disorder and chaos spontaneously as a result of self-organization, where the chance plays the crucial role.

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