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The medium-term Forecasting of the regional tax burden taking into account saving rate from the investment projects

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Abstract. In this article we advance the methodology of the forecasting of the index of tax burden of region on the medium-term taking into account saving rate from the investment projects.

Keywords: tax; burden; region; estimation; forecasting; methodology.

The tax burden of the region is one of the activities, to forecast that it is possible to draw definite conclusions concerning the part of the gross regional product (GRP), remaining at the disposal of businesses after paying taxes, which can be used for reproduction, on the one hand, and concerning the part of the GRP, accumulated public authorities in the form of tax revenues of budget allocated for the solution of public problems, on the other hand.

However, the methodology of forecasting the tax burden on the regional level are not given due attention, to date, it is insufficiently developed, that is corroborated the state and dynamics tax debt to the consolidated budget of Russia.

In this connection, it is necessary to improve methodology of the forecasting of tax burden of the region, in order to enhance the accuracy of forecasts and taking into account the most important factors.

It is possible to implement the forecast by time-series analysis. Time-series analysis aims to study the phenomena on the basis of trends of development in the past and use this information for the prediction of the studied processes.

The value of tax proceeds from the territory of the Amur region in the consolidated budget of Russia and the value of GRP of the Amur region in the period from 2011 to 2015 has been separately forecasted for a more accurate forecast index of tax burden. And then the ratio between predictive level of these values was found. Forecasting was based on growth rates of tax proceeds, calculated on the basis of statistical compilation Finance of Russia 2010, and the growth rates of GRP, calculated on the basis of data from the first official website of the Federal State Statistics Service of Russia. For the forecast used the procedure Forecasting application software Statgraphics, by the instrumentality of which it is possible to compare five trend models simultaneously [1]. Listing also includes five tests that determine the selection of prediction models: RUNS (on the excessive number of peaks and troughs), RUNM (on the excessive amount of deviation from the median), AUTO (on the excessive autocorrelation), MEAN (on a significant difference of averages) and VAR (on a significant difference of dispersions). It is believed that the prediction model fit with data when all tests are set to OK.

Below is a listing of the comparison of trend models of tax proceeds: linear trend (A), quadratic trend (B), exponential trend (C), model is ARIMA (1,0,0) (D) and simple moving average of 3 terms (E):

Models

(A) Linear trend = $1,65276 + -0,0386786 t$

(B) Quadratic trend = $1,76305 + -0,0776055 t + 0,00243293 t^2$

- (C) Exponential trend = $\exp(0,506456 + -0,0280629 t)$
 (D) ARIMA (1,0,0) with constant
 (E) Simple moving average of 3 terms

Table 1

Comparison of the trend models of tax proceeds

<i>Model</i>	<i>RMSE</i>	<i>MAE</i>	<i>MAPE</i>	<i>ME</i>	<i>MPE</i>
1	2	3	4	5	6
(A)	0,159095	0,121517	8,89845	-4,44089E-17	-1,12033
(B)	0,159328	0,116817	8,46505	-2,07242E-16	-1,04671
(C)	0,15722	0,11856	8,59725	0,0078514	-0,555729
(D)	0,203376	0,168589	12,5011	-0,00749307	-2,44535
(E)	0,186476	0,151944	12,1377	-0,0936111	-8,14114

Table 2

The test results of trend models of tax proceeds

<i>Model</i>	<i>RMSE</i>	<i>RUNS</i>	<i>RUNM</i>	<i>AUTO</i>	<i>MEAN</i>	<i>VAR</i>
1	2	3	4	5	6	7
(A)	0,159095	OK	OK	OK	OK	OK
(B)	0,159328	OK	OK	*	OK	OK
(C)	0,15722	OK	OK	OK	OK	OK
(D)	0,203376	OK	OK	OK	OK	OK
(E)	0,186476	OK	OK	OK	OK	OK

Thus, a statistical consultant is automatically rejected model of (B) as a potential for the forecasting the growth rates of tax proceeds in the region. The study of residual statistics shows that exponential trend (C) is the model with the smallest average absolute error and the lowest absolute percentage error.

The formula for calculating the average absolute error:

$$MAE = 1/n \sum |e_t| = 1/n \sum |y_t - \hat{y}_t| \quad (1)$$

where $e_t = y_t - \hat{y}_t$ - the prediction error for a period of time t.

The formula for calculating the absolute percentage error:

$$MAPE = 1/n \sum \left(|e_t| / y_t \right) \cdot 100 \quad (2)$$

Thus, the results of analysis determine the choice of exponential trend for the forecasting the growth rates of tax proceeds. The equation for forecasting the growth rates of tax proceeds from the territory of the Amur Region has the following form: $y = \exp(0,506456 - 0,0280629 t)$.

Below are the results of forecasting the growth rates of tax proceeds for a periods of time t = 16,17,18,19,20, obtained by means of Statgraphics:

Table 3

The results of the forecasting the growth rates of tax proceeds

Serial number of the period	Predictive value of the growth rates	Lower limit of 95.0%	Upper limit of 95.0%
1	2	3	4
16	1,05913	0,801475	1,39962
17	1,02982	0,77428	1,3697
18	1,00132	0,747565	1,34122
19	0,973615	0,721375	1,31405
20	0,946672	0,695749	1,28809

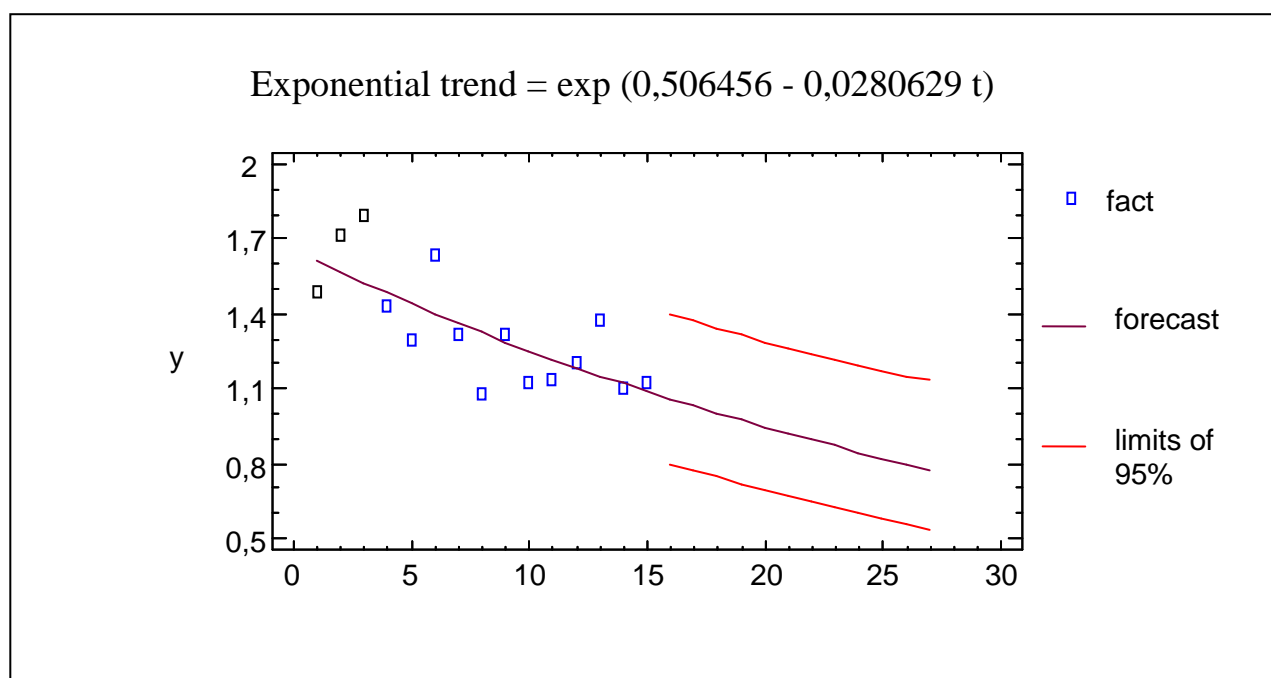


Figure 1 - Predicted values of the growth rates of tax proceeds from the territory of the Amur region, the proportion

Based on predictive growth rates the value of tax proceeds for the period from 2011 to 2015 were determined.

Table 4

Forecasts of tax proceeds from the territory of the Amur region in 2011-2015

<i>Years</i>	<i>Predictive growth rates of tax proceeds, proportions</i>	<i>Predictive tax proceeds, mln. rubles</i>
1	2	3
2011	1,05913	27997,0
2012	1,02982	28831,9
2013	1,00132	28870,0
2014	0,973615	28108,2
2015	0,946672	26609,3

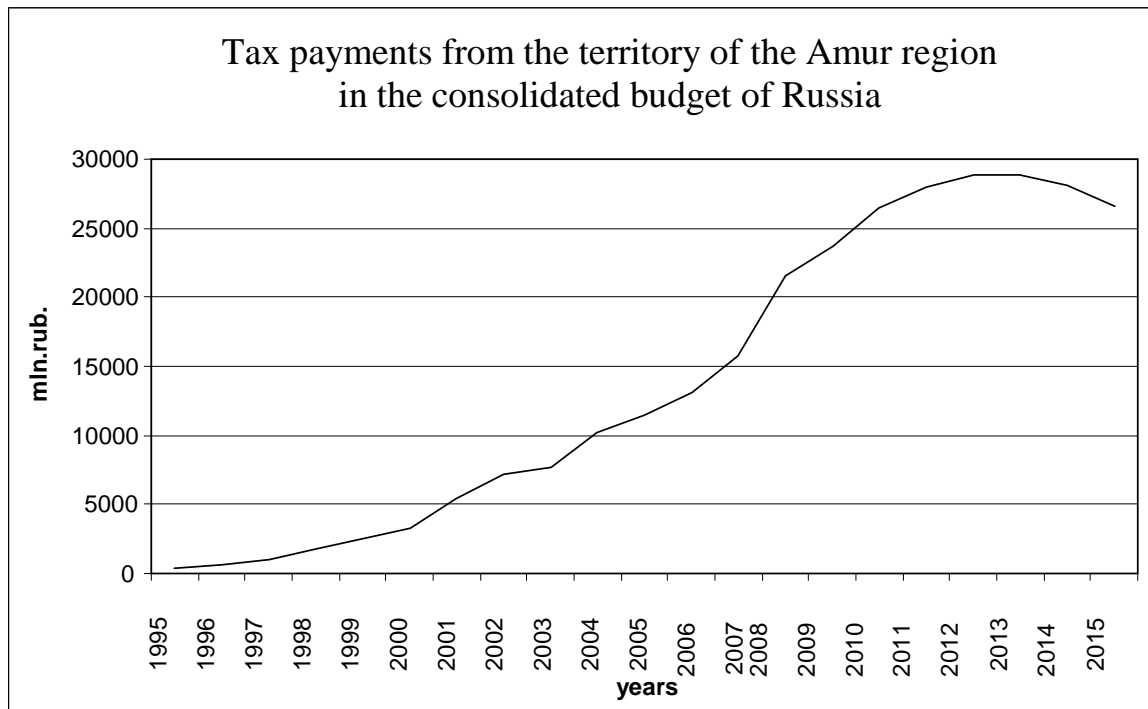


Figure 2 - Tax payments from the territory of the Amur region in the consolidated budget of Russia for the period from 1995 to 2015 years.

The index of GRP in the Amur region for the period from 2011 to 2015 years was predicted similarly.

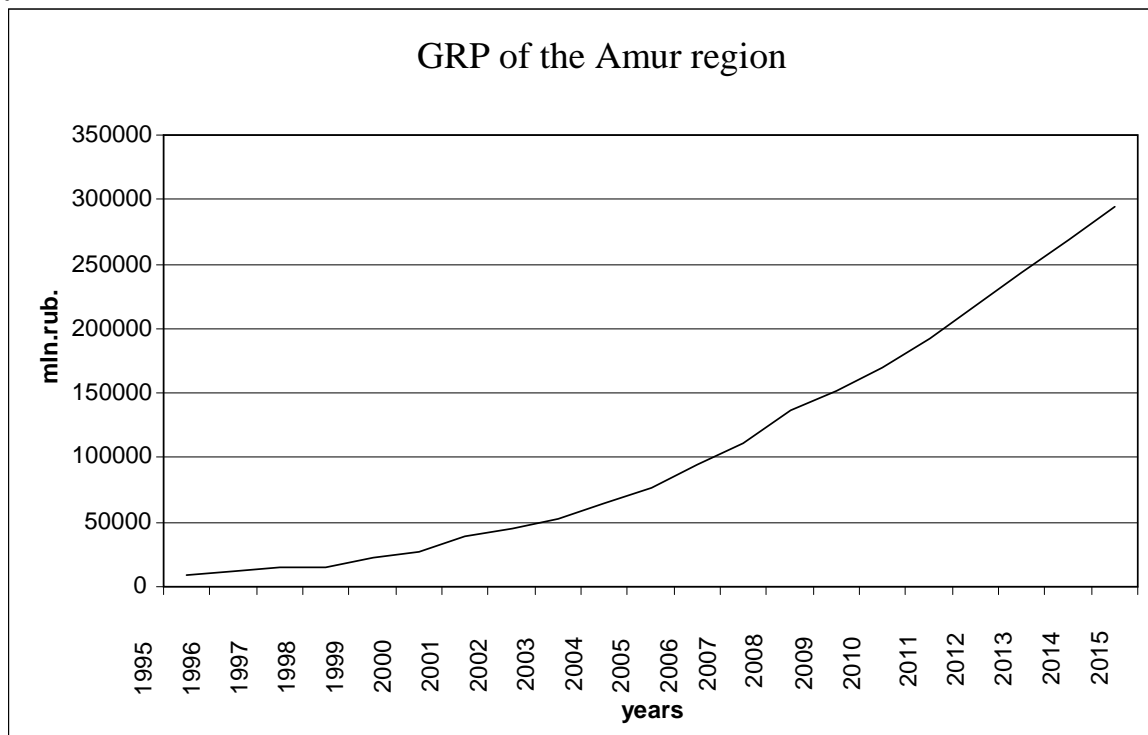


Figure 3 - GRP of Amur region for the period from 1995 to 2015 years.

This method of forecasting is retrospective, it involves the use of the existing growth rates in the past to predict the growth rates in the future. Thus, the forecast based on the time-series does not take into account the economic returns from investment projects, which will only be realized in the forecast period.

Currently, there are many investment projects in the Amur region, some of them are already under implementation, while some are being developed.

During the implementation of the projects are assumed to be GRP growth and additional tax payments in the budgets of all levels from the territory of the Amur region. All this will have a significant effect on the value of the tax burden in the Amur region. Consequently, it is necessary to consider the economic and fiscal impacts from investment projects predicting the level of tax burden.

The most prominent ongoing projects are "Creation advanced technology production of glass products in settlement Raychihinsk", "Creation ore-dressing and processing enterprise at the base of the deposit "Kuranakh", "Construction of the plant for the production of cement at the base of Chagoyanskii deposits of limestone in the Amur region".

Table 5

Economic and fiscal impacts from the implementation of investment projects

Project title	2011	2012	2013	2014	2015	Total
<i>Gross value added</i>						
Creation advanced technology production of glass products	209	1016	1203	1409	1644	5481
Creation ore-dressing and processing enterprise at the base of the deposit "Kuranakh"	1086	985	1045	1045	2045	6206
Construction of the plant for the production of cement at the base of Chagoyanskii deposits of limestone			1224	1335	1335	3894
Total	1295	2001	3472	3789	5024	15581

<i>Tax payments</i>						
Creation advanced technology production of glass products	149	280	388	547	637	2001
Creation ore-dressing and processing enterprise at the base of the deposit "Kuranakh"	505	493	606	647	642	2893
Construction of the plant for the production of cement at the base of Chagoyanskii deposits of limestone			200	302	325	827
Total	654	773	1194	1496	1604	5721

We carried out adjustment of predictive indexes of tax payments and GRP obtained in the prediction by time-series on the economic returns from investment projects.

Table 6

Predictive value of the tax burden of the Amur region, taking into account investment projects

Years	2011	2012	2013	2014	2015
1	2	3	4	5	6
Received tax payments	28651	29604,9	30064	29604,2	28213,3
GRP	194196,3	219414,3	246290,1	272520,6	299736,6
Tax burden	14,75	13,49	12,21	10,86	9,41

Thus, after this analysis it is possible to do the following resumes. During the period 2011-2015 years tax burden in the Amur region will significantly reduce and will amount to 9,41% at the end of the period.

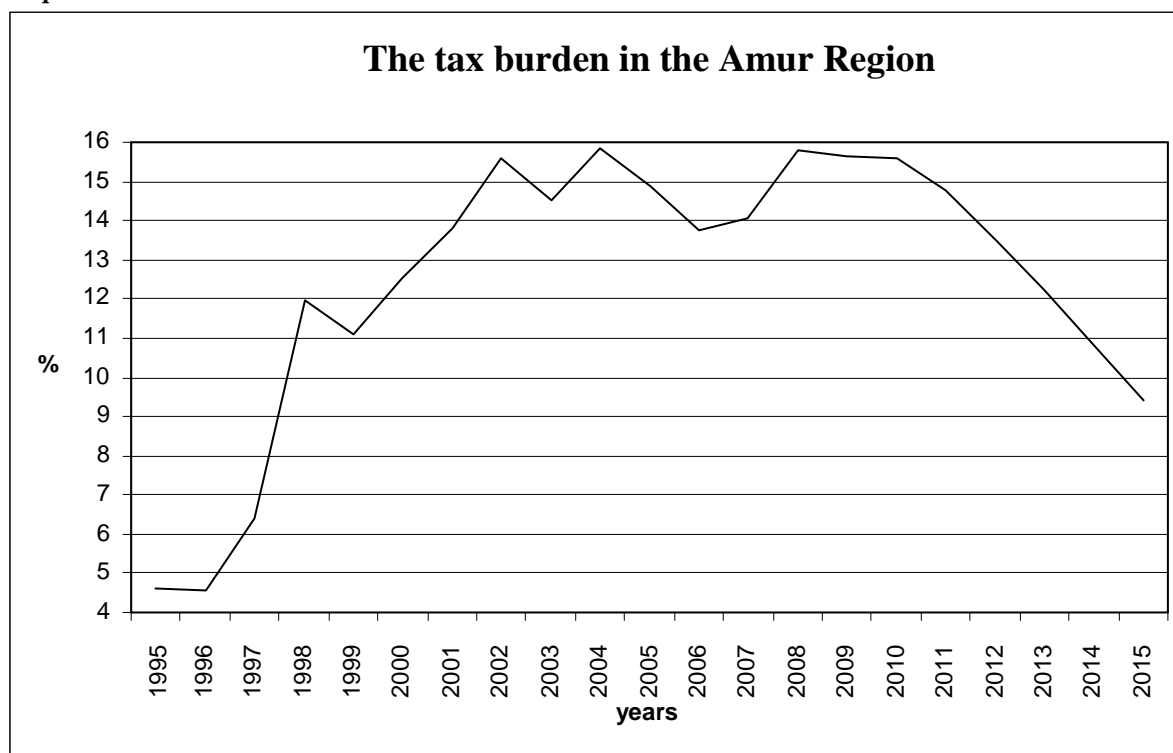


Figure 4 - The tax burden in the Amur region in the 1995-2015 years.

The proposed methodology of forecasting the tax burden in contrast to the methodology used by agencies of the Federal Tax Service, allows to take into account important factor, influenced on the tax burden, such as investment, to include in the calculation of the predicted value of the economic and fiscal impacts from major investment projects. The high accuracy of calculations by using application software Statgraphics is also an important advantage of this methodology.

Thus, the application of this methodology to forecasting of the tax burden in the region will improve the efficiency of state tax forecasting to achieve fiscal and socio-economic objectives.

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**Прогнозирование налоговой нагрузки региона
с учетом инвестиционных проектов**

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Аннотация. В статье представлено развитие методических подходов к прогнозированию показателя налоговой нагрузки региона на среднесрочную перспективу, с учетом реализуемых инвестиционных проектов.

Ключевые слова: налоги; бремя; регион; измерение; прогнозирование; методология.