

## **The policy of economic growth under the conditions of global crisis**

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As forecast by academics dealing with long-term economic development theory, the global financial crisis resulted in a major recession, replacing an extended depression. The poor performance of anti-crisis policy in countries at the core of the world financial system is due to the underestimation of the structural component of the global financial crisis, which is determined by a change in technological structures and corresponding long (Kondratieff) waves of economic growth.

Historical experience and economic theory suggest that crises of this kind occur periodically at intervals of 40-50 years and are accompanied by the formation and collapse of financial bubbles, they are preceded by a rise in energy prices and emerging from them is associated with a storm of innovation, paving the way for the establishment of a new technological order.

The problems of irregularity of the economic growth seem to be well understood, but, at the same time, still do not have systematic scientific explanation. In particular, it is shown by incapability of the economic forecasting institutions working at both the national and global level to predict economic crises and justify measures for their prevention in due time. Low effectiveness of measures for overcoming the current crisis expenses for taking which in the Group of Twenty amounted to 10–40% of GDP evidences absence in the political and economic establishment of understanding of its reasons and the scientifically proved vision of further actions for its overcoming.

The following approach to the research of economic development processes in the context of large-scale technology shifts proceeds from the vision of economic dynamics as a combination of various factors of reproduction of the economic potential, which provides a complicated, diverse and unpredictable, in

many respects, picture. According to the hypothesis proposed a quarter-century ago, the long-term technical and economic development represents, in substance, a process of sequential replacement of large complexes of technology-oriented productions – technological orders<sup>1</sup>. Such structuralization of the process of global technical and economic development has shown its efficiency in a number of works on measurement of technological changes in the modern economy<sup>2</sup>.

Researches conducted within the framework of this school of thought made it possible to identify and describe the groups of technological sets connected to each other with the same technological chains and forming reproducible integrities - technological orders (TO). Each such order represents a complete and steady formation within the framework of which a reproductive cycle is completed, including extraction and production of primary resources, all stages of their processing and release of a set of end products satisfying the relevant type of the public consumption. The life cycle of the technological order covers about one century, but the period of its dominance in the development of the economy is about 40 years (with acceleration of the scientific and technological progress and reduction in the duration of the research and production cycles, this period gradually shortens). Development of the technological order has a non-linear nature and can be represented in the form of sequence of two logistical curves<sup>22</sup>, the first of which reflects the growth of productions of a new technological order in an embryonic phase (in the context of dominance of the latter), and the second one – in a maturity phase when this technological order replaces the previous one and becomes the main driver of economic growth (Fig. 1).

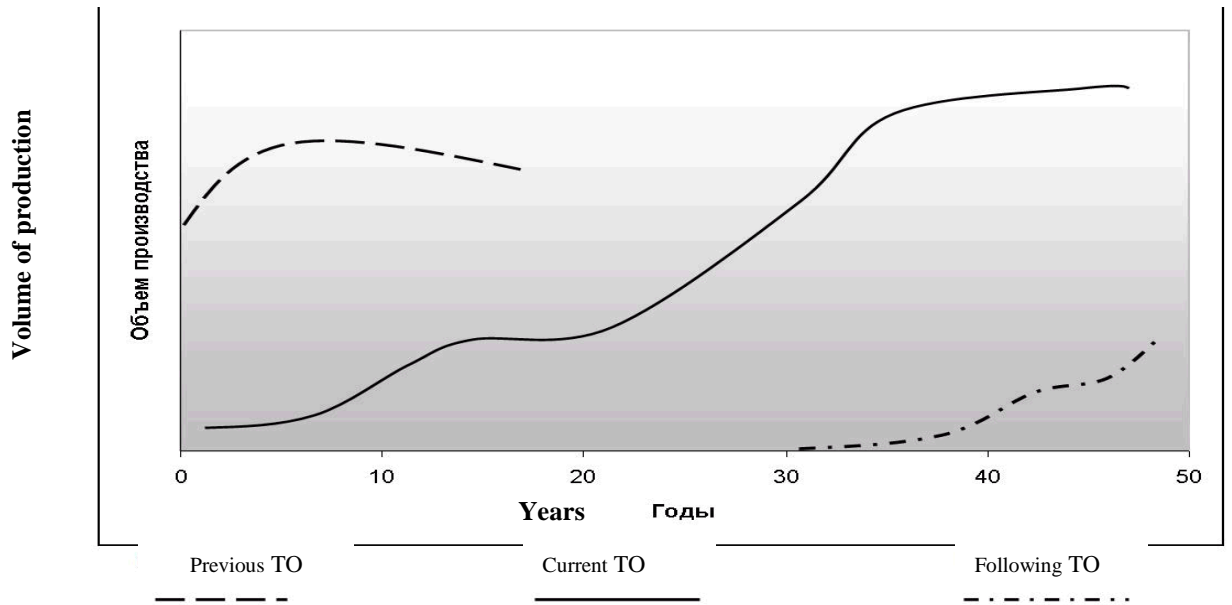
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<sup>1</sup> Lvov D. S., Glazyev S. Yu. Theoretical and Applied Aspects of STP Management / Economics and Mathematical Methods, 1986. No. 5; Glazyev S. Yu. The Theory of Long-Time Technical and Economic Development. M., VlaDar, 1993

<sup>2</sup> Kuzyk B. N., Yakovets Yu. V. Cumulative Macroeconomic Forecast on Innovative and Technologic and Structural Dynamics of the Russian Economy up to 2030; Rumyantseva S. Yu. Long Waves in Economics: Multiple-Factor Analysis. – SPb, SPb University Press, 2003

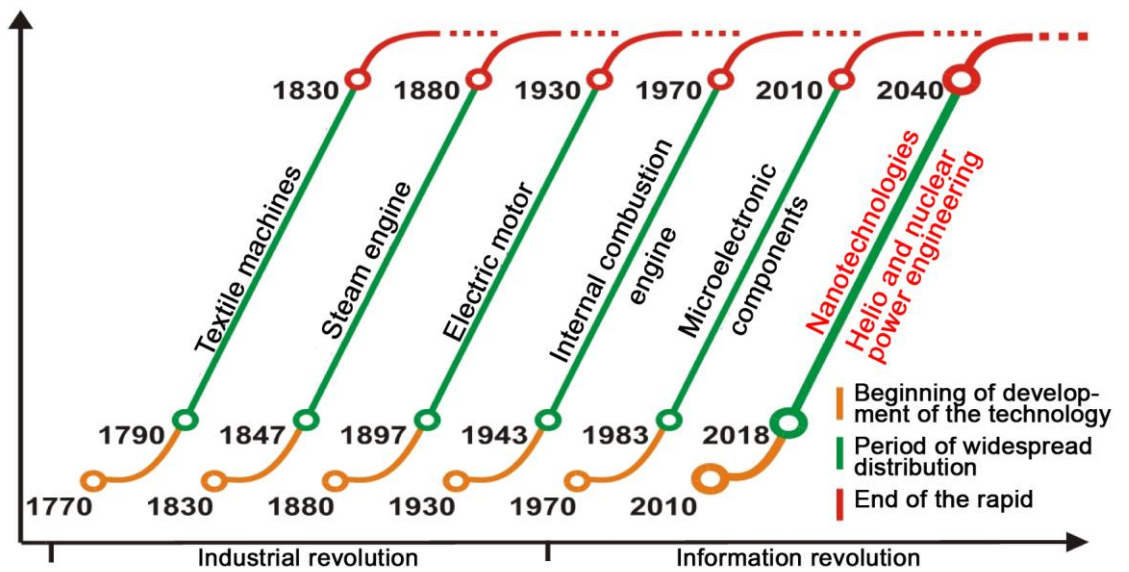
<sup>22</sup> Evolution of Technological and Economic Systems: Potential and Boundaries of Centralized Control Systems. Lvov D. S., Glazyev S. Yu., Fetisov G. G. – M., Science, 1992

**Figure 1**



**Life Cycle of a Technological Order (TO)**

**Figure 2**



## **Change in Technological Orders in the Course of the Contemporary Economic Growth**

Each technological order has a complicated structure consisting of the elements of various functions. The complex of basic sets of technology-oriented productions forms **a core of the technological order**. The technological innovations determining the formation of the technological order core and revolutionizing technological structure of the economy were named “**the key factor**”. Industries intensively using the key factor and playing a leading role in distribution of a new technological order are its **supporting industries**.

By now, it is possible to identify in the world technical and economic development (beginning with the industrial revolution of the XVIII century) life cycles **of five technological orders** sequentially replacing each other, including the information technological order dominating in the structure of the modern economy (Fig. 2, Tab. 1, 2).

The key factors of the technological order dominating today are microelectronics and software. The technological sets forming its core include electronic components and devices, computer facilities, radio- and telecommunication equipment, laser equipment, services related to computer facilities maintenance. The technological innovations determining the development of this technological order are generated in the said complex of industries and mediated with strong non-linear inverse relations between them.

At present, as follows from the existing rhythm of long-term technical and economic development, this technological order is close to the limits of its growth – fluctuations of prices for energy carriers, the world financial crisis are the true signs of the end phase of the dominating technological order life cycle and the beginning of the economy restructuring on the basis of the next order. Today, a reproductive system **of a new (the sixth) technological order** is formed,

generation and growth of which will determine the global economic development in the next two or three decades.

### Chronology and Characteristics of Technological Orders

Table 1

Characteristics of the order	Number of the technological order					
	1	2	3	4	5	6
Dominance period	1770–1830	1830–1880	1880–1930	1930–1970	1970–2010	2010–2050
Technology leaders	Great Britain, Belgium	Great Britain, France, Belgium, Germany, USA	Germany, USA, Great Britain, France	USA, USSR, Western Europe, Japan	USA, EU, Japan	USA, EU, China, Japan, Russia (?)
Developed regions	Europe	Europe	Europe and Russia, North America, Japan	Europe and USSR, North America, Japan, Newly Industrialized Countries (NIC)	Europe and Russia, North America, NIC, Brazil, Australia	Eurasia, America, Australia
Technological order core	Textile industry, textile mechanical engineering, iron smelting, iron	Steam engine, railway construction, transport, mechanical engineering, steamship	Electrical engineering, heavy engineering, steel making and rolling, power lines,	Motor-vehicle construction, tractor construction, nonferrous metallurgy,	Electronics industry, computer engineering, fibre optic engineering, software,	Nanoelectronics, molecular and nanophotonics, nanomaterials and nanostructured

	processing, canal laying, water engine	engineering, coal industry, machine-tool industry, ferrous metallurgy	inorganic chemistry	production of durable goods, synthetics, organic chemistry, oil production and processing	telecommunications, robot industry, gas production and information services	coverings, nanobiotechnology, nanosystems engineering
Key factor	Textile industry	Steam engine, engineering tools	Electric motor	Internal combustion engine, petrochemistry	Microelectronic components	Nanotechnologies, cellular technologies
Core of a new order under formation	Steam engines, mechanical engineering	Electrical engineering, heavy engineering, inorganic chemistry	Motor-vehicle construction, organic chemistry, oil production and processing, nonferrous metallurgy, road construction	Radio electronics, aircraft construction, gas industry	Nanotechnologies, molecular biology, genetic engineering	
Advantages of this technological order in	Mechanization and concentration of production	Growth of scales and concentration of production	Enhancement of flexibility of production owing to the	Mass and serial production	Personalization of production and	Rapid reduction in power intensity and

comparison with the previous ones	at the factories	owing to the use of steam engines	use of electric motors, standardization of production, urbanization		consumption, enhancement of flexibility of production	material intensity of production, designing materials and organisms with predetermined properties
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Table 2

### Institutional Structure of Technological Orders

Social and economic characteristics of orders	Number of the technological order					
	1	2	3	4	5	6
Modes of economic regulation in the leading countries	Destruction of feudal monopolies, restriction of trade unions, freedom of trade	Freedom of trade, restriction of government intervention, appearance of branch trade unions. Formation of social law	Expansion of government regulation institutions. Government ownership for natural monopolies, basic kinds of infrastructure, including social infrastructure	Development of government institutions of social support, military-industrial complex. Keynesian government regulation of the economy	Government stimulation of research and development, growth of expenses related to education and science, liberalization of regulation of financial institutions and capital markets	Strategic planning of scientific and technological economic growth. E-government. Institutions of development and funds for financing innovation activity
International modes of economic regulation	Combination of protectionism of internal and foreign trade freedom	Freedom of international trade. Government support of national monopolies with respect	Imperialism and colonisation	Economic and military dominance of the USA and the USSR	Dominance of financial institutions of the USA. Regional blocks, Liberal	Establishment of global regulation institutions. Globalization. Multi-currency



		to trade			globalization	nature of the world financial system
Major economic institutions	Competition of separate sole proprietors and small firms, their consolidation in partnerships providing cooperation of individual capital	Concentration of production in large-scale organizations. Development of joint stock companies providing concentration of capital on the principles of limited liability	Merge of firms, concentration of production in cartels and trusts. Dominance of monopolies and oligopolies. Concentration of financial capital in the banking system. Separation of management from property.	Transnational corporation, oligopolies in the world market. Vertical integration and concentration of production. Divisional hierarchical control and dominance of technostucture in organizations	International integration owing to information technologies, integration of production and sales. Seamless structures of management in corporations.	Strategic alliances. Integration structures of business, science and education, technoparks, public private partnership
Arrangement of innovation activity in the leading countries	Arrangement of research in the national academies and scientific organiza-	Formation of research and development institutions. Accelerated development of vocational	Creation of intracompany research and development departments. Engaging scientists and	Specialized research and development departments in firms. Government financing of	Horizontal integration of research and development, designing of production. Computer	Transition to continuous innovation process, inclusion in the cost of goods

	tions, local scientific and engineering societies. Sole engineering and inventive proprietorship and partnership. Occupational training of personnel	education and its internationalisation. Formation of national and international systems of intellectual property protection.	engineers with university education into production. National institutes and laboratories. Universal primary education.	military research and development activities. Involvement of government in the sphere of civil research and development activities. Development of secondary, higher and vocational education.	networks and joint researches. Government support of new technologies and collaboration of universities and industries. Universal higher education.	production of expenses related to research and development. Commercialization of science and scientific production integration, computer control of the life cycle of products.
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Глазьев С.Ю. Теория долгосрочного технико-экономического развития. М.: ВладДар, 1993;

Perez Carlota. Structural change and assimilation of new technologies in the economic and social system//Freeman C.(ed.) Long waves in the world economy. L., 1983;

Dosi G. Technical change and industrial transformation.L.,1984

Adopting nanotechnologies of substance transformation and designing new material objects and cellular technologies of change of living organisms, including methods of genetic engineering, should be considered as a reference point of the sixth technological order formation. Application of nanotechnology methods in the industry begins from the middle of the 90th owing to the development of instruments for linear measurement and manipulations in the nanometric range which, in fact, made it technically possible to create nano- and cellular technologies. First of all, it implies invention of electronic raster and atomic-force

microscopes and development of metrological systems based on their use. Such achievements of molecular biology as discovery of genetic information transfer mechanisms enabling reproduction of organisms at the cellular level, decoding of genomes of plants, animals and humans, invention of the technology of cloning of living organisms, discovery of stem cells also should be referred to basic inventions with the introduction of which the trajectory of the sixth technological order life cycle begins.

Methods of technological forecasting allow determination of the basic line of development of a new TO: biotechnologies based on the achievements of molecular biology and genetic engineering, nanotechnology, artificial intelligence systems, global information networks and integrated high-speed transport systems. Flexible automation of production, space technologies, production of constructional materials with predetermined properties, nuclear industry, air carriage will also be developed. Growth of atomic engineering and consumption of natural gas will be accompanied by the expansion of the sphere of use of hydrogen as environmentally friendly energy carrier, application of renewable energy sources will be substantially increased. More considerable intellectualization of production and transition to continuous innovation process in the majority of industries and continuous education in the majority of professions will occur. Transition from “the consumer society” to “the intellectual society”, where the priority values will have the requirements to the quality of life and the level of comfort of the environment, will be completed. The industrial sphere will apply environmentally friendly and non-waste technologies. Information, educational and medical services will become dominant in the structure of consumption. The progress in technologies of information processing, telecommunications systems, financial technologies will result in further globalization of the economy, formation of the single world market of goods, capital, labour.

Along with the industries constituting the core of a new technological order, its supporting industries will become quickly growing spheres of nanotechnologies application. They will include supporting industries of the previous fifth technological order: electrotechnical, aircraft, space-rocket, nuclear industries, instrument engineering, machine-tool industry, education, communications. Along with them, the revolution related to distribution of nanotechnologies will spread to the public health services (efficiency of which will increase manifold with the application of cellular technologies and methods of diagnostics of genetically caused diseases) and the agriculture (owing to application of the achievements of molecular biology and genetic engineering), as well as creation of new materials with predetermined properties. Owing to appearance of nanomaterials, the number of supporting industries of a new technological order will also include chemical and metallurgical complex, building, shipbuilding and motor-vehicle construction.

Major changes will occur in the management culture. Further development of the computer-aided design systems which together with the technologies of marketing and technological forecasting allow transition to computer-aided management of the entire life cycle of production on the basis of so-called CALS-technologies becoming the dominating culture of production development management will take place<sup>1</sup>. CALS (Continuous Acquisition and Life-Cycle Support) is a technology of integrated information environment on the basis of the international standards for uniform information interaction of all participants of the life cycle of production: developers, customers and suppliers of products, operating and repair personnel, which is accepted in the majority of industrially developed countries.

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<sup>1</sup> Kolchin A. F., Ovsyannikov M. V., Strekalov A. F., Sumarokov S. V. Product Life-Cycle Management. – M., Anakharsis, 2002. – 304 p.

Developed countries apply in management of nanotechnologies introduction the strategy of “bringing product from laboratory to the market” allowing minimization of the most complicated and risky phase of the life cycle of production – implementation of the research and development results in production.

On the basis of the foregoing, **the structure of a new (sixth) technological order** can be presented as follows (Fig. 3):

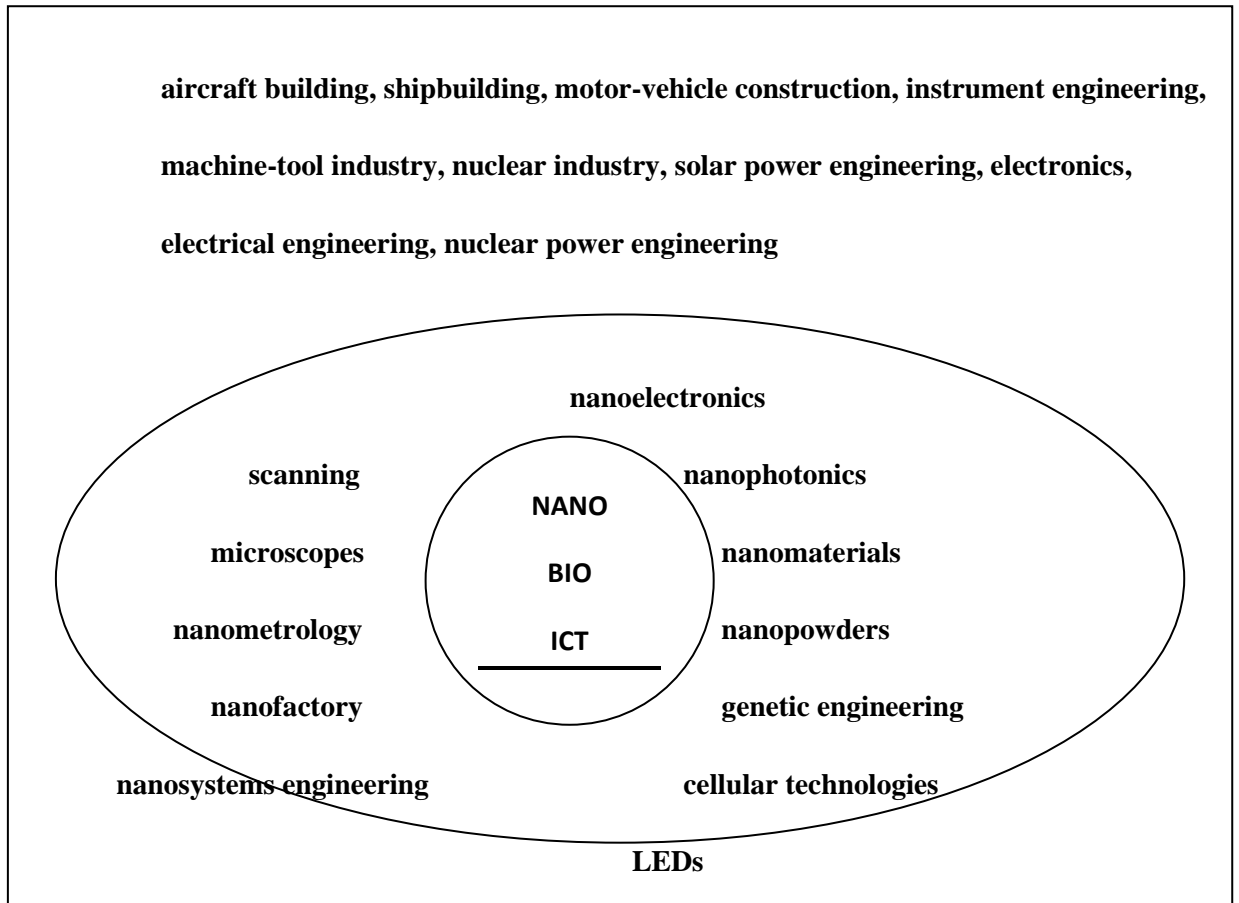
**Key factor:** nanotechnologies, cellular technologies, and methods of genetic engineering based on use of electronic raster and atomic-force microscopes, relevant metrological systems.

**Core:** nanoelectronics, molecular and nanophotonics, nanomaterials and nanostructured coverings, optical nanomaterials, nanoheterogeneous systems, nanobiotechnologies, nanosystems engineering, nanoequipment.

**Supporting industries:** electronic, nuclear and electrotechnical industries, information and communications sector, machine-tool industry, shipbuilding and motor-vehicle construction, instrument engineering, pharmaceutical industry, solar power engineering, space-rocket industry, aircraft building, cellular medicine, seed farming, building, chemical and metallurgical complex.

**Figure 3**

**Structure of New (VI) Technological Order**



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*core*

telecommunications education      chemical and metallurgical complex  
space-rocket industry      crop production      public health

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*supporting industries*

As shown below, the expansion of a new technological order provides multiple increases in the efficiency of production, reduction in its power and material intensity.

There is continuity in the technological orders dominating today and new incipient technological orders. According to the studies<sup>1</sup>, the mature technological order is a source of initial intellectual, material and financial resources (the initial capital) for a new one, within the framework of which basic technologies of a new technological order and demand for their products also arise. The first accumulation contour of a new technological order arises as a superstructure over technological chains of the previous one. While it is forming, new appropriate technological sets generating their own demand for new products are developed and the second accumulation contour is formed, a new technological order enters into the phase of extended reproduction on its own technological basis.

Formation of the reproduction contour of a new technological order is a long process comprising two qualitatively different stages. The first stage includes occurrence of its key factor and core in the conditions of dominance of the previous technological order which objectively limits the formation of productions of a new technological order with the needs of its own expanded reproduction. Upon exhaustion of the economic opportunities of this process, the second stage begins with replacement of the dominating technological order with a new one and continues in the form of a new long wave of the economic conditions.

It determines the dynamics of investments into fixed assets typical for long waves. Economic growth within one long wave is based on the sequence of two qualitatively different Kuznets rhythms: 30 years – on the basis of investments into manufacture of the means of production, the next 30 years – on the basis of

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<sup>1</sup> Dementyev V.E. Long Waves of the Economic Development and Financial Bubbles. – Preprint # WP/2009/252. – CEMI RAS, 2009

investments into manufacture of the means of consumption<sup>1</sup>. The policy of priority development consists in making these cycles closer and their maximum possible synchronization. In this case, technologically less developed countries gain an advantage – during formation of the reproduction contour of a new technological order they may rely on already accumulated investment and technological experience of developed countries in optimization of the structure of technological chains being created for maintenance of the integrity and optimum scale of the relevant technological sets.

Replacement of technological orders requires appropriate changes in the social and institutional systems removing organizational barriers and promoting mass introduction of technologies of a new technological order, the type of consumption and the way of life corresponding to it. In the phase of growth of a new technological order, the majority of technological chains of the previous one are restructured in line with its needs. While the next technological order is being developed, a new kind of infrastructure overcoming limitations of the previous one is created and the transition to new kinds of energy carriers being the base for formation of the following technological order is performed.

The nature of technical and economic development changes at different stages of the life cycle of the technological order. In the phase of formation of a new technological order there are a considerable number of variants of its basic technologies. Competition of the economic subjects having applied alternative technologies leads to selection of several most effective variants. In the conditions of actualization of the relevant public needs in the phase of growth of the technological order, development of its basic productions follows the way of increasing the release of a small number of universal models concentrated in few organizations which have adopted a new technology. After saturation of the said

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<sup>1</sup> Rumyantseva S. Yu. Driving Force of Long Waves. Problems of N. D. Kondratieff's Methodology Development // Vestnik of SPb University. Series 5 – Economics. 1998, Vol. 3, No. 19; Forrester J. W. Innovations and Economic Change // Futures. 1981, vol 13, No. 13

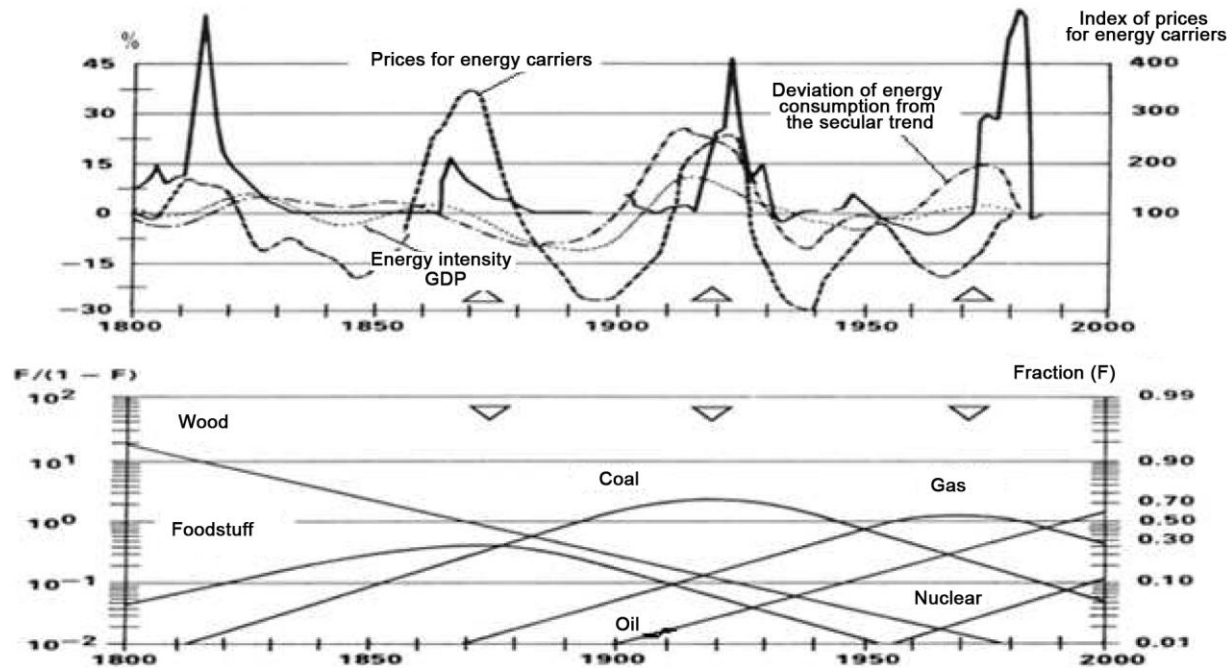


public needs, the necessity to modify products of basic productions in line with the consumer preferences, to reduce the costs of production and to improve the quality of products in order to expand the demand appears. After expansion of a variety of manufactured products and ramification of the reproduction contour of a new technological order, the specialization of production increases. Decreasing relative efficiency of highly concentrated production in the late phase of the technological order growth forces large-scale economic organizations to diversify their production program. Completion of the technological order life cycle is accompanied by saturation of the relevant type of consumption, overproduction of the relevant goods and overaccumulation of capital in its technological sets.

The phase of growth of a new technological order is accompanied not only by the reduction in the costs of production which proceeds especially rapidly with the formation of its reproduction contour, but also by the change of economic evaluations subject to the conditions of its reproduction. The process of replacement of technological orders begins with a sharp rise of prices for energy carriers and raw materials due to their overconsumption in the expanded technological chains of overmature TO. This sharp rise of prices corresponds to the maximum deviation of energy consumption from the secular trend (fig. 4). Subsequently, energy consumption increases owing to use of more effective energy carrier satisfying the needs of a new technological order.

**Figure 4**

**Fluctuations of prices for energy carriers and structural shifts in power consumption**



Source: Grubler, N. Nakicenovic, *Long Waves, Technology Diffusion Substitution*, Review XIV (2) Spring 1991:313–342 (Fig. 16, p. 333)

*F* – a fraction of the energy carrier in the aggregate consumption of primary energy sources.

Jump in prices for energy carriers and raw materials leads to sharp fall in profitableness of production in the technological sets of the dominating TO. It serves as a signal for mass introduction of a new less energy and material intensive technologies. Simultaneously, there is a release of capital from productions of the overmature technological order having reached its limits of growth. While the capital is flowing to productions of a new TO, the latter is growing. Change in the price ratio favours the improvement of efficiency of technologies comprising a

new TO and, after replacement of the previous technological order, efficiency of the whole public production. Subsequently, after saturation of the relevant public needs, decrease in the consumer demand and prices for products of a new TO and after exhaustion of the technical potential for improvement and cheapening of productions comprising it, growth of effectiveness of the public production slows down. In the final phase of the life cycle of this technological order which became dominating, this period coinciding with the phase of origination of the next one, decrease in the rates of economic growth and relative or, possibly, absolute decrease in effectiveness of the public production occur.

The phenomenon of gradual decrease in the capabilities of technological improvement of any production and technical system is well known in the theory and practice of the technological forecasting and was reflected in many laws of diminishing effectiveness (productivity) of the evolutionary improvement of machines and equipment. In particular, according to the Grosch's law, if the technical system is improved on the basis of an invariable scientific and technical principle, when a certain level of its development is achieved, the cost of its new models grows as its squared effectiveness. Due to the conjugacy of productions comprising the technological order and their synchronous development, fall in the effectiveness of their technical improvements occurs more or less simultaneously, which is reflected in sharp deceleration of the rates of technical development of the economy and reduction in the indicators reflecting contribution of the scientific and technological progress to the increment in the gross national product. During the life cycle of the following technological order, fluctuations of effectiveness of the public production, various structural ratios and proportions repeat again<sup>1</sup>.

Driving forces of the economic growth vary subject to the phase of the

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<sup>1</sup> Glazyev S. Yu. The Theory of Long-Time Technical and Economic Development. M., VlaDar, 1993

dominating technological order life cycle<sup>1</sup>. In the period of formation of a new technological order, innovators who are the first in adoption of its basic innovations play a leading role. Owing their activity, prerequisites for replacement of the former technological order with a new one are created, which will be implemented after the jump in prices for energy carriers and changes in the ratio of production profitableness in favour of a new TO technological sets. In the phase of TO growth, the trajectory of its formation becomes rather certain, the scale of production grows, its technological order becomes stiff. In this phase, the role of innovators decreases, and the routine activity of simulating businessmen becomes prevailing. Each of these phases lasts about two decades. They are characterized by different mechanisms of the economic growth with different ratio of financial and industrial capital roles.

As has been stated above, the life cycle of a new technological order already begins during the period of dominance of the previous one, which is well established in the industrial and institutional structures, governing institutions and social organizations. During this period, it is possible to speak about strong inertia of the industrial capital invested in tangible and intangible assets, arrangement, preparation of the personnel, relations with suppliers, distributors and customers. Only a few businessmen inclined to radical innovations have sufficient own funds for this purpose.

Financial capital is more mobile than industrial capital. When it is liquid, it easily flows to new spheres, including innovation projects. Therefore, in the phase of formation of a new technological order, financial agents (managers of venture funds, bank executives, etc.) play a crucial role in making decisions on investments into basic innovations and financing of research and development necessary for

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<sup>1</sup> Dementyev V. E. Long Waves of the Economic Development and Financial Bubbles. – Preprint # WP/2009/252. – CEMI RAS, 2009

this purpose<sup>1</sup>. Opportunities of mass introduction of new technologies appear when there is redundant capital in the financial market. It occurs as the opportunities for growth of the previous technological order are being exhausted, when the most far-sighted financiers facing decrease in the rates of growth and profitability of productions financed by them begin to search principally new opportunities for investments. In such situation, V. E. Dementyev speaks about the leadership of financial agents in support of the technological development<sup>2</sup>.

Government investments, funds of educational centres and venture capital financing institutions play a major role in the formation of a new technological order. In the context of formation of a new TO technological trajectories, the government assuming a considerable part of risks provides an opportunity for innovators to implement the scientific and technical projects in the environment of high competition of alternative engineering solutions in case of lack of demand for their results. Financial agents are required to assess the prospects of commercialization of the new knowledge and to make the decision on investments into such innovations in due time. While the trajectory of growth of a new technological order is being formed, these prospects become clearer, the skills of fast replication of the technology and forced raising of the volumes of production, which, in fact, may be an imitation of the variants already presented in the market, come to the forefront. As a consequence, in this phase, the leading role in technological development passes to the agents of production and industrial capital.

The works of C. Perez and V. Dementyev show the mechanism of financial crises occurrence in the course of change of the technological orders<sup>3</sup>.

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<sup>1</sup> Perez Carlota. Finance and technical change: A long-term view / H. Hanusch and A. Pyka, eds., The Elgar Companion to Neo-Schumpeterian Economics. – Cheltenham: Edward Elgar, 2004

<sup>2</sup> Dementyev V. E. Long Waves of the Economic Development and Financial Bubbles. – Preprint # WP/2009/252. – CEMI RAS, 2009

<sup>3</sup> Perez Carlota. Finance and technical change: A long-term view / H. Hanusch and A. Pyka, eds., The Elgar Companion to Neo-Schumpeterian Economics. - Cheltenham: Edward Elgar, 2004

Reduction in investments in productions of the dominating technological order which has reached the limits of its growth creates considerable redundant capital looking for the sphere of application. In this phase, securities forming the trajectory of growth of a new technological order of the leading firms start to be in demand by many investors. At the same time, investments into productions of a new technological order which is still not formed remain highly risky, the technological trajectories of its growth remain uncertain, the intense competition of various scientific and technical ideas continues. It creates favourable conditions for financial speculation for appropriation of funds of trustful investors under the veil of breakthrough innovation projects.

Stratification of firms by the level of attractiveness for investments contributes to formation of a group of issuers showing a steady tendency of growth of their securities market value. The opportunity to earn as a result of such growth increases the demand for such securities further and further. The search for alternative ways of capital investments increases activities in the market of another speculative asset - the real estate market. High demand by investors leads to formation of a financial bubble in the stock market and the real estate market at the end of the life cycle of the dominating technological order. According to C. Perez, a financial bubble is a ruthless way to concentrate accessible investments in new technologies<sup>1</sup>. Its liquidation by a financial crisis results in the depreciation of a considerable part of capital and the beginning of long-wave depression<sup>2</sup>. Though the financial crisis worsens the investment climate and may provoke a pause in the course of basic innovations<sup>3</sup>, the collapse of the financial bubble stimulates

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<sup>1</sup> Perez Carlota. Great Surges of Development and Alternative Forms of Globalization. 2007 (www.carlotaperez.org).

<sup>2</sup> Berry B. J. L. Long-Wave Rhythms in Economic Development and Political Behaviour. – London, 1991, p. 122–125

<sup>3</sup> Rumyantseva S. Yu. Specific Character of Long-Wave Technical and Economic Fluctuations Paradigm Shift. – Vestnik of SPb University. Series 5 – Economics. 1998, Vol. 2, pp. 74–79

reorientation of investments to fixed assets. As a consequence, the way out of the depression begins, first of all, with the growth of new industries.

Some revival will also occur in the old industries. In such case, they will be modernized on the basis of a new technological order, the key factor of which penetrates into all spheres of the economy and opens new opportunities for increasing the effectiveness of production and the quality of products. While a long wave of economic activity is on the rise, the demand for energy carriers and raw goods is growing, which results in certain increase in prices.

Now, the new technological order completes the embryonic phase of development, and the process of replacement by it of the previous TO having reached the limits of its growth begins. This process emerges as a financial and structural crisis of the economy of the leading countries of the world accompanied by the rise and subsequent fall in prices for energy carriers and other raw materials. In order to overcome these crises, the measures for salvation of the banking system or revival of the financial market are insufficient. They should be supplemented with the programs stimulating growth of a new technological order, the expansion of which is the only means to create a new long wave of economic growth.

It follows from the above that, in case of any scenario, the economic upswing occurs on a new technological basis with new production capabilities and qualitatively new consumer preferences. As a result of formation of a new sixth technological order, material changes will take place in the structure and the relative value of the factors of production. As has been mentioned above, the transition from the economy of mass production to the economy of knowledge, where the priority value is assigned not only to the means of production, but to skills of action, from the society of mass consumption to the society of creative consumption, the society of development, where the priority value will be assigned to the scientific-and-technical and intelligent potential and the requirements to the

quality of life and comfort of the environment, will be completed. It shows inevitability of major changes in the system of economic institutions and the mechanisms of management of economic activities, unreadiness of which for the development of new types of economic activities suppresses the formation of a new technological order.

The basic technologies of a new technological order are characterized with their high level of integration, which requires a comprehensive policy of their development providing for simultaneous creation of clusters of technology-oriented productions and the relevant sphere of consumption and culture of management. Successful work in the conditions of the economy of knowledge, which develops in an innovative way, requires substantial improvement of professional skills of managers, creative approach to solving problems of enterprise development, adoption of methods of inventive activities.

Now expansion of a new technological order is suppressed due to small scope of application of technologies and failure to master the same, as well as unreadiness of the social and economic environment for their wide application. Though expenses related to development of the newest technologies and the scope of their application grow exponentially and the volumes of production in the core of a new technological order, in spite of the crisis, increase with the rate of growth about 35% per annum, its weight in the structure of the modern economy remains insignificant. The qualitative jump and entering the next long wave of economic growth will occur upon completion of restructuring of the leading economies of the world on the basis of a new technological order expected in the middle of the next decade. Economic growth will become substantially less energy and material intensive. Therefore, the demand for energy carriers and raw materials will grow at substantially smaller rates in comparison with the release of finished goods due to multiple increase of effectiveness of the basic technologies.



A distinctive feature of the current crisis is the extremely broad range of the financial fluctuations, fueled by the global financial pyramids of world currency debt issuing centers. The occurrence of these pyramids (primarily U.S. Treasury bonds and off-balance sheet derivatives of U.S. financial institutions) during a phase of self-destruction is associated with the exhaustion of opportunities for economic growth based on the existing technological order. Since there was a synchronization of the structural and financial crises, fighting the latter while ignoring the former was doomed to failure, as this in itself will not open up new opportunities for economic growth. The following are the main causes of the economic crisis.

The most visible cause of the global crisis, lying on the surface of economic phenomena, is the snowballing growth in informal trading in derivatives, which is not accounted for on the balance sheets of financial institutions and not regulated by the state, which caused a systemic underestimation of financial risks, the formation of giant "financial bubbles" and their subsequent collapse.

Instead, in order to restore balance in the financial and real sectors of the economy, the U.S. monetary authorities encouraged the expansion of the derivatives market. Here, a key role was played by well-known economists, advocates of the doctrine of market fundamentalism, who continue even today to determine economic policy in Washington.

The temptation to indefinitely issue newer derivatives, further removed from real collateral, was backed by speculative confidence in the unlimited capacity of this financial market, based on the close connection between the largest derivative issuers and the issuer of dollars - the U.S. Federal Reserve. The latter has always supported its shareholders with unlimited refinancing, which gave them a sense of guarantee from the lender of last resort, including for commitments on uncontrolled and unregulated instruments. Because they were not included on bank

balance sheets, their total volume was hidden from the financial regulators and became known only with the onset of the financial crisis, when having encountered multiple depreciated assets, investment banks turned to the Fed for loans.

The very possibility of uncontrolled issuing of global currency lies at the heart of the fundamental cause of the global financial crisis. Since 1971, having abandoned their international commitments to exchange dollars for gold, the U.S. financial authorities have strong-armed the non-socialist world to use its currency as a world currency. Moreover, issues are not carried out by the state, but by a joint stock company of powerful banks, which have pushed their monopoly on issuing dollars, enshrined in the law of the Federal Reserve System (FRS), onto the American state.

The mechanism for issuing U.S. debt is in fact a kind of financial pyramid. In drafting the budget, the U.S. financial authorities determine the amount of money needed to cover the deficit and repay previous debt obligations. The appropriate number of government bonds is issued for this amount, and at the same time the same amount of currency is issued to buy them on the market. Commercial banks, using these bonds as collateral, receive money issued by the Fed at minimal interest rates.

A key element of this mechanism for printing dollars is the procedure for refinancing commercial banks using government securities as collateral, which forms the main channel for printing dollars. In this way, the Fed prints money to finance U.S. government debt. The vast majority of dollars in circulation have been issued in this way. These are currently not more than 4% backed up by gold and currency reserves. More than 90% of the dollars in circulation have been issued to service the debt obligations of the U.S. Treasury and is effectively not backed up by anything.

Perhaps the issue of dollars, U.S. government bonds and derivatives may have been carried out by the closely inter-related creators of this financial pyramid for a lot longer, if it wasn't for the intrinsically limited capacity of the global financial market, demand on which depends on the ability of end borrowers to repay loans. To some extent, the insolvency of individual borrowers is neutralized by their refinancing and the writing off of bad debts. However, the economic crisis manifested itself at time of falling end demand and a sharp decline in profitability in almost all sectors of the real economy, which led to the insolvency of many large companies. This was the root cause of the global economic crisis as a structural one, bringing about the replacement of the dominant technological structures.

Today's global crisis fits into the overall picture of a change in the long economic waves and the replacement of the technological structures that form their basis.

The sharp rise and subsequent, even more dramatic drop in stock indices and energy prices is characteristic of a structural crisis, preceding the replacement of technological structures. This process is being repeated for the fifth time in the history of modern economic growth.

A price surge for the main energy products is an essential element of the mechanism for replacing technological structures. It leads to a sharp rise in the cost of production and consumption of existing production and, correspondingly, a drop in demand for products. A simultaneous drop in profitability in the production sector results in less investment in developing production and the concentration of capital in the financial sector. This causes the appearance and subsequent collapse of financial bubbles. A financial crisis accompanied by the devaluation of capital, forces it to seek new areas of application, the center of gravity of which become the innovations of the new technological order. "A storm of innovations" paves

the way for its development - an increase in innovative activity draws free capital into a new long wave of economic growth based on the expansion of the corresponding technological structure.

It is easy to see that the current decade's sharp rise in oil prices with a simultaneous increase in financial speculation and the emergence of financial bubbles with stagnation in the production sector in developed countries represents a typical pattern of maturation of a structural crisis in the final phase of the life cycle of the dominant technological order. Rapid growth in prices for oil, gas and electricity over seven years has caused changes in the price structure, and broken the reproductive processes and stereotypes of consumption. At the same time, and in full compliance with the theory, financial capital began to play a leading role in shaping the path of further economic development. Conversely, industrial capital, which is concentrated in traditional industries, is depreciating and losing the ability to replace itself. The simultaneous self-destruction of the financial pyramid of bonds from the issuer of the world currency, the collapse of the global financial bubble and the associated financial and banking crisis, create a dangerous repercussion, threatening the collapse of the global financial system.

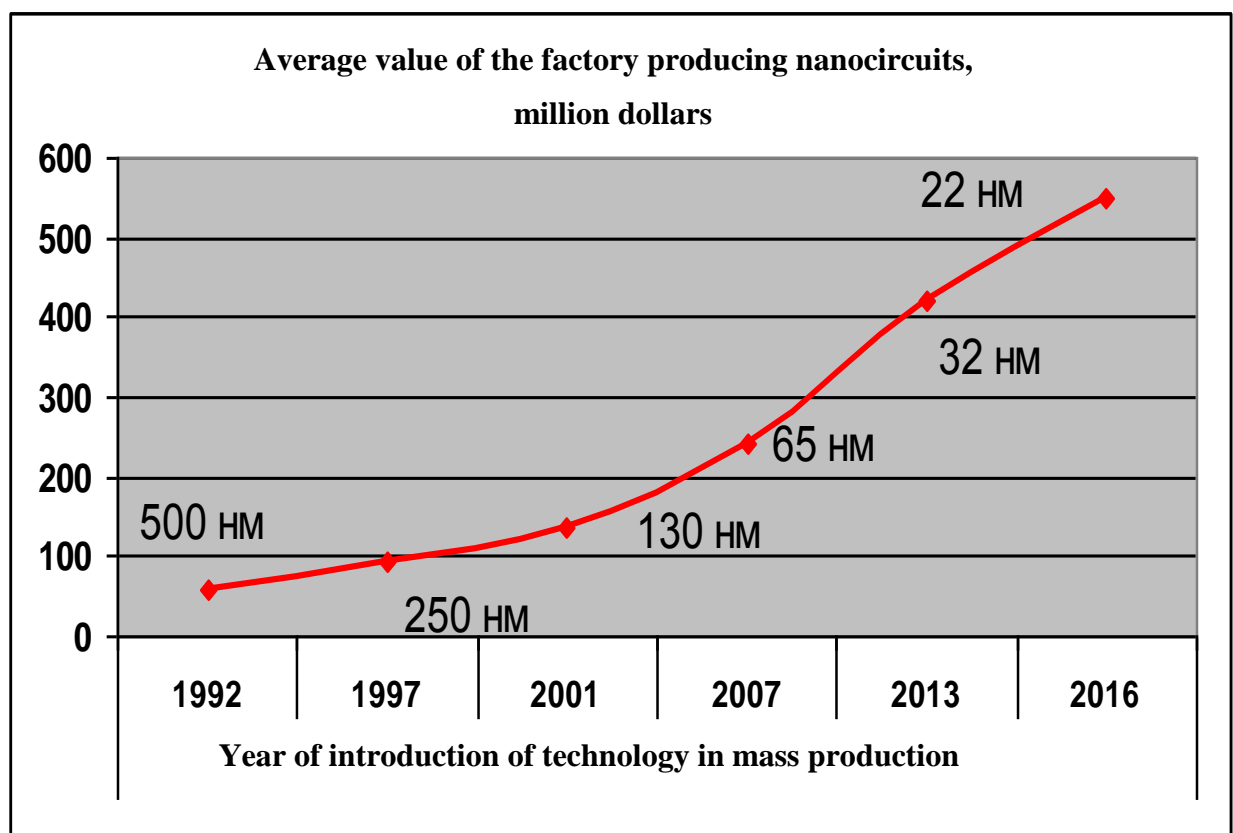
Despite the complexity of the current global crisis, which some scientists and politicians have called systemic, the way out from it involves the formation of a new technological order. Its expansion will create a material basis for a new long wave of economic growth and ensure the technological innovation of the productive capital remaining after depreciation, and will breathe new life into halted production through modernization and the expansion of development opportunities.

The further development of the crisis will be determined by a combination of two processes – destruction of the structures of the former technological order and formation of the new structures. In this case, the existing financial, economic

and political institutions will either be transformed in accordance with the needs of growth of a new TO or cease to exist.

The historical experience shows that with the change of technological orders and the entering of the world economy into a new long wave of economic growth, it is not only the technological structure of the economy that changes, but also its institutional system, as well as the structure of leading companies, countries and regions. The faster a structure will be able to enter the trajectory of growth of a new TO, the less investments will be required for this purpose. On the contrary, entrance for those who come late will become more and more expensive every year. A typical example is the forecast of capital intensity of the nanoelectronic components production (Fig. 5). Reproduction of the technology with its improvement becomes more and more expensive. In this context, the advantages of the leaders protecting the monopoly for technological superiority by means of intellectual property institutions will increase. Reproduction of the technology with its entering into the maturity phase becomes prohibitively expensive for beginners.

**Figure 5**



Transition to a new technological order requires large-scale investments into development of technologies comprising it and modernization of the economy on their basis. The need for such investments usually significantly exceeds the capabilities of the existing financial institutions, many of which face the depreciation of capital and suffer disaster in the conditions of the structural crisis causing replacement of the technological orders. In such circumstances, the role of

the government having opportunities for concentration of the resources for the development of new technologies and taking risks of the relevant investments increases manifold. In such case, the forms and methods of concentration of resources are determined by the functions of the government, among which the national security protection plays a special role. Up to the present, expenses related to the arms race played a key role in mobilization of the means for development of the latest technologies. However, the effectiveness of expenditure of these means was determined by the capability of the economic systems for wide adoption of new technologies outside the defence industry.

Experience of two previous structural crises of the economy (in the 30's and 70's of the last century) evidences their extreme painfulness for the leading countries and unique opportunities which are being opened for the developing countries. The Great Depression of the 30's led to the Second World War which resulted in destruction of the core of the world economic system (European colonial empires) existing at that time and formation of the two opposing global political and economic systems. Leadership of the American capitalism in the entering into a new long wave of economic growth was caused by extreme growth of defence orders for the development of new technologies and inflow of world capital to the USA at the time of destruction of the industrial potential and depreciation of capital of the main competitors.

The depression of the mid-70's – early 80's led to the arms race with a wide use of information technologies with a risk of involvement of the leading countries of the world into the “star wars”. This resulted in the collapse of the world socialist system, which failed to shift its economy to a new technological order, and allowed the leading capitalist countries to use the resources of the former socialist countries for soft entering into a new long wave of economic growth. Capital export and brain drain from the former socialist countries, colonization of their

economy facilitated restructuring of the economy of the countries constituting the core of the world capitalist system, which previously stimulated formation of a new technological order by means of expansion of the arms race in space. New industrial countries, which managed to create the key productions and prerequisites for their rapid growth on a global scale, were able to develop their economy on the same wave of growth of a new technological order. Liberal globalization with the dominance of the USA as an issuer of the primary reserve currency became a political result of this.

The way out of the present depression will also be accompanied by large-scale geopolitical and economic changes. As in previous cases, the leading countries show their incapability to make radical institutional innovations which could direct free capital to restructuring of the economy on the basis of a new technological order with continuation of reproduction of the developed institutional system and meeting economic interests intrinsic to it.

In the best-case scenario for overcoming the crisis, globalization will become more manageable and balanced from the point of view of the interests of the world's leading countries. The influence of international economic regulators is likely to increase, and we may see the appearance of supra-national institutions to regulate markets and the world currency. A strategy of sustainable development will replace the doctrine of the Washington Consensus as the leading ideology of globalization. The common goals used to unite the leading countries of the world will include counter-terrorism, global warming, hunger, illiteracy, disease and other threats to humanity.

The crisis will have a different impact on different countries depending on a combination of the objective state of their scientific and technological potential and the efficiency of their economic policy. It may be disastrous for some countries and regions, and manageable for others. It should be understood that the countries



and institutions that form the core of the global financial system will try to use their dominant position to survive by appropriating the resources of peripheral countries by establishing control over their assets. This will be achieved through the exchange of issues of reserve currencies for the assets of the countries receiving these currencies.

In contrast to the previous cases of finding the way out of the depression owing to the escalation of military expenses and extraction of resources from the defeated countries, today the leading countries do not have such opportunities. The war provoked by them by means of international terrorism with separate peripheral countries as victims cannot create sufficient pressure for concentration of global resources on the necessary scales. The financial war also worked itself out, it is conducted by Washington with unprotected national financial systems making them dependant on dollar by means of imposition of the monetary macroeconomic policy with the assistance of IMF, rating agencies, agents of influence dependent on it. The capital extracted from them is already insufficient for servicing of the snowballing commitments of the USA, the amount of expenses for which approaches to one third of their GDP. A catastrophic scenario of collapse at the core of the global capitalist system and the financial institutions serving the same is expected with increasing probability. A new long wave of economic growth generates new centres of the world economy – China, India, Brazil, Iran. The world's financial system becomes multi-currency, large regional economic alliances capable of independent development are being formed.

Along with the objective reasons for the economic crisis, determined by the principles of economic development and the operating mechanisms of financial institutions, ideological and political causes played a significant role in its formation. Primary among these is the inadequacy of the neo-liberal ideology of real processes of socio-economic development dominant among elites in Russia

and the world's leading countries, that has resulted in the dismantling of strategic planning systems, and the neglect of objective economic research, which had predicted the global and Russian economic crises a few years ago. Secondly there is liberal globalization, accompanied by the dismantling of state currency regulation institutions, and the opening to U.S. credit organizations of an unlimited opportunity to build global financial pyramids and absorb the national wealth of other countries.

The verification and mutual writing off of off-balance sheet derivatives and the elimination of the budget deficit and the U.S. balance of payment could stop the expansion of the crisis of global monetary and financial system. However, the U.S. authorities are unable to make private issuers of derivatives, which exceed the Fed's balance ten-fold, to carry out mutual clearing or write them off in some other way. Burdened with their own overwhelming obligations, they are no longer able to manage their financial system. One of its core elements alone – the insurance company AIG which is in a state of default - issued derivatives in an amount exceeding the money supply of the world's twenty largest countries. American taxpayers could never hope to repay this debt.

To avoid default, the U.S. government must drastically reduce government spending, which is unrealistic for social reasons and counter-productive in terms of anti-crisis policy. Emerging from the depression will involve the development of new technological trajectories and a sharp increase in innovative activity. And this requires, perversely, an increase in government spending to stimulate investment.

The preservation of the existing world financial system is hardly possible. To retain its leading role the U.S. dollar will have to simultaneously rid itself of enormous financial obligations, reduce public spending and force the modernization of the economy.

Countries that have retained their economic sovereignty (China, India), are not opening up their financial systems, and are demonstrating stable growth in crisis conditions. Their example was followed by the largest countries in Latin America and Southeast Asia, which resisted the absorption of assets by speculative capital.

The space the U.S. Federal Reserve has to maneuver is inexorably shrinking - the U.S. economy has to bear the brunt of the depreciation of capital. The U.S. financial system has entered a vicious circle of self-destruction: increased money issues to save their financial institutions undermine confidence in the dollar and provoke capital flight, which worsens their condition, requiring a further increase in the issuing of money.

Based on the above, the most likely course of events will include: the depreciation of a significant part of financial capital, devaluation of the dollar and the loss of its position as the world's reserve currency, and the regional fragmentation of the global financial system. The crisis will end with the flow of capital remaining after the collapse of the dollar financial pyramid and other financial bubbles into the production of new technological order. After the restructuring of the world economy on the basis of a new technological order, which will last 3 - 5 years and will be accompanied by changes in the composition of the leading companies, countries and management practices, a new long wave of economic growth will begin. At the same time the balance of negative tendencies in the destruction of the old technological order and the positive effects of forming a new one will determine the growth rate of the new technological order, compensating the contraction of the obsolete section of the economy.

For the moment things are developing according to a scenario of inertia, which is accompanied by the segregation of the world's leading countries in terms of the depth of the crisis. The greatest damage is to countries with open economies,

in which the depth of the decline in industrial production and investment amounts to 15-30%. Countries with autonomous financial systems and large domestic markets, protected from attacks by financial speculators, are continuing to grow (China, India), and their economic clout is rapidly increasing.

The optimistic scenario calls for a deep restructuring of the global currency and financial system with the creation of the following elements, proposed by experts from international organizations: a global regulatory organization, to monitor and assess systemic risks, the harmonization of national financial regulation legislation, and the adoption of compulsory global rules for financial institutions. These include rules calling for the responsibility of managers, the transparency of stock options, the elimination of internal conflicts of interest in institutions assessing risk, restriction of leveraging, standardization of financial products, and the handling of cross-border insolvencies.

Many reputable Russian and foreign academics have written about the need for this reform of the global financial system. However, the creation of a universal system for regulating the global and national financial markets will require not only the goodwill of national leaders, but also the consensus of national political and business elites in the world's leading countries; which is not likely given existing conflicts of interest.

Countries with strategic planning systems do not rely on market forces or the wisdom of international financial institutions, that follow the lead of the U.S. Federal Reserve, which serves the interests of an American oligarchy. While talking about solidarity between leading countries in stabilizing the global financial system, China is building its monetary and financial system of international payments by carrying out currency swaps with interested countries. In no hurry to limit their sovereignty and to follow recommendations from Washington, India,

Brazil, Venezuela, Iran and several other large developing countries are resorting to an active industrial, scientific-technological and structural policy.

Not only the largest developing countries, but also G8 countries that preach an export-oriented neo-liberal ideology, are actively resorting to measures to protect and support their economies by expanding domestic sources of financing.

With talk focusing on the mutual rejection of protectionist measures and maintaining the status quo, the current world economic system is undergoing rapid erosion. The WTO and IMF have lost their former effectiveness and credibility. Both developed and developing countries have moved quite far from their previous seemingly unshakeable dogmas of liberal globalization. Meanwhile, the more resolutely that a country pursues an independent pragmatic policy to support and protect the national economy, the more effective it is.

The obvious conclusion referred to in the foreword follows from the foregoing: for any country, a necessary prerequisite for controlled overcoming of the crisis is that it should have a strategy focused on maintaining its economic potential that anticipates prerequisites and key productions for a new technological order. This includes the protection of strategic assets and the domestic market from attacks by foreign speculative capital, as well as the implementation of an active scientific-technical and structural policy to expand competitive companies into promising new lines of economic growth. The latter is impossible without a national financial and investment system that relies on domestic sources of credit and that is protected from the destabilizing effects of the global financial market.

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