

## ROLE OF THE HIGHER SCHOOL IN FORMATION OF THE FOURTH INDUSTRIAL REVOLUTION IN THE RUSSIAN FEDERATION

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**Abstract:** Authors conduct modeling of long-term economic cycles of national economic. Implemented estimations supported by methods of economic-mathematic modeling, allowed to determine perspectives and time horizons for transition of Russian economic into fairway of fourth industrial revolution, to conduct factor analysis on this basis and detect role of the higher school in system of transformations generating in future. Results of conducted study allowed to determine major problems in system of higher education of Russia from point of view of rates and quality of Russian economic development limitation in accordance with new forming global principles and mechanisms of economic growth. Method of study conduction is based on application of tools of statistic analysis of wide range of data that characterize institutional and opportunistic potential of national economic in period of 1965-2017, as well as tools of descriptive analysis that allowed to detect major drawbacks in higher education system, limiting perspectives of formation of economic development rates in accordance with detected sequential cycle of long-term development of RF economic. Study novelty is comprised in developed conceptual approach to determination of key directions of higher school development with taking into account of global tendencies of conversion of re-production processes and predictable phases of economic transformations in national economic system.

**Key words:** fourth industrial revolution, higher school, long-term economic cycle, role of Russian HEIs, scientific-technological development, system problems in higher education development.

### 1 Introduction

At present time, issues of perspectives and abilities of transition of Russian economic system into so-called fairway of fourth industrial revolution that received conventional name Russia 4.0 are gaining momentum to more and more degree. This type of economic development is based on absolutely new principles of humanity development; in their basis occurs practically complete absolutization of human, biological and digital technologies cooperation process. It is enough to note that, according to estimations of a range of experts and expert agencies, by the end of year 2035 it is expected that number of robotized and automatized work places will reach approximately 95% and approximately half of work places existing today will be unclaimed (Villalobos Antúnez, 2016).

It should be noted that Russian economic has a significant potential not only in part of synchronization relatively to global trends, process of entering into fourth industrial revolution, actively absorbing the global economic system, but also signs of rapid transition into a new type of economic pattern. At this, in spite of active role of state in this issue, expressed, particularly, in development and implementation of government-sanctioned program "National technological initiative" (Miriago, 2018), the most important factor that substantiates or, vice versa, refutes theses on possibilities of Russian economic transition into new reality, is the degree of readiness of economic entities to such

transformations and changes (Wu, 2014; Carayannis & Grigoroudis, 2016). Undoubtedly, this measure of readiness, in natural evolutionary manner, along with measures of state impact, will reach its summit and Russian economic will be integrated into global trends that anticipate the change of new technological pattern. The question is when this will happen, what key factors will promote this and what quality level of such transformation will be reached? The answer for these questions is very uncommon and requires its complex and system solution and analysis.

### 2 Methodology

One of possible tools that allows to approach to solution of question raised, may be the approach based on estimation and construction of long-term economic cycles with regard to national economic system. After determination of current phase of long-term cycle economic development, its future transformations and possible perspectives of long-term development may be predicted. Due to this, questions that disclose perspectives of Russian economic transition into fairway of industrial revolution 4.0, may be solved on the basis of modeling tools for long-wave fluctuations of national economic system and identification of factors generating current and future phase shifts in the system of so-called big cycles.

Previously, in frames of publication of series of author's works dedicated to theme of economic cycles modeling on the basis of construction and estimation of economic agents' expectations (Safiullin et al, 2016; Yelshin, 2017), we presented, in sufficient detail, a methodological apparatus that discloses peculiarities of identification of cyclic fluctuations of economic of short-, middle- and long-term nature, based on construction and estimation of economic agents' expectations.

Methods applied in this study are based on use of multi-factor approach, e.g. detection of set of factors impacting economic agents' expectations and, therefore, economic activity of system in general. At such approach, in the beginning, analyzed factors are united into sub-indexes representing a sum of multiple average weighted estimations by analyzed components. On the basis of this system of indicators characterizing certain types of activity and behavioral models and index method, the integral (composite) or aggregate index is calculated - "Index of rapid development cycles". At this, by cycles of rapid development in this work is understood periodical stable fluctuations of economic agents' expectations with specific types of laws, complying with change of short-term, middle-term and long-term opportunistic and institutional factors and forming conditions of economic dynamics phase shifts on the basis of transforming current and mental estimations related to upcoming transformations in the future; this, on the basis of known postulates of expectations theory, allows to increase regional forecasting quality, predict turning points of phase shifts of economic cycle dependently non programmable (identifiable) parameters of economic agents' expectations in timely manner.

Structure-logical chart of rapid development cycles modeling in generalized view is shown in Fig 1 (Safiullin et al, 2016).

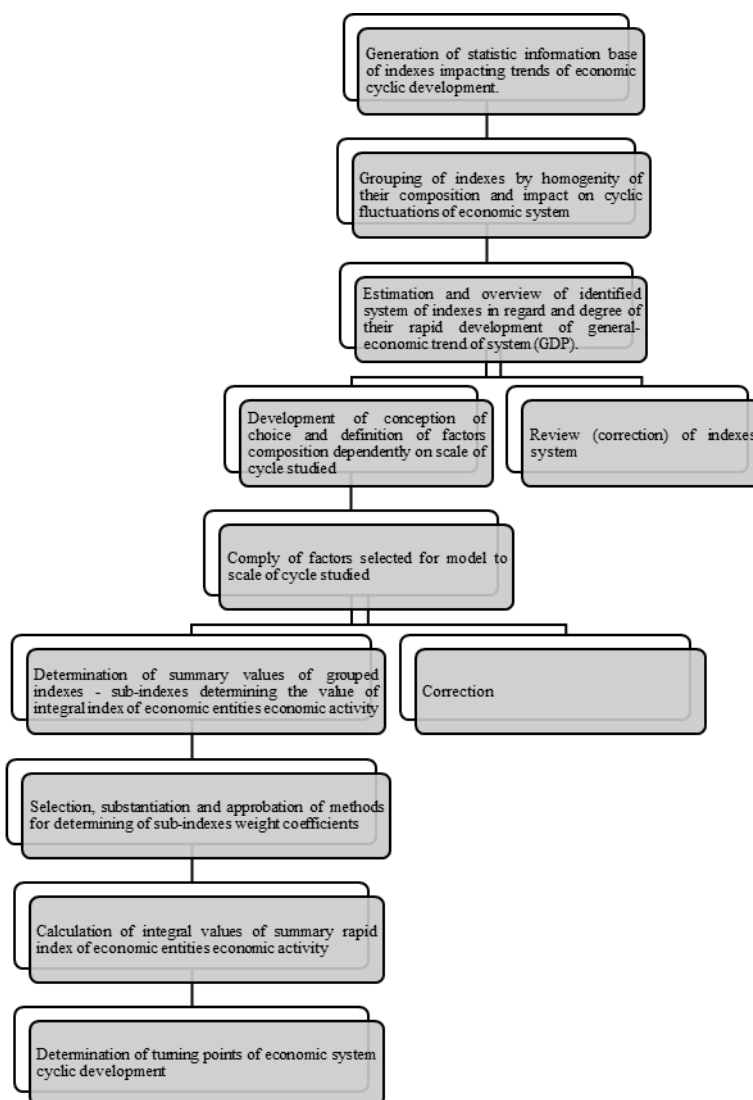


Fig 1. Structure-logical chart of rapid development cycles modeling

Search for solutions directed at identification of factors system in regard and degree of their rapid development relatively to general economic trend of system (IPI) was implemented by application of cross-correlation analysis tools.

### 3 Results and Discussion

$$I_i = W_1 \cdot I_{1i} + W_2 \cdot I_{2i} + W_3 \cdot I_{3i} + W_4 \cdot I_{4i} + W_5 \cdot I_{5i} + W_6 \cdot I_{6i} + W_7 \cdot I_{7i},$$

where  $I_i$  - value of rapid development index (RDI);

$i$  - period value (in our case it is one year);

$I_{1i}$  - index of urbanistic development in year  $i$ ;

$I_{2i}$  - index of human capital assets in year  $i$ ;

$I_{3i}$  - index of production and resource development in year  $i$ ;

$I_{4i}$  - index of institutional and cultural development in year  $i$ ;

$I_{5i}$  - index of economic activity development in year  $i$ ;

Implementation of methodological procedures presented above allows to move to concluding stage - construction of so-called summary index of rapid development (RDI). Value of this index that estimates expectations of economic agents consists of calculated rows of indicators or sub-indexes.

In formula from, calculation of RDI looks the following way:

$I_{6i}$  - index of research and development potential in year  $i$ ;

$I_{7i}$  - index of capital change;

$W_1, W_2, W_3, W_4, W_5, W_6, W_7$  - weight coefficients of respective indexes.

By results of conducted estimations and calculations, according to stated methodological approaches, results, determining nature and trends of long-term cyclic development of national economic were obtained (Fig 2). Values of indexes were determined as weighted sum of standardized values of analyzed rows, generalized by group sign, constructed on the bases of factors detected by results of cross-correlation analysis.

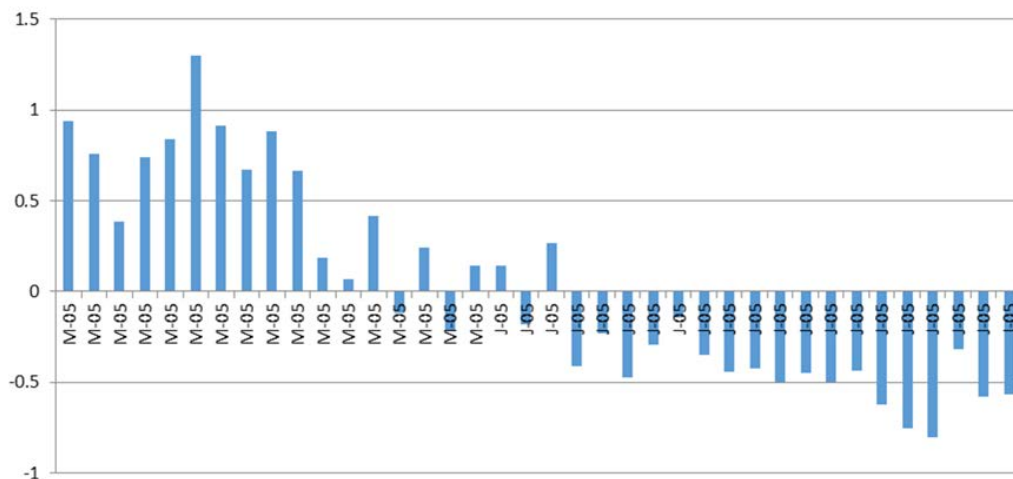


Fig 2. Long-term cycles of economic rapid development in period of 1951-1999.

According to obtained data on development trajectory of summary index of rapid development, possible crisis of economic depressed condition, from view point of long waves theory is dated by period of 1997-2000 (in spite of default of 1998 that happened in Russian economic). Therefore, we may suggest (by projecting data on rapid development on actual time trend) that phase of new long-term cycle in Russian economic, characterized by revival and development of new technologies, corresponding to sixth technological pattern, entered its "rights" at border of the end of 2000s and the beginning of 2010s. With taking into account of the fact that duration of this period of technological patterns change (embryonic phase in terminology of Glazyev is approximately 10-15 years, phase of growth in RF economic will not occur until 2020-2025 (Glazyev, 1993).

#### 4 Summary

Implemented estimations largely confirm that national economic of RF is developing in fairway of global tendencies. On the basis of conclusion about the change on new technological pattern predicted in period of 2020-2025, as well as on the basis of average valued of cycle phase duration (8-10 years) is expected that by 2030-2035, RF economic will enter the phase of active long-term growth. Therefore, we have all reasons to suggest that fourth industrial revolution will totally adsorb Russian economic in this time period; this is significantly synchronized with conclusion about the quantity of robotized and automatized work places in the world that would reach 95% to the end of 2035; approximately half of working places existing in the world today will be unclaimed.

However, in spite of obtained estimations and forecasts, the problem of quality of new long-term cycle of economic development of national economic stays an important unsolved question. In this case, quantity is understood as the level of compliance of parameters and structure of re-production processes to key factors generating new type of economic pattern. To such factors, as was presented earlier, may be related level of integration into Russian economic system of such tools as synchronization of artificial and human intellect, development of Internet-things, nanoelectronics, nanotechnologies, anomaterials, nanotools, solar-powered, colloid nuclear power plants, medical high-precision technologies, emerging of unmanned transport, quantum computers etc (Freitas et al, 2013; Kruss et al, 2015).

In more concentrated form, listed tools of development complying with fourth industrial revolution are concentrated around the core pillar of future type of economic growth - digital economic, which development is largely supported by higher education system.

At this, we have to regret that at contemporary stage of development, in spite of obvious breakthroughs within last

several years, high school does not completely comply to expected challenges of future transformations in system of global re-production processes based on digitalization of economic, stipulating new type of arrangement and development of labor market, new trends in formation of labor productivity, new creative abilities of society (Gunasekara Chrys, 2004). Meanwhile, new type of economic growth requires new forms of organization of high school system, directed at development of such types of activity and types of labor organization that would promote and organically comply to new needs of labor market in 15-20 years.

In spite of new requests and trends, at present moment a major part of Russia HEIs use the model of processes organization based on concentration of processes in educational environment ("teaching universities"), at this paying an insignificant of inadequate attention to issues of research and development sphere development and commercialization. In result of this, today higher school of RF plays insufficient role in organization of innovative processes in system of regional economic systems, and, accordingly, in national economic. Largely, current state of affairs is stipulated by insufficient attention to higher education branch in 90s. However, in spite of significant intensification of processes of higher school system development activation starting from 200s, problems, acquired in "perestrojka" epoch, are still there. The most important among them are comprised in insufficient financing of research and development elaborations (today the amount of financial resources of RF allowed for conduction of scientific researches and developments is approximately 1% of GDP, which is practically two-fold lower than similar average index in the world). For instance, amounts of financial resources allowed for researches and developments in RF for present moment are 10 folds lower than similar allowances in OECD countries. Nearly half of Russia HEIs is characterized by extremely low indexes of effectiveness in RTD sphere. For example, in 40% of Russia HEIs, amount of RTD calculated per one educational research employee is less than 100 thousand RUR (a little more than 1 thousand EUR) (for comparison, the average value of this index in European countries is approximately 50 thousand EUR).

A significant drawback limiting the development of research and development environment in Russia regions is also comprised in absence of effective system of high category personnel training organization for active implementation of scientific breakthroughs and creation of innovations on their basis.

The most important problem in process of RF higher education development is also a low level of demand of engineering training programs among applicants. In other words, acquiring of special skills by technical directions of training are not popular among high-school students. For instance, according to published data of Ministry of Education and Science of RF, approximately quarter of all applicants for engineering

specialties have average USE score of approximately 55 points, which, in fact, corresponds to mark “satisfactory” in school disciplines of natural profile.

The key problem of Russian HEIs is also their “disconnect” from real sector of economic, contemporary achievements of science and technique. Due to this, implementation of target measures directed at harmonization of these phenomena and processes in result of construction of net relations with external and internal environment of universities is required.

Stating the foregoing, it may be noted that existing system of innovation and technological development of RF is significantly under-financed. Result of all considered phenomena characterizing major parameters of research and development sphere of Russian economic development is a low level of effectiveness of functioning of Russian HEIs, the core generators of researches and scientific developments. According to data of Center for Strategic Research and Higher School of Economics Report, “...today, Russia participates in less than 5% of those research areas that are developing in global market of researches and innovations most actively. There is a sharp lag in quantity of filed patents (40 thousand in Russia vs. 1300 thousand in China in 2017”.

It seems that inertial development of higher education system in Russia in existing conditions would not allow the transition of RF economic into trajectory of accelerated technological development. Along with this, predicted trajectory of sequential long-term economic cycle, which stage of revival is expected in RF in 2016-2020 (Figure 2) would anyway promote transformation of re-production processes in national economic. However, quality of such changes may largely not comply with progressive technologies of development of than moment, based, as was previously noted, on tools of total digitalization of operational processes and creation of new forms of labor organization.

## 5 Conclusions

Higher education system is a connecting link that is able and should provide quality transition of Russian economic in fairway off fourth industrial revolution and forming stable basics of economic growth. However, for occurrence of this process, a significant reevaluation of values and development formats of higher school and all educational system in general. And first of all, institutionalization of new working processes and results, new principles of higher school organization, oriented at growth of existing and new progressive scientific school, activation of commercial activity in scientific environment, development of innovation culture is required.

Elimination of stated problems in higher school sphere would allow to create the basis promoting more progressive and accelerated development of national economic in period of sequential long-term economic cycle; now national economic system is at its beginning.

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