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RUSSIAN FEDERATION AND THE CZECH REPUBLIC: A DYNAMIC VIEW OF SUSTAINABLE DEVELOPMENT

The concept of socio-economic systems' sustainable development has been developed by the world community. One of the most important areas is the methodology improvement for the assessment of sustainable development. Most of the existing indicators` systems are static and do not allow to estimate the dynamics of the balance level of social, economic and environmental components indicators. Considering sustainable development as a dynamic process, the author proposes to use the method of dynamic standards. In this article, new method of estimating comparative dynamics tempo characteristics of sustainable development indicators of the national socio-economic systems is proposed. The equilibrium dynamics of sustainable development indicators – social, economic and environmental of the Russian Federation and the Czech Republic for 2005-2012 are analyzed on the base of proposed method. The results of the study revealed an imbalance in the ratio of individual social, economic and environmental indicators' tempo characteristics. Problems of struggle against the environmental consequences of economic activity, implementation of resource and environmentally friendly technologies, reducing the rate of environmental pollution, measures intensification for reducing the incidence of population, income growth and decent of living standard are actual for both countries. The research results can provide the basis for the elaboration of sustainable development programs for the Russian Federation and the Czech Republic.

Keywords: *sustainable development, sustainable development indicators, assessment of sustainable development*.

JEL Code: R 1

Introduction. Active evolution of the sustainable development concept at the international level is caused by the systemic crisis of civilization. A large number of ecosystems, economic sectors and geographical areas of the modern world is inherent in unsustainable development. It reveals in the forest area reduction, natural soil fertility reducing, depletion of productive oceans` resources, expanding the fossil fuels use, global warming, etc. Within sustainable development concept, a biosphere is not considered as a resource supplier, but as a life foundation, ensuring the operation of socio-economic systems. This concept implies a balanced combination of material wealth capacity to the protection of the environment and observance of social equality and justice.

Sustainable development is regarded as a set of processes for positive changes and technologies implemented these changes aimed at harmonizing the relations between economic, environmental and social spheres in order to meet the needs of socio-economic system in the long-term existence [3]. To characterize the sustain-

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able development as a dynamic process an adequate system of indicators to assess the dynamics of indicators of economic, social and environmental spheres, as well as the extent of the unevenness of their development is required. It is to noted that a great number of researchers study dynamic approach to sustainable development. Thus, Rehma Mumtaz and co-authors within the research of the relationship between changes in the main macroeconomic indicators and changes in electricity consumption studied a comparable dynamics of sustainable development indicators [5]. A dynamic game model of environmental pollution in the process of economic interaction between the countries was examined in the work of Akihiko Yanase [1]. The long-term trends of consumption in the industrialized and in developing countries aimed at the reducing per capita levels of resource use and sustainable long-term development was investigated by Sanwal Mukul [6].

1. ***Description of the method.*** In this paper, the author proposes method of dynamic standards for evaluating sustainable development of socio-economic systems. The method was first proposed in 1980 [7]. The theoretical basis of the method was generated in 1991 [4]. The possibility of its application in the sustainable development evaluation of socio-economic systems was justified in 2013 [9]. Dynamic assessment technique for sustainable development of socio-economic systems was applied in 2014 [8], and then adapted for industrial enterprises in 2014 [2].

The method is based on the use of ranked tempo characteristics of indicators. The rate of change indicators can be used as the tempo characteristics. Dynamic standard is a reference dynamic model of continuous changes of the basic sustainable development indicators and is considered to be the best mode of system operation. The efficiency of the system is estimated by comparing the reference and actual conditions of its operation.

The method of dynamic standards provides the following:

- forming a dynamic model of a normative (standard) activity mode;
- revealing an actually existent mode of activity and development of its dynamic model;
- comparing these two modes, measure of similarity between their quantitative and qualitative assessments that is actually considered to be a level of effectiveness;
- analyzing and interpreting the obtained results in order to substantiate management decisions for the future period for the purpose of bringing the system's standard and actual operation modes together.

The advantages of dynamic standards method are as follows:

- This method allows to form the indicators body which reflect different (economical, social and ecological) functioning aspects of complex systems and get integral value of its activity;

- Every indicator keeps its own role, the effect of mutual elimination of "positive" and "negative" changes of their values can be avoided;
- To compare in dynamics the indicators which can not be compared in statics (for example compare quantitative and qualitative indicators, indicators with different units of measurement) and give full quantitative and qualitative analysis of the results of system's functioning having only limited set of basic indicators;
- To provide simultaneously evaluation, diagnostics and effectiveness analysis of social-economic systems` functioning;
- Interpret the results in order to give grounds for management decisions for future period to converge benchmark and current modes of system's functioning.

Besides that the advantage of this method is its flexibility because dynamic norms if necessary can be easily transformed by change of set of indicators and the way of putting them in order in the benchmark model of functioning mode.

2. *Dynamic models*. The complex dynamic standards is formed for each sustainable development sphere (economic, environmental and social), as well as between the spheres.

The balance in the dynamics of basic indicators for the economic sphere can be estimated on the base of the following system of inequalities:

$$\begin{cases} t_{GDP} > t_{GFCF} > 100\ \% > t_{CGD\ \%GDP}, \\ t_{GDP} > t_{GFCF} > 100\ \% > t_{ME\ \%GDP}, \\ t_{GDP} > t_{RDE} > 100\ \% > t_{CGD\ \%GDP}, \\ t_{GDP} > t_{RDE} > 100\ \% > t_{ME\ \%GDP}, \\ t_{GDP} > t_{NBR} > 100\ \% > t_{TTR}, \end{cases} \quad (1)$$

where t_{GDP} is the rate of change in GDP (current US$); t_{GFCF} is the rate of change in a Gross fixed capital formation (current US$); $t_{CGD\ \%GDP}$ is the rate of change in a Central government debt, total (% of GDP); $t_{ME\ \%\ GDP}$ is the rate of change in a Military expenditure (% of GDP); t_{RDE} is the rate of change in a Research and development expenditure (% of GDP); t_{NBR} is the rate of change in a New businesses registered (number); t_{TTR} is the rate of change in a Total tax rate (% of commercial profits).

These inequalities are the dynamic standards that reflect the subordinate order of indicators. In particular, the rate of change of gross fixed capital in excess of 100% reflecting the growth of economic potential. In this case, the rate of change of GDP, exceeding the rate of change of gross fixed capital formation, shows the growth of efficiency in the use of capital. These processes should not be accompanied by increasing levels of debt of the central government and the

military expenditure in relation to GDP. In addition, sustainable development requires the growth of spending on research and development, and advancing towards rising cost of GDP for the purpose of increasing the return on costs in the innovation sphere.

Reference dynamics of the social sphere indicators can be reflected by the following system of inequalities:

$$\begin{cases} t_{LE} > 100\ \% > t_{PH}, \\ t_{LE} > 100\ \% > t_{GINI}, \\ t_{EE\ \%GDP} > 100\ \% > t_{\%U}, \\ t_{EE\ \%GDP} > 100\ \% > t_{GINI}, \\ t_{EE\ \%GDP} > 100\ \% > t_{PH}, \\ t_{FCE} > t_{PG} > 100\ \% > t_{DR}, \\ t_{FCE} > t_{PG} > 100\ \% > t_{T}, \\ t_{FCE} > t_{PG} > 100\ \% > t_{IH}, \\ t_{TTS} > t_{HE} > 100\ \% > t_{T}, \end{cases} \quad (2)$$

where t_{LE} is the rate of change in life expectancy at birth, total (years); t_{PH} is the rate of change in poverty headcount ratio at $2 a day (PPP) (% of population); t_{GINI} is the rate of change in GINI index (World Bank estimate); $t_{EE\ \%GDP}$ is the rate of change in education expenditure (current US$); $t_{\%U}$ is the rate of change in unemployment, total (% of total labor force) (modeled ILO estimate); t_{FCE} is the rate of change in final consumption expenditure (current US$); t_{PG} is population growth (annual %); t_{DR} is the rate of change in death rate, crude (per 1,000 people); t_{T} is the rate of change in tuberculosis case detection rate (%, all forms); t_{IH} is the rate of change in Intentional homicides (per 100,000 people); t_{TTS} is the rate of change in tuberculosis treatment success rate (% of new cases); t_{HE} is the rate of change in health expenditure per capita (current US$).

Social sustainability implies the improvement of the level and quality of life. Reference dynamics of indicators provides for an increase in life expectancy at birth, final consumption expenditure, reducing poverty, mortality, morbidity, the social stratification by income level. The change in the population must be accompanied by anticipating growth of final consumption expenditure and spending on health should be accompanied by the growth of social benefits, in particular anticipating growth of successful treatment of socially significant diseases. Increased spending on education

contributes to the cultural level and social responsibility of people increases the chances of finding a new high-paying jobs.

Reference dynamics of environmental spheres indicators can be reflected by the following system of inequalities:

$$\begin{cases} 100\ \% > t_{\text{NRD \% GNI}}, \\ 100\ \% > t_{\text{CO2}}, \\ 100\ \% > t_{\text{PED}}, \\ t_{\text{AE}} > 100\ \% > t_{\text{EPC}}, \\ t_{\text{EPR}} > 100\ \% > t_{\text{EPC}}, \end{cases} \quad (3)$$

where $t_{\text{NRD \% GNI}}$ is the rate of change in the value of natural resource depletion (% of GNI); t_{CO2} is the rate of change in CO_2 emissions (metric tons per capita); t_{PED} is the rate of change in particulate emission damage (current US$); t_{AE} is the rate of change in alternative and nuclear energy (% of total energy use); t_{EPC} is the rate of change in electricity production from coal sources (% of total); t_{EPR} is the rate of change in electricity production from renewable sources, excluding hydroelectric (% of total).

Ordering dynamic model of sustainable development indicators involves the need to reduce the depletion rate of natural resources, carbon dioxide emissions and particulate matter, the expanding use of alternative and renewable energy sources and a reduction in electricity production from coal sources.

Dynamic standard model for the socio-economic sphere can be reflected by the system of inequalities:

$$\begin{cases} t_{\text{GDPpc}} > t_{\text{PG}} > 1{,}0 > t_{\%\text{U}}, \\ t_{\text{GDPpc}} > t_{\text{PG}} > 1{,}0 > t_{\text{GINI}}, \\ t_{\text{GDPpc}} > t_{\text{PG}} > 1{,}0 > t_{\text{PH}}, \end{cases} \quad (4)$$

where t_{GDPpc} is the rate of change in GDP per capita (current US$).

This model provides that the achievements in the economic sphere, expressed growth in GDP per capita should outpace population growth, contributing to the reduction of unemployment, poverty and the degree of social stratification by income level.

Reference subordination dynamic tempo characteristics of sustainable development indicators in ecological and economic sphere can be reflected by a system of inequalities:

$$\begin{cases} t_{GDP} > t_{NRD\ \%\ GNI}, \\ t_{GDP} > t_{PED}, \\ t_{GDP} > t_{EU}, \\ t_{GDPpc} > t_{CO2}, \\ t_{GDPpc} > t_{EUpc}, \\ t_{GDPue} > 100\ \%, \\ t_{RDE} > 100\ \% > t_{PED}, \\ t_{RDE} > 100\ \% > t_{EU}, \end{cases} \quad (5)$$

where t_{EU} is the rate of change in energy use (kg of oil equivalent) per $1,000 GDP; t_{EUpc} is the rate of change in energy use (kg of oil equivalent per capita); t_{GDPue} is the rate of change in GDP per unit of energy use (PPP $ per kg of oil equivalent).

According to sustainable development ecological and economic dynamic model shows that GDP growth should not be accompanied by a faster rate of depletion of natural resources, emissions and energy consumption leading growth. The growth of per capita GDP should not be accompanied by advance growth of CO_2 emissions per capita and leading growth of energy consumption per capita. Expenditure on research and development have to be accompanied by a decrease of pollution and energy consumption. Sustainable economic development have to be accompanied by an increase of energy efficiency (increase in GDP per unit of energy use).

Reference dynamics of the social and environmental spheres indicators can be reflected by the following system of inequalities:

$$\begin{cases} t_{PG} > t_{NRD\ \%\ GNI}, \\ t_{PG} > t_{PED}, \\ t_{PG} > t_{CO2}, \\ t_{EE\ \%GDP} > t_{NRD\ \%\ GNI}, \\ t_{EE\ \%GDP} > t_{PED}, \\ t_{EE\ \%GDP} > t_{CO2}. \end{cases} \quad (6)$$

The model suggests that population growth should not be accompanied by outrunning growth of the depletion of natural resources and polluting emissions. At the same time increase the level of spending on education contributes to the cultural level and social responsibility of people, restrains the growth of the natural resources depletion and emissions of pollutants which associated by the population growth.

3. Description of the technique of data processing**.** The above inequalities characterize the dynamics of the reference indicators of sustainable development. For comparison, the actual dynamics of the reference inequalities must be transformed into a matrix form. Matrix reference ordering sroitsya follows:

$$\mathrm{M[SI]} = \{\mu_{ij}\},$$
$$\mu_{ij}\begin{cases}1, \text{if } t^s(i) > t^s(j), \text{and } i = j,\\ -1, \text{if } t^s(i) < t^s(j),\\ 0, \text{if the normative ordering between}\\ t^s(i) \text{ and } t^s(j) \text{ has not beet found,}\end{cases} \quad (7)$$

where μ_{ij} is an element of the standard ordering matrix; i and j are the numbers of indicators, and t^S (i) and t^S (j) are the normative rates of change in the indicators i and j.

For the actual order, an analogous matrix M[AI] $=\{\eta_{ij}\}$ is built according to the same rules. Similarity measure the reference and the actual matrix is given by:

$$S = \left(1 - \frac{1}{2K}\sum_{i=1}^{n}\sum_{j=1}^{n}|\mu_{ij} - \eta_{ij}|\right)\cdot 100\,\%, \quad (8)$$

where μ_{ij} is the element of the matrix in the intersection of the ith line and jth column M[SI]; η_{ij} is the element of the matrix in the intersection of the ith line and jth column M[AI]; K is the number of nonzero cells in M[SI] without taking the cells in the major diagonal into account.

The measure of similarity (S) shows the share of coinciding relationships (inequalities) in the total amount of the established relationships; it can take the values of from 0% (there is no similarity between M[SI] and M[AI]) to 100% (M[SI] and M[AI] completely coincide).

4. ***Data*****.** Reliable source of analysis is an important factor that affects the quality results. For the study statistical data provided by the World Bank website were used.

5. ***Results and discussion*****.** The results showed that the similarity measure for the years 2005-2012 was 76.99% for the Czech Republic and 84.07% for the Russian Federation. Thus, in general, the dynamics of indicators characterized as

balanced. However, the studies have shown that the dynamic balance is not the same by the spheres. The similarity measure of social sphere amounted to 82.05% for the Czech Republic and to 79.49% for the Russian Federation respectively. The similarity measure of ecological sphere accounted for 77.78% for the Czech Republic and to 66.67% for the Russian Federation. As for the economic sphere, the similarity measure made up 77.05% for the Czech Republic and to 90.00% for the Russian Federation. The results indicate priority of economic sphere for the Russian Federation, and of social one – for the Czech Republic in management decisions concerning the development path.

The study also shows that within 2005-2012 dynamic tempo characteristics of sustainable development has been subject to considerable fluctuations in the Czech Republic (Fig. 1), and in the Russian Federation (Fig. 2).

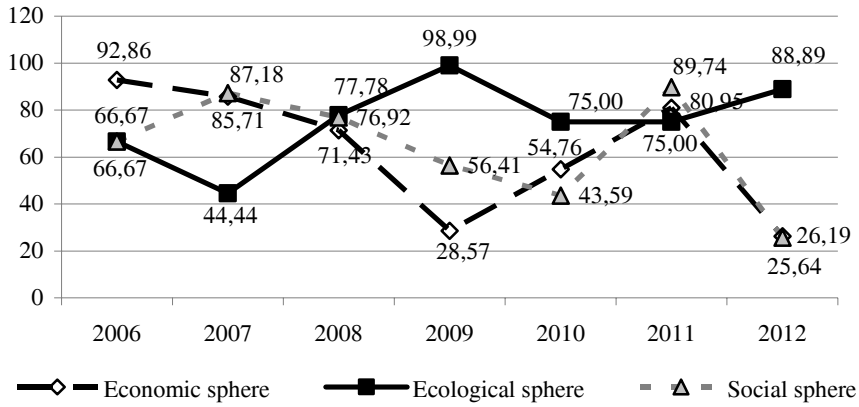

Fig. 1. Dynamics of balance tempo characteristics of sustainable development indicators for the Czech Republic (economic, ecological and social)

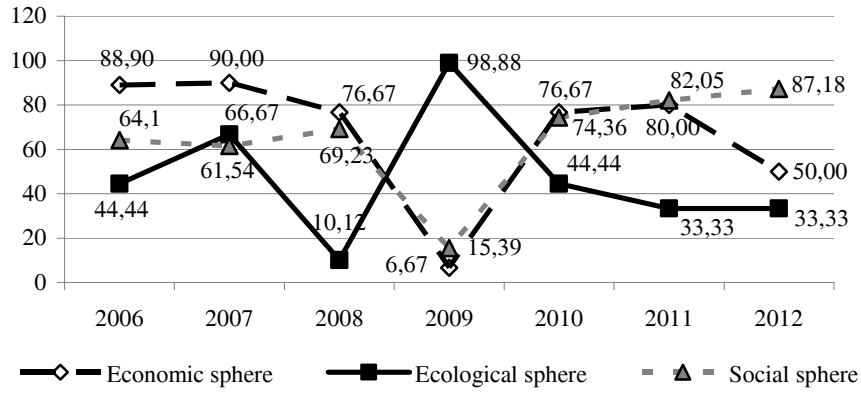

Fig. 2. Dynamics of balance tempo characteristics of sustainable development indicators for the Russian Federation (economic, ecological and social)

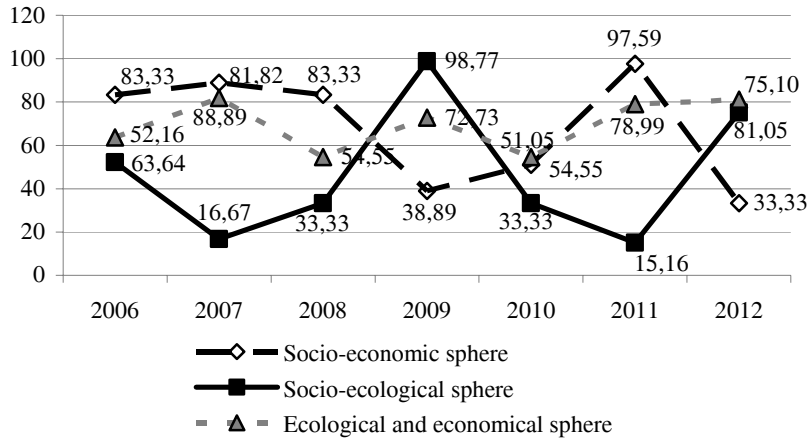

Fig. 3. Dynamics of balance tempo characteristics of sustainable development indicators between social, ecological and economic spheres in the Czech Republic

The graphs show a reduction of balance indicators of the economic component in 2008-2009, in both countries. Adverse trends in the balance of economic and ecological components are marked. The decrease of the dynamic balance in the economic sphere, accompanied by an increase of the level in the environmental sphere.

Significant fluctuations within the balance level assessment in the dynamics between the sustainable development spheres in the Czech Republic (Fig. 3), and in the Russian Federation (Fig. 4) were noticed.

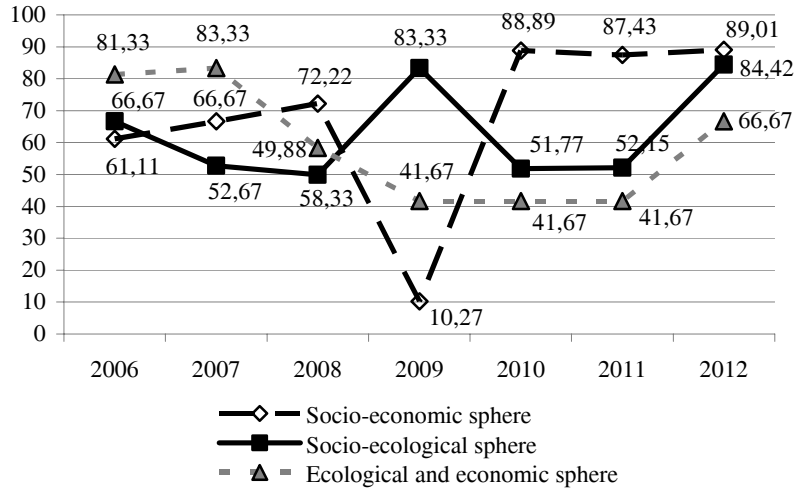

Fig. 4. Dynamics of balance tempo characteristics of sustainable development indicators between social, ecological and economic spheres in the Russian Federation

The application of the dynamic standards for assessing sustainable development has enabled to select the following steadily appearing inconsistencies between the actual and reference dynamics of the indicators. Thus, in both countries, the rate of natural resources depletion and pollutants emissions outpacing population change; the number of new businesses do not provide outstripping GDP growth; tuberculosis bursts are periodically observed; and the rate of success change of the tuberculosis treatment is kept pace with changes in the magnitude of health spending per capita. Increase of government debt as a percentage of GDP, outpacing growth of the damage caused by emissions of solids polluting in compared with GDP growth and accelerated depletion of natural resources are typical for the Czech Republic. In Russian Federation rate of gross fixed capital exceeds the growth rate of GDP, indicating the decrease of capital productivity in the economy; the rate of change in CO_2 emissions per capita are ahead of the rate of population change, the increase in the degree of stratification of the population by income level is not overcame.

The results are to be considered for the elaboration mechanisms and activities towards sustainable development. T. Yigitcanlar and S. Teriman underline the importance of integral planning and process of potential generation for the further support of the progress towards sustainability development of socio-economic systems [10].

Conclusion. The results of the study indicate the need to develop the scientifically grounded programs for sustainable development that ensure the compliance of the proposed measures to the conditions of functioning and real needs of the national economic systems, which are aimed at changing their functioning mode towards sustainable development.

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РОССИЙСКАЯ ФЕДЕРАЦИЯ И ЧЕШСКАЯ РЕСПУБЛИКА: ДИНАМИЧЕСКИЙ ВЗГЛЯД НА УСТОЙЧИВОЕ РАЗВИТИЕ

Концепция устойчивого развития социально-экономических систем активно разрабатывается мировым сообществом. Одним из важнейших направлений является совершенствование методологии оценки устойчивого развития. Большинство существующих на данный момент систем индикаторов являются статичными и не позволяют оценивать в динамике уровень сбалансированности показателей социальной, экономической и экологической составляющих. Рассматривая устойчивое развитие в качестве динамического процесса, автор статьи предлагает использовать метод динамических нормативов. Автором предложена новая методика оценки сопоставительной динамики темповых характеристик индикаторов устойчивого развития национальных социально-экономических систем. С использованием данной методики проанализирована сбалансированность динамики социальных, экономических и экологических индикаторов устойчивого развития Российской Федерации и Чешской Республики за 2005–2012 годы. По результатам исследования выявлен дисбаланс в соотношениях темповых характеристик отдельных социальных, экономических и экологических индикаторов. Для обеих стран актуальными являются проблемы борьбы с экологическими последствиями хозяйственной деятельности, внедрения ресурсо- и природосберегающих технологий, снижения темпов загрязнения окружающей среды, усиления мер по снижению заболеваемости населения, росту доходов и обеспечению достойного уровня жизни. Полученные результаты исследования могут служить основой для разработки программ устойчивого развития Российской Федерации и Чешской Республики.

Ключевые слова: *устойчивое развитие, индикаторы устойчивого развития, оценка устойчивого развития*.

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