The Methodological Aspects of Forecasting and the Analysis of Macroeconomic Indicators

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Abstract

Purpose – The main research goals by macroeconomic analysis is to assess the effectiveness of state regulation, the sustainability of development, and the financial stability of the state.

Research design, Data, and methodology – The research were analyzed using the methods of multivariate statistics and application of the software package Stat graphics. The volume of data from the 1995 to the 2021 was analyzed by Russian Federation. The scale of research on Belarus: to be analyzed the amount of data from the 2015 by 2021, on Kazakhstan – from the 19941, on Kyrgyzstan - from the 2002, on Tajikistan – from the 2008, on Armenia – from the 2021, on Japan – since the 1970, on China – since the 1950, on South Korea - since the 1953.

Result – The methods of multivariate statistics was demonstrated exact of result in forecasting of macroeconomic indicators. The most of tendency with the accurate results of are described using the second-degree polynomials. In the most research of country there are the macroeconomic proportion are broken.

Conclusion – In the countries studied, the monetary aggregates have a significant growth rate. The shares with a substantial monetary stock and the speed of its growth are divided in the two groups: having placements in the real sectors of the economy and not having received the same result of development from the growth of the monetary stock.

Keywords: Macroeconomic Analysis, Forecast, Methods of Forecasting

JEL Classification Code: E41, E6, E58

1. Introduction

One of the main goals of macroeconomic analysis is to assess the effectiveness of state regulation, the sustainability of development, and the financial stability of the state. In the process of analysis, the continuous monitoring and forecasting of the system of indicators are carried out. The higher the accuracy of the analysis results, the more effective the study, which is largely determined by which method is used. This article is devoted to the features of the methods of analysis and forecasting. Forecasting of macroeconomic indicators is a complex and time-consuming process. The widespread use of mathematical and statistical forecasting methods is limited by a significant deviation of the forecast indicators from the actual ones. In practice, this disadvantage is usually compensated by using the simplest methods of direct counting. In this regard, it is important to systematize forecasting methods taking into account their advantages and disadvantages in relation to the studied macroeconomic indicators. Long-term research by scientists in different countries has not allowed to form a universal system of macroeconomic indicators (especially, the cost indicators), the forecasting of which allows to achieve a minimum deviation from the actual values. As a rule, researchers limit themselves to trying to predict individual thematic indicators (Eckert, 2021; Alfonso Perez, 2021; Neunhoeffer, 2021; Wang, 2017; Zhang, 2014). At the same time, the forecast results still give a significant deviation that is not acceptable in practice.

The long-term monitoring of macroeconomic indicators (Vyborova, 2017a; Vyborova, 2017b; Vyborova, 2017c; Vyborova, 2018) has allowed us to come close to creating a system of indicators (Appendix A), which, combined with methods of multidimensional statistics, allow us to achieve a good result in terms of practical use. Within the framework of this work, the goal is not only to demonstrate the main results of the study, but also to present a theoretical and methodological overview that would be useful not only in practice, but also in scientific and pedagogical activities.

2. Literature Review: The Result of Theoretical Research.

2.1. The Historical Digression

The first works on forecasting appeared in the works of the "Club of Rome", where the analysis of the dynamics of the world system was considered. The origins of forecasting can be found in the works of Leonardo da Vinci, and Aristotle and other scientists.

The authors interpret the content of the basic concepts in different ways. We will stick to classical approaches. As D. Kruk notes, the forecasting has different planes of concretization: predictive (descriptive, descriptive) and other, associated with it, related to the category of management-predictive (prospective, prescriptive). In the classical form, the process of forecasting should meet at least the principles of consistency, integrity, continuity, verification, consistency and adequacy. This should be a continuous process (Table 1). The forecast should complement the other stages of the analysis and answer the question in full and with maximum accuracy.

Table 1: The forecast as an iterative process

Main stages	Additional stages, explained
1. The organizational stages - the goal of the forecast is formed, the object of the forecast is formed, the task for the forecast is made.	
2. The scientific-analytical or prognostic retrospective stages - the object of forecasting is specified, the composition and boundary of information arrays describing with sufficient accuracy the state of the object in the past before the diagnosis is determined; the optimal depth of the retrospective is established; an approximate hypothetical model of the object is created. Such models can serve as dependencies that reflect the patterns of behavior of the forecast object. At this stage, the prognostic	1. The predictive orientation, which implies the formation of goals, the research objectives, initial data about the process under consideration, the external environment, the mutual relations, the definition of possible control actions, the development of initial hypotheses about the laws of development, the methods and organization of the forecasting procedure. 2. Description of the external environment (the forecast background), which implies the identification of uncontrolled impacts on the process, their patterns and

background, understood as a set of external conditions in relation to the object of forecasting, is of significant importance. This takes into account both endogenous and the exogenous effects.	characteristics, as well as controlled impacts, clarification of the criteria and the nature of management.
3. The diagnosis - determine the possible methods of forecasting, the number of methods, the degree of approximation of the statistical set of retrospective data by various mathematical dependencies, logically, economic and mathematical analysis of the selected hypothetical models. In this case, a number of tasks are solved the identification: of the position; of changes in the state in the space-time section; of the main factors that caused the change in the object of study.	1. Building a predictive model, that is, determining the composition of its elements, characterized by certain indicators, the parameters, and establishing relationships between them that allow you to track the variability of the process and time. 2. The development of an alternative version of the forecast based on the adoption of an appropriate forecasting method (one or more). It is based on the use of a set of formalized and non-formalized techniques that allow you to transform the current state of the process into its future state.
4. The verification – the forecast is checked and its reliability is evaluated.	1. The assessment of the reliability, accuracy, validity, the development of the forecast, including its comprehensive analysis, identifying the possibility of consequences from a certain direction of the process. The one of the verification methods is a logical analysis.
5. The development of recommendations for managing the development of the process, taking into account alternative options for the impact of the external environment on it, the degree of achievement of goals with the found version of the forecast.	1. The clarification of the task for developing a new version of the forecast and conducting a new research cycle based on the results of the analysis of previous versions and newly received information about both the process itself and the external environment.

3. The Result of Methodological Research.

The classification of forecasting methods is extensive. In particular, analytical modeling is the study of a process based on the construction and use of a model that reflects its internal and external relationships in the course of development. This group of methods is used when it is possible to recreate the conditions for the development of processes through its model, and then on the basis of the available minimal information to reproduce alternative versions of its development. Models make it possible to identify certain patterns in the processes, clearly presenting the relationship of different parties.

The formalized methods focused on sufficiently complete and reliable information and the non-formalized ones are often used (Table 2). The methods of expert assessments, which are widely used, are inherently subjective. They can be divided into individual and collective. The individual methods include, for example, the "interview" method, the analytical memos, and the script writing. These methods involve independent work, which in some cases refers to the advantages of this method, each of the experts is working on a solution to the problem. The final solution in this case is determined by analyzing the expert data directly by the researcher.

Most often, statistical methods are used in research, one of which is the method of extrapolating trends. The extrapolation is the continuation of the process trends in the future, reflected in the form of dynamic series of its indicators, based on the developed regression-type models. The extrapolation is usually used when trends are expressed by retrospective data series, on the basis of which it is possible to determine the regularity of the development of the process.

There is a distinction between temporal extrapolation, that is, determining the value of a parameter outside of a fixed time interval in the future based on the knowledge of the temporal characteristics of the process within the interval, and objective, that is, transferring the mechanism of action of a law known in the field of one science to the process of phenomena studied by another science. The initial position that allows you to look into the future is a retrospective, which also depends on the initial point of view of the forecaster, his ability to take into account the limitations and possible jumps in the external environment, allows you to extrapolate to the future in one direction or another. For extrapolation, the facts of randomness and determinism are essential. The current pattern, which needs to

be transferred to the future, can be represented as the sum of the deterministic part, determined by a function of time and a random component. However, this is not the only approach to decomposing the levels of a series of dynamics into their component components. Let's consider some methods of identifying the main trend, which can be divided into the two types.

Table 2: The classification of unformalized forecasting methods of forecasting

The individual methods	The collective methods
1. The questionnaire (interviewing, survey) involves the identification of subjective opinions of individuals in order to organize, determine objective estimates of a predictive nature. This method can be used in cases where, for a number of reasons, the regularity of the development of the process cannot be reflected by the formal apparatus, either because of its excessive complexity, or because of the lack of necessary data, or for a number of other reasons. 2. The method of analytical expert notes assumes independent work of the expert on the analysis of process trends. In the course of such work, the expert can use all the necessary information. The result of the work is a report with a justification of the expected future states of the process. This method is similar to the development of an audit report. The advantage of this method is the independence of the expert's work, the ability to use any information. The disadvantage is the subjectivity that is present in the report, since the study was conducted by a single expert. As a modification of the analytical expert note, you can consider writing a script, although the latter can be much broader in terms of the range of methods used. It is based on the establishment and description of a logical sequence of situations that, based on the existing state of the process, will transfer it to another state in the future. The advantage of this method, in our opinion, is the possibility of its use in the management of financial resources, in economic modeling.	One of the widely used methods is the method of Delphi, which is a series of consistently implemented procedures aimed at preparing and justifying a forecast. It allows experts to take into account new circumstances in their responses and at the same time saves them from any pressure when defending their position. At the present stage, there are several modifications of the Delphi method. In our opinion, the application of these methods in practice would contribute to making the right decisions in terms of managing the economic resources of the enterprise. However, the use of this approach is difficult due to the lack of a sufficient number of analysts in most enterprises. The methods of expert assessments have a complex formalizability and, accordingly, poor tools used", which can be agreed with in terms of forecasting some aspects in the field of economic conditions.

The first is "mechanical smoothing", which is based on determining individual trend points using groups of neighboring (upcoming or subsequent) points. This can include smoothing a number of dynamics by enlarging the interval and applying various types of moving averages. But at the same time, the moving average method, as L. N. Kovaleva notes, with which we fully agree: "... has a number of disadvantages: the distortion of the tendency with small numerical data, difficulty in justifying the choice of the smoothing interval, etc. ".

Another type of method is called "analytical alignment". When finding a trend, it is assumed that the considered series of dynamics has some regularity, which can be revealed by a curve drawn through specific points of this series. This type of methods includes: the methods for identifying the main tendency of a series of dynamics using finite differences, least squares, Lagrange polynomials, and others (Table 3).

Table 3: The varieties of analytical alignment

Variety	Content
1. The method of elucidating the main trend of a series of dynamics using finite differences was developed and justified by such prominent scientists as O. Anderson, A. A. Chuprov, V. I. Romanovsky and others.	This method, compared to the least squares method, requires fewer different calculations. Its advantages are also obvious in terms of revealing the economic content of the phenomena under consideration (in the sense of establishing the speed and intensity of its development).

Variety	Content
	In addition, this method allows you to take into account the influence of the previous level of the series on the subsequent ones.
2. The alignment of the dynamic's series using *the Lagrange's polynomial.*	Assumes that the level of a series of dynamics does not have sharp regular fluctuations. The number of terms of the polynomial and its degree depend on the number of terms of the series taken to determine the trend. The application of the formula of Lagrange is associated with cumbersome calculations, which is very difficult for dynamics series with a large number of terms. динамики с большим числом членов.
3. If we consider the economic series of dynamics from the point of view of stochastic processes, since their level in successive periods reflects the influence of many interacting factors and can be considered as random variables that have a certain pattern in time, then we should use the alignment of the series of dynamics by autoregression. The theoretical foundations of this method were developed by E. E. Slutsky, E. Yul, M. G. Kendall, and others.	The autoregression model is simple and convenient for aligning the dynamics series. However, it is not without its drawbacks. It cannot be used to calculate the future levels of the series, bypassing the intermediate ones, as it is done according to the analytical equation of the trend. The parameters of the autoregressive model change continuously, and the initial terms remain unaligned. The general economic tendency of a number of dynamics, identified by the autoregression method, includes random deviations.

When considering several time series in parallel, the study uses the methodology of correlation and regression analysis. The use of the correlation method in the study of a number of dynamics opens up opportunities for their comprehensive study, for finding connections, for quantifying the closeness of this connection. As N. S. Chetverikov rightly points out, the ultimate goal and at the same time the epistemological justification of correlation analysis is to establish causal dependencies between phenomena caused by a complex of numerous mutually intertwining influences of elementary causes. However, the correlation does not reveal the reasons for the connection. The methods of correlation and regression analysis have not been widely used for a long time. The critics of the econometric direction, first of all, point out that when constructing regression equations, the main emphasis is not on revealing the essence of the processes taking place, but on establishing surface dependencies between the observed changes in numerical indicators, which is impossible to agree with. Using the econometric models, the genetic trend leading to the achievement of this goal is established.

We can agree that it is necessary to correlate the series of dynamics if they reflect mutually conditioned processes and if the correlation is studied on the basis of qualitative analysis. In particular, due to the fact that when calculating the correlation coefficient, we determine the tightness of the connection caused by the actions of both random and constant factors, its value may be exaggerated or underestimated. In this regard, some scientists suggest correlating not the levels of the dynamics series themselves, but deviations from the trend. Others believe that it is better to correlate the level differences of each row. In our opinion, the choice of a particular technique in the study of financial processes will be determined in each specific case individually, depending on the characteristics of the levels of the series and their preliminary analysis, as well as the goals formulated in it.

The correlation analysis together with regression analysis considers different, but related tasks that together solve the question of the reality and essence of the connection, the assessment of the strength of the connection, the identification of the form and the assessment of reliability.

4. The Result of Research.

The methods of multivariate statistics showed a good result in the studies of the seven-year monitoring of the macroeconomic indicators of Russia and the countries of North-East Asia and the CIS (Table 4, Figure 1-5), despite the fact that in most countries the macroeconomic proportions are broken. In the methodological aspect, in the process

of monitoring, the macroeconomic forecasting, most tendency that give more accurate results are described using the second-degree polynomials.
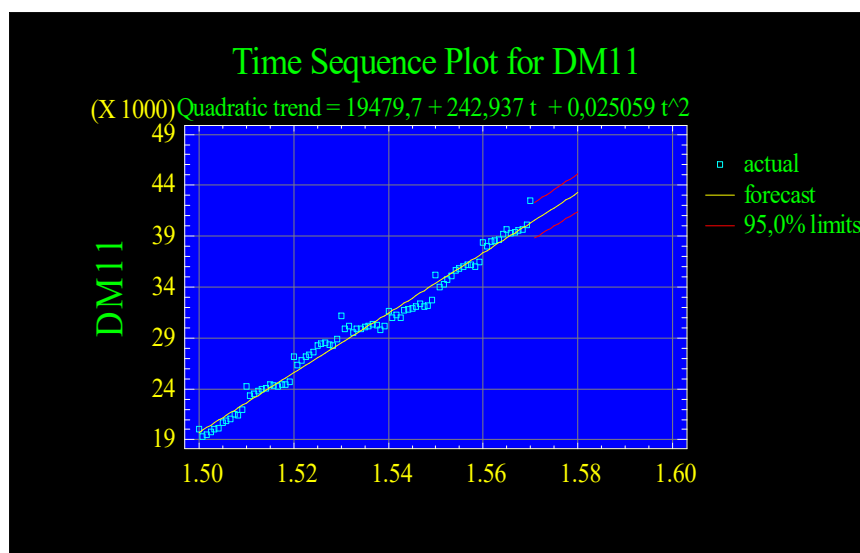

Figure 1: The dynamic of monetary stock of Russia [2]

In the countries studied, the monetary aggregates have a significant growth rate. The shares with a substantial monetary stock and the speed of its growth are divided in the two groups: having placements in the real sectors of the economy and not having received the same result of development from the growth of the monetary stock. The first group can be from South Korea, China, Japan.

Table 4: The main of macroeconomic indicators of Russia, CIS and country of North-East Asia

№	Indicators	Values[3]	Explanations
		Russia	
1.	Monetary base	18 472,4 billion RUB	$Y= 98,96 – 5,86*t+0,2* t^2$ The model is based on monthly data since the 1995.
2.	Monetary stock	58 652,1 billion RUB[4]	$Y= 19 479,7 + 242,94*t+0,03* t^2$ The model is based on monthly data from the 2011.
3.	International reserve	44 015,79 billion RUB, 595 774,1 mill.$ USA	
4.	GDP	106 967 billion RUB in 2020	$Y= -763,76 + 72*t + 2,17* t^2$ The model is based on monthly data since the 1995.
5.	Debt	463 666 mill.$ USA or 34 255,6 billion RUB - <u>External debt</u> 14 751,438 billion RUB - <u>Internal debt</u> <u>Total debt – 49 007,04 billion RUB</u>	$Y = \exp(8,65785 + 0,00829988*t)$ The model is based on monthly data from the 2014.

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[2] The model is based on the data (monthly) from the 2011.
[3] Presents official data on the last date.
[4] The average value – 54 205,3 billion RUB.

№	Indicators	Values[3]	Explanations
		CIS	
		Republic of Belarus	
6.	The monetary stock	50 800,7 mill.BYR[5]	У = exp(10,23 + 0,008*t) The model is based on monthly data from the 2015.
7.	The international reserves	7 368,5 mill.$ USA	У = exp(8,23 + 0,18*t) The model is based on monthly data from the 2015.
		Kazakhstan	
8.	The monetary stock	23 391 985 mill. CZT[6]	У= 31248,7 -25988,7*t + 314,03* t^2 The model is based on monthly data from the 1994.
9.	The international reserves	35 563 mill.$ USA or 14 968,8 billion CZT	У= -5033 + 139,98*t – 0,05* t^2 The model is based on monthly data from the 1994.
		Kyrgyzstan	
10.	The board monetary stock	285 248,2 mill. KGS[7]	У= 87469 + 606,15*t + 9,62* t^2 The model is based on monthly data from the 2012.
11.	The international reserves	2 747,02 mill.$ USA or 23 818 224,7 mill. KGS	У= 0,53 + 18,13*t – 0,03* t^2 The model is based on monthly data from the 2002.
		Tajikistan	
12.	The monetary stock	25 710 mill.TJS	У= 2437,8 + 28,6*t + 0,73* t^2 The model is based on monthly data from the 2008.
		Armenia	
13.	The monetary stock	3 286 760 mill AMD	У= 204306 + 2210,7*t + 55,66* t^2 The model is based on monthly data from the 2003.
		The countries of North-East Asia	
		Japan	
14.	The monetary base	6 114 206 mill JPY	У= 763638 – 9449,2*t + 25,17*t^2 The model is based on monthly data from the 1970.
		China	
15.	The monetary stock	218 679,6 billion CNY[8]	У= 848 853 + 10535,9*t + 14,37*t^2 The model is based on monthly data from the 2012.
16.	The international reserves	3 356 529 mill.$ USA or 2 195,5 billion CNY	У= 662479 – 86057,7*t + 1800,67*t^2 The model is based on monthly data from the 1950.
		South Korea	
17.	The monetary base	221 503,7 billion KWR[9]	У= 13604,6 – 215,8*t + 0,73* t^2 The model is based on monthly data from the 1970.
18.	The monetary stock	3 199 835,7 billion KWR or 218 447,4 trillion $ USA	У= 1,68 + 11974,3*t The model is based on monthly data from the 2012.
19.	The international reserves	443 098,1 mill.$ USA or 405,3 mill. KWR	У= 47149,4 – 8242,12*t + 245,11* t^2 The model is based on monthly data from the 1960.
20.	GDP	1 924 452,90 billion KWR or 1 010 552 trillion $ USA	У= 157963 – 26697,4*t + 778,35* t^2 The model is based on monthly data from the 1953.

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[5] The dollar rate on the 01.01.2021 –1$ USD - 2,58 BYR.
[6] The dollar rate on the 01.01.2021 –1$ USD – 420,91 CZT.
[7] The dollar rate on the 01.01.2021 –1$ USD – 83,5 KGS.
[8] The dollar rate on the 01.01.2021 –1$ USD – 6,54 on the 10 CNY.
[9] The dollar rate on the 01.01.2021 –1$ USD – 9,148 on the 10 000 KWR.

№	Indicators	Values[3]	Explanations
21.	The external debt	510,58 billion \$ USA[10] or 467,1 mill. KWR	У= 73,72 + 3,22*t + 0,009* t^2 The model is based on monthly data from the 1994.
		Russia *The estimated indicators on the 01.01.2021*	
22.	Monetary stock / International reserve	98,45 RUB/\$[11] or 1,33 RUB	Shows: how much on the 1 RUB of international reserves accounts for money stock.
23.	Monetary stock / Debt	1,2	Shows the degree of coverage of debt by the monetary stock.
24.	Monetary stock / External debt	1,71	Shows the degree of coverage of extent debt by the monetary stock.
25.	Monetary stock / GDP	0,51 RUB	1. Calculate the level of monetization as the ratio of the average monetary stock to GDP. 2. It is expedient to apply in the calculation the average indicator of money stock. Shows the level of monetization of the country's economy.
26.	International reserve / Debt	0,9	Shows the degree of coverage of debt by the international reserves.
27.	International reserve / External debt	1,28	Shows the degree of coverage of extent debt by the international reserves.
28.	International reserve / GDP	0,41	Shows the level of international reserves in the country's GDP.
	Debt / GDP	0,46	Shows the level of external debt in the country's GDP.
	External debt / GDP	0,14	Shows the level of debt in the country's GDP.
29.	International reserve / The most urgent needs in the foreign currency[12]	1,18	In this calculate use the total external debt.
30.	The monetary stock / The international reserves	1,28	**CIS:** Republic of Belarus
31.	The monetary stock / The international reserves	1,56	**CIS:** Kazakhstan
32.	The monetary stock / The international reserves	0,01	**CIS:** Kyrgyzstan
33.	The monetary stock / The	99,6	China

[10] Average in the 1-4'Q 2020 - 46 462 780 billion KWR

[11] The dollar rate on the 01.01.2021 –1\$ USD - 73,88 RUB.

[12] The most urgent needs consist from a percent of external debt (total) (3 773 mill.\$ USA – on the 3 month of 2021), the shot part of external debt, the value of import of the 3 month (average in the 2020 - 57 857 mill.\$ USA), the short deposit in the foreign currency (6,8 mill.\$ USA – all deposit).

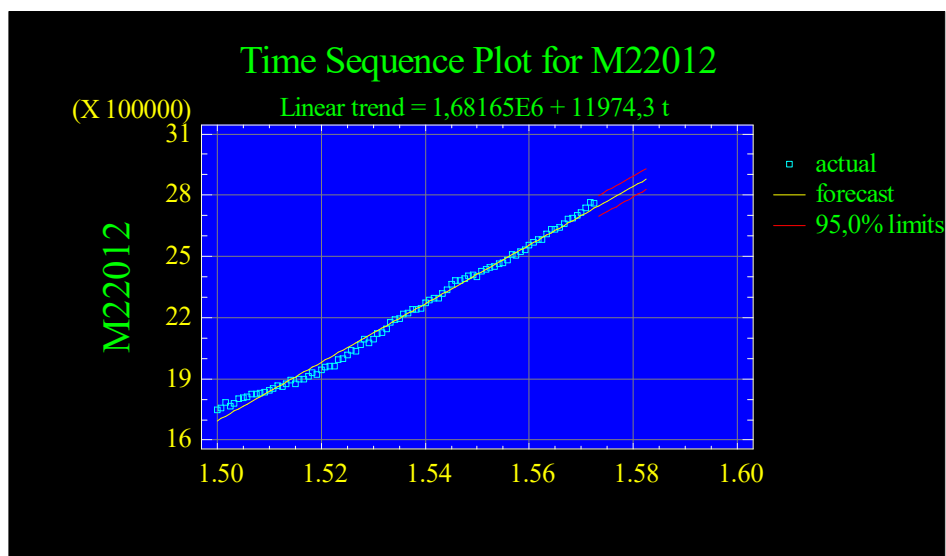| №	Indicators	Values[3]	Explanations
	international reserves		
34.	Monetary stock / GDP	0,22	South Korea
35.	International reserve / External debt	0,87	

Figure 2: The dynamic of monetary stock of South Korea [13]
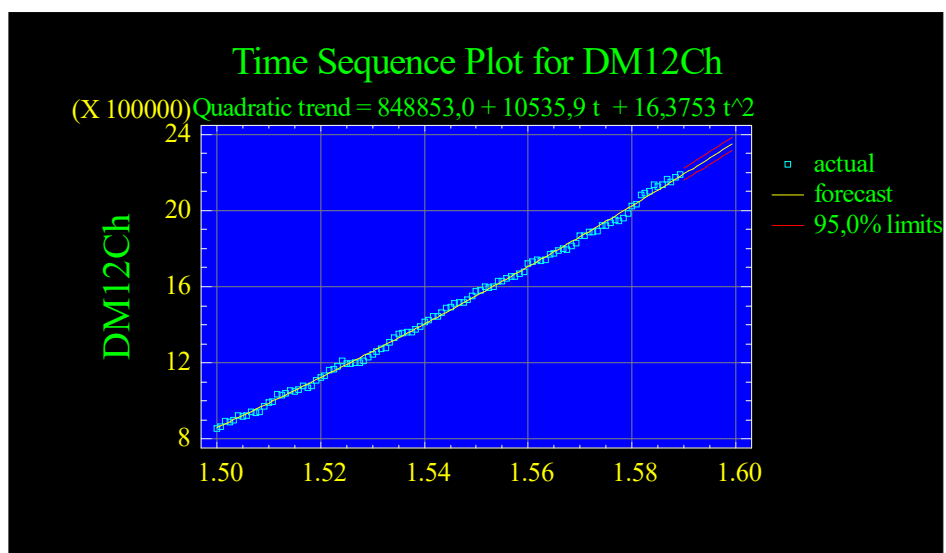

Figure 3: The dynamic of monetary stock of China[14]

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[13] The model is based on the data (monthly) from the 2012.
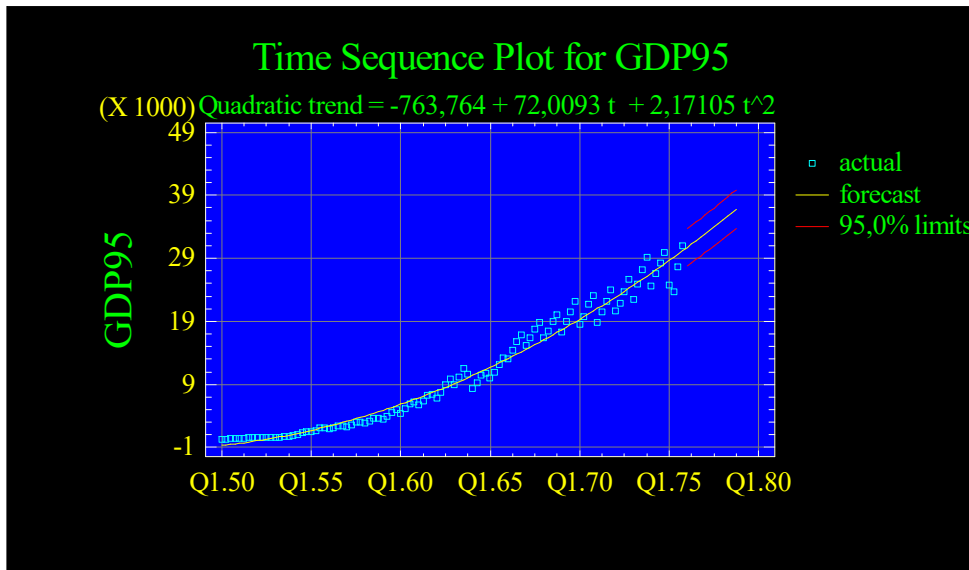[14] The model is based on the data (monthly) from the 2012.
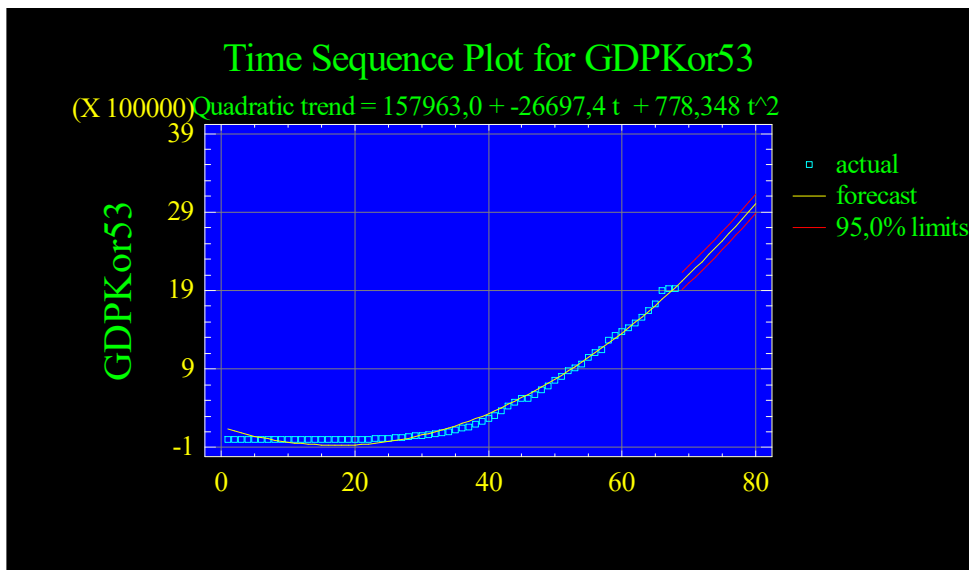
Figure 4: The dynamic of GDP of Russia[15]

Figure 5: The dynamic of GDP of South Korea[16]

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[15]The model is based on the data (quarterly) from the 1995.
[16] The model is based on the data from the 1953.

5. Conclusion

In conclusion, let us summarize the main conclusions on the macroeconomic indicators of Russian Federation in comparison with some indicators with the countries under study in the methodological context. In the countries studied, the monetary aggregates have a significant growth rate. The shares with a substantial monetary stock and the speed of its growth are divided in the two groups: having placements in the real sectors of the economy and not having received the same result of development from the growth of the monetary stock. The first group can be from South Korea, China, Japan. In Russia, studies show that there is an increase in placement in the financial market. In the Republic of Belarus, denomination is an active instrument for regulating excess monetary stock. The real growth of the monetary stock in the countries of CIS under study has been a cause for concern.

From a methodological point of view, in most cases, the tendency of development of monetary stock is described as second-degree polynom. Here are models that are of analytical interest in the performance of the forecast. In the methodological aspect, it is also necessary to calculate the composition of macroeconomic indicators by elements. It is possible to increase the accuracy of forecasting results through a combination of methods. We propose to use techniques of technical analysis and analytical geometry. The tools of this science are used by scientists in economic research. However, the possibilities of this science are not limited by this. The main economic indicators, after theoretical and logical processing, are located in a three-dimensional coordinate system and to determine the position in the future, it is necessary to use the tools of technical analysis (fan and speed lines relative to the origin and relative to extremes).

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Appendix

Table 1: The system of indicators used in the process of macroeconomic analysis.

Ratios	Coefficients
1. Monetary stock (DM) 2. Monetary base (DB)	K_1= DM / D – shows the degree of coverage of extent debt by the monetary stock; K_2= DM / VD – shows the degree of coverage of extent debt by the monetary base; K_3 =DM / MR – shows: how much on the 1 RUB of international reserves accounts for money stock; K_4 =DM / GDP – it is expedient to apply in the calculation the average indicator of money stock. Shows the level of monetization of the country's economy; K_5=DM / Ex – shows: how much the monetary stock is accounted for the 1 RUB of export; K_6 =DM / Ip – shows: how much the monetary stock is accounted for the 1 RUB of import;
3. International reserves (MR)	K_7 =MR / D – shows the degree of coverage of extent debt by the international reserves; K_8=MR / VD – shows the degree of coverage of foreign debt coverage by international reserves; K_9=MR / GDP – shows the level of international reserves in the country's GDP; K_{10} =MR / Ex – shows: how the many international reserves are accounted for the 1 RUB of export; K_{11} =MR / Ip – shows: how many international reserves are accounted for the 1 RUB of import; K_{12} =MR / IF*– shows the degree of coverage of the most urgent needs in the foreign currency;
4. Export (Ex) 5. Import (Ip) 6. Debt (D) (external (VD), internal (VnD)) 7. GDP	K_{13}=Ex / D – shows the degree of coverage of debt by export; K_{14}=Ex / VD – shows the degree of coverage of extent debt by export; K_{15}=Ex / GDP – shows the level of exports in the country's GDP; K_{16} =Ex / Ip – shows the ratio of exports and the imports; K_{17}=Ip / D – shows the degree of coverage of debt by imports; K_{18}=Ip / VD – shows the degree of coverage of external debt by imports; K_{19}=Ip / GDP – shows the level of imports in the country's GDP; K_{20} =D / GDP – shows the level of debt in the country's GDP; K_{21} =VD / GDP – shows the level of external debt in the country's GDP.

IF* - IF - the deposits in foreign currency, the portfolio investments in foreign currency, the accounts in the foreign currency etc. In the course of the express-analysis the 3-month value of this indicator is taken. In the detailed analysis - the cumulative value.