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CLASSIFICATION OF GDP GROWTH IN KAZAKHSTAN

This article analyzes the stochastic dynamics of the GDP of the Republic of Kazakhstan using applied problems, economic and mathematical models and using statistics from the World Bank. By structural characteristics, such as: building a trajectory of equilibrium growth, adjusting values by Fibonacci levels, frequency of time intervals, measuring the characteristics of the limiting structure, determining the environment of the economic mass, creating indicators of statistical control data, analyzed the behavioral characteristics and structures of aggregated agents at all stages of growth GDP and economy.

Keywords: GDP, growth, behavior, classification, structure, indicator.

Introduction

It is known that a wide range of reviews of using economic and mathematical models for solving many applied problems of both stock markets and economic growth in the real sector are given in works [1–9], in particular, the average model with a constant dispersion measure [1], methodologies of difference equations [2], models of actuarial payments [3], econometric modeling [4], models of the function of conditional expectation [5–7], as well as estimates of the negative effects of growth [8] and finance [9].

In this paper, based on the above research, we will classify the stochastic dynamics of Kazakhstan's GDP based on the World Bank statistical data [10] both by structural characteristics - trajectories of equilibrium growth, and by behavioral characteristics – target economic trajectories. agents.

To build a trajectory of equilibrium growth, it is necessary to construct a number of structures, for the beginning we identify the periods of complete stochastic cycles, for example, using the Fibonacci number at levels 3, 5, 8, 13; 21 on the basis of the growth dynamics of the GDP of the Republic of Kazakhstan for the period of 1990–2017. in current dollar prices.

Methods

Further, using the source [10] statistical data on the observation of the GDP of the Republic of Kazakhstan (hereinafter y_{t+T} , see Fig. No. 1, designated as a circle with fills, billion US dollars), we renumber the sequence of times $t+T$ as a sequence of groups of time intervals $(\overline{t+T})_{y_{t+T}}$ according to the following formula (1):

$$(t+T)_{y_{t+T}} = \frac{\text{SUMPRODUCT}(j; y_j)}{\text{SUMPRODUCT}(1_j; y_j)}, j = \overline{t+1, t+T}. \quad (1)$$

Then, ranking the values (1) by the Fibonacci levels of 3, 5, 8, 13 and 21, we obtain the regrouped time intervals of stochastic cycles (hereafter – $(\overline{t+T})_{y_{t+T}}$), characterizing the complete y_{t+T} stochastic dynamics cycles consisting of five time intervals $(\overline{t+T})_{y_{t+T}} = 3; 5; 8; 13; 21$, indeed, on the basis of calculations using formula (1), we have:

$$(1991; 1995)_{y_{t+T}} = 2.89 < 3, (1996; 1999)_{y_{t+T}} = 4.78 < 5, (2000; 2004)_{y_{t+T}} = 7.94 < 8, (2005; 2008)_{y_{t+T}} = 12.74 < 13 \text{ and } (2009; 2017)_{y_{t+T}} = 19.87 < 21.$$

Also, we will build the Nominal structure of the GDP of the Republic of Kazakhstan (hereinafter – $\hat{y}_{t+T}$) as the average value of observation y_{t+T} , at time intervals $(\overline{t+T})_{y_{t+T}}$ according to the following formula (2); note that the values $\hat{y}_{t+T}$ form a kind of economic mass of a moving force y_{t+T} , both throughout (1991; 2017) and five intervals of time $(\overline{t+T})_{y_{t+T}}$:

$$\hat{y}_{t+T} = \begin{cases} \text{AVERAGE}(y_{t+T}), t+T = \overline{1991; 1995}, \\ \text{AVERAGE}(y_{t+T}), t+T = \overline{1996; 1999}, \\ \text{AVERAGE}(y_{t+T}), t+T = \overline{2000; 2004}, \\ \text{AVERAGE}(y_{t+T}), t+T = \overline{2005; 2008}, \\ \text{AVERAGE}(y_{t+T}), t+T = \overline{2009; 2017}. \end{cases} \quad (2)$$

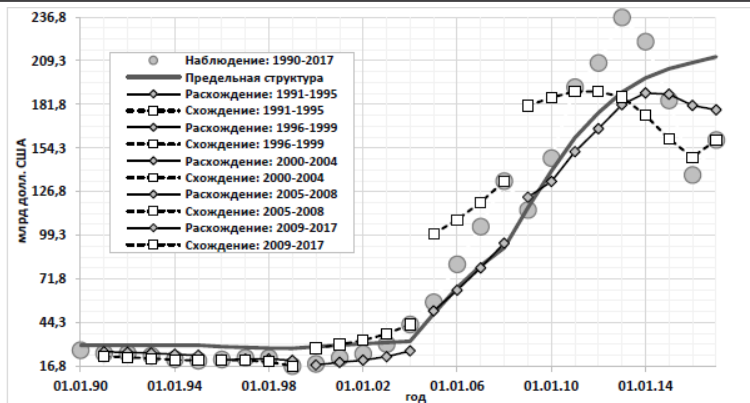


Figure 1 – Classification results of the dynamic development of the GDP of Kazakhstan at current prices, billion US dollars, 1990–2007: marginal structure, divergence and convergence indicators
Source: Compiled by the author on statistical data [10].

Next, we define the Economic Mass Center (hereinafter – $\bar{y}_{t+T}$) of the moving force y_{t+T} according to the nominal structure $\hat{y}_{t+T}$ for all observation times (1991; 2017) the weighted average value $\hat{y}_{t+T}$ with y_{t+T} weight with $t = y_{1995}$ center (see (3)):

$$\bar{y}_{t+T} = \frac{\text{SUMPRODUCT}(y_{t+T}; \hat{y}_{t+T})}{\text{SUMPRODUCT}(1_{t+T}; y_{t+T})} \quad t = 1995 \quad t + T = 1991; 2017 \quad (3)$$

From where we have the opportunity to build and measure the characteristics of the limit structure (hereinafter – $\tilde{y}_{t+T}$ – the trajectory of the equilibrium growth of GDP of the Republic of Kazakhstan, see Fig. No. 1, solid line) of the moving force y_{t+T} on the structure of the center of economic mass $\bar{y}_{t+T}$ as an econometric model of statistical data for observing GDP RK y_{t+T} by the factor sign $\bar{y}_{t+T}$ – the center of economic mass of the moving force y_{t+T} , and the results of estimating the parameters by the least squares method are given in (4):

$$\tilde{y}_{t+T} = -4.2239 + 1.4923 \bar{y}_{t+T}, \quad t = 1990, \\ R^2 = 0.8903 \quad (7.705) \quad (0.103) \quad T = 0, 1, \dots, 27$$

Now, we will construct a series of target trajectories indicators of national economy agents, we will start with the Divergence indicator of statistical data

for observing the GDP of the Republic of Kazakhstan (hereinafter – $y_{t+T}^{\text{Divergence}}$, see Fig. No. 1, a solid line with a diamond shaped marker); along the marginal structure of the moving force y_{t+T} at time intervals of stochastic cycles $(\overline{t+T})_{y_{t+T}}$ as the weighted average value of y_{t+T} with $\tilde{y}_{t+T}$ weight with a fixed initial summation time at t (see. (5)):

$$y_{t+T}^{\text{Divergence}} = \frac{\text{SUMPRODUCT}(\tilde{y}_{t+T}; y_{t+T})}{\text{SUMPRODUCT}(1_{t+T}; \tilde{y}_{t+T})} \quad t + T = \overline{(t, t+T)}_{y_{t+T}} \quad (4)$$

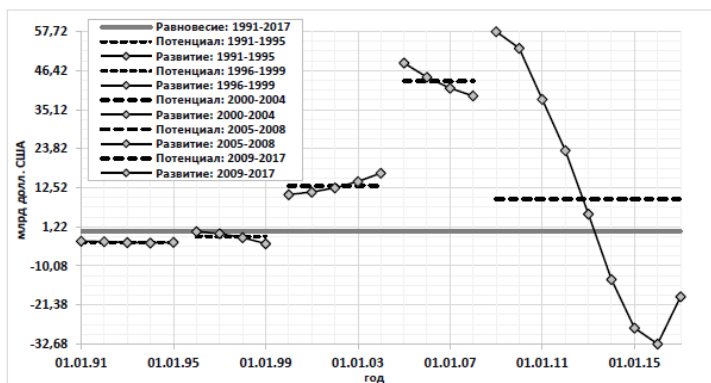


Figure 2 – Results of a systematic study: potential and dynamics of development GDP of RK at current prices, billion US dollars, 1990–2017

Source: Compiled by the author on statistical data [10]

Then, we will build the Convergence indicator of statistical data of GDP of the Republic of Kazakhstan (hereinafter – $y_{t+T}^{\text{Convergence}}$, see Fig. No. 1, dashed line with a square shaped marker) along the marginal structure of the moving force y_{t+T} on time intervals of stochastic cycles $(\overline{t+T})_{y_{t+T}}$ the weighted average value of y_{t+T} with $\tilde{y}_{t+T}$ weight with a fixed finite summation time at T (see (6)):

$$y_{t+T}^{\text{Convergence}} = \frac{\text{SUMPRODUCT}(\tilde{y}_{t+T}; y_{t+T})}{\text{SUMPRODUCT}(1_{t+T}; \tilde{y}_{t+T})}, \quad t + T = \overline{(t, t+T)}_{y_{t+T}} \quad T = \text{fixed} \quad (6)$$

Also, we will build the Development indicator of statistical data of observation of GDP of the Kazakhstan Republic (hereinafter – $y_{t+T}^{\text{Divergence}}$, see Fig. No. 2, solid line with a diamond shaped marker) as the difference of Convergence

and Divergence of y_{t+T} moving force on the time intervals of stochastic cycles $(t+T)_{y_{t+T}}$ (see (7)):

$$y_{t+T}^{\text{Development}} = y_{t+T}^{\text{Convergence}} - y_{t+T}^{\text{Divergence}}, t+T = (\overline{t, t+T})_{y_{t+T}} \quad (7)$$

In conclusion, we construct the Potential indicator of statistical data of observation the GDP of the Kazakhstan Republic (hereinafter – $y_{t+T}^{\text{Divergence}}$, see Fig. No. 2, dashed line) as the arevage value of the Development indicator of y_{t+T} moving force on the time intervals of stochastic cycles $(t+T)_{y_{t+T}}$ (see (8)):

$$y_{t+T}^{\text{Potential}} = \text{AVERAGE}(y_{t+T}^{\text{Development}}), t+T = (\overline{t, t+T})_{y_{t+T}} \quad (8)$$

Results

Thus, the constructed time intervals $(\overline{t+T})_{y_{t+T}}$ of stochastic cycles (1), the nominal structure $\hat{y}_{t+T}$ (2), the center of economic mass $\bar{y}_{t+T}$ (3) and the marginal structure $\tilde{y}_{t+T}$ – an econometric model (4) of the moving force of GDP of the Kazakhstan Republic in the current US dollars for 1990–2017 allows to classify the stochastic growth dynamics according to the structural and behavioral characteristics of the aggregated agents of the national economy, which also allows the following conclusions:

- the moving force of GDP for a period of time 1991–1995 created the situation the phase of correction of the stochastic cycle with values for indicators: Divergences (5) – an increase of \$ 124.415 billion (see Fig. No. 1), Convergence (6) – an increase of \$ 108.3015 billion (see Fig. No. 1), Development (7) – did not prioritize the national economy by \$ 16.1 billion (see Fig. No. 2), and the Potential indicator (8) – cooled the national economy at \$ 3.22 billion from standard deviation of \$ 0.208 billion (see Fig. No. 2);

- moving force of GDP for the period 1996-1999. created the situation of the phase-falling of the stochastic cycle with values for the indicators: Divergences (5) – an increase of 83.815 billion US dollars (see Fig. No. 1), Convergence (6) – an increase of 77.358 billion US dollars (see Fig. No. 1), Development (7) – did not underestimate the national economy by \$ 6,457 billion (see Fig. No. 2), and the Potential indicator (8) – cooled the national economy at the level of \$ 1.614 billion. with a standard deviation of \$ 1.545 billion (see Fig. No. 2);

- moving force of GDP for the period of 2000-2004 created the situation of revitalization phase of the stochastic cycle with values for indicators: Divergences (5) – an increase of \$ 106.523 billion (see Fig. No. 1), Convergence (6) – an increase of \$ 171.821 billion (see Fig. No. 1), Development (7) – overestimated

the national economy by \$ 65.298 billion (see Fig. 2), and the Potential indicator (8) – overheated the national economy at \$ 13.06 billion from a standard deviation of \$ 2.507 billion (see Fig. 2);

– the moving force of GDP for the period 2005-2008 created the situation of phase of growth in the stochastic cycle with values for indicators: Divergences (5) – an increase of \$ 289.484 billion (see Fig. 3), Convergence (6) – an increase of \$ 462.908 billion (see Fig. 3); Development (7) – overestimated the national economy by \$ 173.424 billion (see Fig. 4), and Potential indicator (8) – overheated the national economy at \$ 43.356 billion. With a standard deviation of US \$ 4.134 billion (see Fig. 2);

– the moving force of GDP for the period 2009-2017 created the situation of phase of correction of the stochastic cycle with values for indicators: Divergences (5) – an increase of \$ 1,493.367 billion (see Fig. 1), Convergence (6) – an increase of \$ 1,576.381 billion (see Fig. 1); Development (7) – overestimated the national economy by \$ 83.014 billion (see Fig. 2), and Potential indicator (8) – estimated the national economy at \$ 9.224 billion. With a standard deviation of US \$ 34.971 billion (see Fig. 2).

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Классификация роста ВВП в Казахстане

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Мақалада қолданбалы есептерді пайдаланып экономикалық және математикалық моделдерді қолдана отырып, Бүкіләлемдік банктен алынған статистикалық деректерді еліміздің жалпы ішкі өнімінің стохастикалық динамикасының сыныпталуы қарастырылды. Онда құрылымдық сипаттамалары бойынша – тепе-теңдік өсу траекториясын құру, Фибоначчи деңгейлері бойынша мәндерін реттеу, уақыт аралығының жиіліктері, шекті құрылымның өлішем сипаттамасы, экономикалық массалық ортасын анықтау, статистикалық бақылау деректерінің индикаторын құру, сондай-ақ ЖІӨ-нің барлық өсу фазалары мен экономикасындағы агрегирленген агенттердің мінезқұлық сипаттамалары мен құрылымдарына талдау жасалынды.

Кілтті сөздер: ЖІӨ, өсу, мінезқұлық, сыныптау, құрылым, индикатор.

В данной статье анализируется стохастическая динамика ВВП Республики Казахстан с применением прикладных задач, экономико-математических моделей и с использованием статистических данных Всемирного банка. По структурным характеристикам, таким, как: построение траектории равновесного роста, корректировка значений по уровням Фибоначчи, частотность временных интервалов, измерение характеристик предельной структуры, определение среды экономической массы, создание индикаторов статистических данных контроля, проанализированы поведенческие характеристики и структуры агрегированных агентов на всех этапах роста ВВП и экономики.

Ключевые слова: ВВП, рост, поведение, классификация, структура, индикатор.

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