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Methods of forecasting VAT revenues for the state budget of Ukraine

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Introduction

Indirect taxes, especially VAT, play a key role in the formation of a consolidated budget. Its fiscal feature is characterized by the fact that VAT has a very large tax base which is less exposed to price fluctuations of raw materials and energy. This feature distinguishes VAT from other taxes and is confirmed by the stable dynamics of tax revenues to the state budget. Despite this, and regardless of the volume of revenues that are provided by VAT, the process of VAT administration is accompanied by a large number of problems and misunderstandings.

Solving the problems related to the planning and forecasting of budget revenues and expenditures is associated with the use of effective models for forecasting tax revenues. For transition countries, tax forecasting is one of the areas that is in most need of reform.

In Ukraine, the works of local scientist-economists are devoted to researching problems of the forecasting and planning of tax revenue. They are: M.Ja. Azarov, V.V. Vitlinskuj, V.P. Vishnevsky, S.V. Davydenko, A.D. Danilov, A.I. Krysovatuj, A.I. Lutsyk, Jy.V. Sybiryanska and others.

However, despite numerous studies on various aspects of the planning and forecasting of all tax systems in general, and VAT in particular, there are still a number of unanswered questions. The aim of the article is to show the use of two methods of forecasting VAT revenues to the budget, analyse their efficiency, calculate a forecast for the years 2014–2016 and to identify the key reasons of the problems of VAT forecasting.

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The methodological base for tax revenues forecasting

Tax forecasting is an assessment of tax potential and the scope of tax revenues to the budget, based on the program of socio-economic development of the state for the relevant year.

Tax forecasting is a versatile process and it should be implemented in compliance with the following provisions:

1. Forecasting should be used to solve most political problems. Tax prediction must answer a series of questions concerning more than just accounting. Such forecasting underlies the determination of the general fiscal and monetary policy, including the expected budget deficit and sources to cover it, the correlation of tax policy with the policy of social benefits, determination of the total volume of the public sector and the extent of its impact on market economic relations.
2. It is necessary to use multiple models and approaches at the same time. A large number of questions that should be answered by forecasting requires different approaches and the specifics and comparative advantages of each approach should be taken into account.
3. It should ensure the preservation of flexibility in the choice of models depending on the specific tasks of planning.
4. It should support interdepartmental cooperation. Tax planning is impossible without coordination between agencies, including such aspects as data sharing, coordination of approaches applied and the overall problem statement.

Despite the fact that the process of tax forecasting and evaluation is largely a technical challenge of rigorous economic analysis, the degree of its practical utility for the government is higher if the specificity of particular administrative issues on strategic planning is taken into account.

The methodological base for tax revenues forecasting is very broad and is constantly changing and evolving. The choice of method is influenced by the following factors:

1. the selection of tools which would be best to solve certain issues of budget planning;
2. the accuracy of the forecast (the most important component when choosing a forecasting method is to assess the reliability of indicators);
3. the purpose for which the forecast is made (in some cases there is a need to use a fiscal forecast for purposes beyond the budget planning, for example, a forecast is required for participation in international projects and organisations, or for obtaining support from international organizations and etc.);
4. the period for which the forecast or plan is made – short-term (up to 1 year), medium-term (2–5 years), long-term (over 5 years);

5. the level of accessibility and accuracy of the information used for forecasting (see Azarov et al. 2004).

One of the methodologies for calculating a theoretical VAT base was developed for Mexico using Mexican national accounts and input-output tables (see Aguirre, Shome 1988). The authors found that there was a gap in the literature concerning VAT base calculation and they tried to fill in the gap. They suggest starting with production data and modifying them through adjusting for exports, imports, capital transactions, changes in stocks, exemptions and all intermediate users to obtain taxable consumption (with the help of the input-output table). The authors came to the conclusion that this method could be applicable to other countries as well.

A VAT revenue simulation model was developed for the economy of Nepal (see Jenkins, Kuo 1995). The major purpose of this research paper was to develop an analytical framework that could be used for estimating a potential tax base and associated VAT revenues for a typical developing country. The approach is based on national accounts and input-output tables and on the equivalence of the VAT base to retail sales tax imposed on the final sales price of all goods and services.

Econometric modeling of the fiscal sector was developed for the Slovak Republic (see Olexa 1997). A conditional OLS method was used to model VAT revenues. In the linear form, VAT was modeled in the following way: VAT = f (GDP + Imports – Exports, lag of VAT, seasonal filters for the 1st and 4th quarters and dummy variables for the explanation of the extreme shifts in the development of VAT which do not correspond to the development of the exogenous variables) (see Legeida, Sologoub 2003).

Having reviewed the general principles of forecasting, we proceed directly to the forecasting of VAT in Ukraine.

Forecast of VAT revenues to the State budget of Ukraine

In Ukraine, VAT is the only tax forecasted by a unified officially approved method. Other taxes are also predictable but there are no unified methods at the country level. The adoption of the appropriate document in 2004 was due to the growing problems of abuses in VAT payments, sharp unpredictable negative trends in its revenues and the growing discontent of taxpayers regarding these problems.

In order to implement the Decree of the President of Ukraine of June 23, 2004 No. 671 On Urgent Measures To Improve The Efficiency Of Charging VAT, the State Tax Service of Ukraine and the Ministry of Finance, the Ministry of Economy and European Integration, the State Customs Service with the participation of the Research Financial Institute under the Ministry of Finance, the Academy of the State Border Guard Service of Ukraine, the National Institute for Strategic Studies under the Presidential Administration of Ukraine, and the Institute of Economic Forecast-

ing of the National Academy of Sciences of Ukraine developed a VAT revenues forecasting methodology (see Decree of the President of Ukraine 2004).

The joint Decree of the Ministry of Finance, the Ministry of Economy and European Integration, State Tax Administration and the State Customs Service of 31.08.04 No. 545/315/502/637 On Approval Of Methods Of VAT Forecasting, was registered with the Ministry of Justice on September 23, 2004 under No. 1202/9801 (see Decree of the Ministry of Finance et al. 2004).

The purpose of the adoption of a common forecasting method was an attempt to coordinate the positions and efforts of various departments in this process, and was the answer to increasing political and public inquiries about the information sources and accuracy of forecasts of VAT revenues to the budget.

The Ukrainian VAT forecasting model is characterized by a significant level of detailing of the tax base on components for which particular effective rates are calculated and used. The essence of the approach is to reflect accurately the VAT structure taking into account the specifics of its collection from individual elements of the tax base. That is why the forecast is calculated separately for domestic goods, imports and budgetary compensation, and then the overall forecast is calculated.

The main disadvantages of the methodology approved by the Ministry of Finance are the following:

1. The method does not take into account the effect of changes in tax rates or the tax base changing.
2. The main problem is the low level of accuracy of the potential tax base.
3. The considerable complexity of the model. In this regard, the effective rate method of forecasting is a complicated and costly process.
4. The high degree of uncertainty of the obtained forecast and significant reliance on subjective judgments (see Sidelnikova 2011).

The process of forecasting volumes of VAT revenues to the state budget of Ukraine is the most difficult of all other taxes, because this process is influenced by a large number of factors (inflation, dynamics of exports and imports, the level of protection, domestic consumption etc.).

In addition to the forecasting methodology officially adopted in Ukraine, we present several methods that can also be applied.

The methods of moving averages are based on the Weierstrass theorem, according to which any function under the most general assumptions can be locally (i.e. in a certain range of variation of argument t) represented by an algebraic polynomial of the corresponding degree.

The moving average of degree k is calculated as follows:

$$M = \frac{y_t + y_{t-1} + \ldots + y_{t-k+1}}{k}$$

where k – number of members of the time series included in the moving average.

All observations are assigned equal weighting factors. Each new observation is included in the average according to its occurrence, and „the oldest" are immediately removed. The speed of response to changes in the data structure depends on the length of the smoothing interval (the number of members of the time series included in the moving average k).

If the data have a linear trend then the method of Double Moving Averages is applied. The method is that the data series is originally calculated by the moving averages method, and then the data set is averaged by the same method. The Double Moving Average is determined as:

$$M'_t = \frac{M_t + M_{t-1} + ... + M_{t-k+1}}{k}$$

where M_t – moving average of degree t.

To calculate the forecast level, the coefficient a is used:

$$a_t = M_t + (M_t - M'_t) = 2M_t - M'_t$$

and the additional adjusting coefficient b_t (slope coefficient), which may vary for different ranges of values in the time series:

$$b_t = \frac{2}{k-1} (M_t - M'_t)$$

Thus, the predictive equation for p periods is as follows:

$$y_{t+p} = a + b_t \cdot p$$

where p – the number of periods covered by the forecast.

The forecasting of tax revenues is also carried out using correlation and regression analysis, taking into account the impact of the results of tax administration. In this case, the regression equation is as follows:

$$p = a + b \cdot VAT_k$$

where P – estimated tax revenues by type of tax,

a and b – regression coefficients,

k – forecast period,

VAT_k – forecasting of VAT in the kth forecast period.

Regression coefficients a and b are calculated by the following formulas:

$$a = TR' - b \cdot VAT'$$

$$b = \frac{\sum_{i=1}^{n}(VAT_i - VAT') + (TR_i - TR')}{\sum_{i=1}^{n}(VAT_i - VAT')^2}$$

where n – the number of values of quantities measured (number of periods),

TR' – average tax revenues by type of tax,

VAT' – average VAT (see Krusovatuj 2011).

Table 1 shows details regarding the amounts of VAT revenues to the budget of Ukraine and GDP in 2007–2013 required for the calculations of the forecast. All data was taken from official websites of the Ministry of Finance and Treasury (see Ministry of Finance 2007–2013, Treasury 2007–2013).

Table 1. Dynamics of GDP and VAT revenues to the budget of Ukraine in 2007–2013, billion UAH

	2007	2008	2009	2010	2011	2012	2013
GDP	720,7	948,1	913,3	1082,6	1302,1	1408,9	1454,9
VAT revenues	59,38	92,08	84,6	102,75	130,09	138,83	128,27

Source: the author's own elaboration.

We could analyze the effectiveness of correlation and regression analysis by forecasting VAT revenues in 2011, 2012 and 2013 and forecasting the amounts of VAT for 2014–2016. Table 2 shows the results of the calculations. Mean values of GDP in the respective years were as follows: 2007–2010 – 916,18 bln UAH, 2007–2011 – 993,36 bln UAH, 2007–2012 – 1062,62 bln UAH.

Correspondingly, the mean values of VAT revenues to the budget were as follows: 2007–2010 – 84,7 bln UAH, 2007–2011 – 93,78 bln UAH, 2007–2012 – 101,288 bln UAH.

Table 2. Calculation of forecast VAT revenues in 2011, 2012, 2013

Year	VAT' – VAT	TR' – TR	(VAT' – VAT)^2	(VAT' – VAT) (TR' – TR)
2011				
2007	–195,48	–25,32	38212,43	4949,55
2008	31,92	7,38	1018,19	235,57
2009	2,88	–0,1	8,29	–0,29
2010	166,88	18,05	27695,62	3003,88
∑	–	–	66934,53	8188,71

Year	VAT' – VAT	TR' – TR	(VAT' – VAT)^2	(VAT' – VAT) (TR' – TR)
2012				
2007	–272,66	–34,4	74343,48	9379,5
2008	–45,26	–1,7	2048,47	76,94
2009	–80,06	–9,18	6409,6	734,95
2010	89,24	8,97	7963,78	800,48
2011	308,74	36,31	95320,39	11210,35
∑	–	–	186085,72	22202,22
2013				
2007	–341,92	–41,91	116909,29	14329,87
2008	–114,52	–9,21	13114,83	1054,73
2009	–149,32	–16,69	22296,46	2492,15
2010	19,98	1,46	399,2	29,17
2011	239,48	28,8	57350,67	6897,02
2012	346,28	26,98	119909,84	9342,63
∑	–	–	329980,29	34145,57

Source: the author's own elaboration.

Based on the interim results and the available formulas we obtained the following values of the basic coefficients that are shown in Table 3.

Table 3. Forecast of VAT revenues to the budget in 2011–2013

	2011	2012	2013
b	0,1223	0,1193	0,1035
a	–27,35	–24,72	–8,69
P	131,9	143,36	141,89
Deviation of forecast data from actual data	1,4%	3,2%	9,6%

Source: the author's own elaboration.

Based on these data we can conclude that the method of correlation and regression analysis provides quite a precise forecast. This method is based on the potential GDP values of the indicator but it is possible to choose another indicator. The problem in this choice is the lack of complete and accurate information.

Overall, VAT forecasting is a complex process as it is based on forecasts of GDP which are often too optimistic, leading to a high rate of errors. An example is 2013 where the error was 9,6%. This resulted from a difficult and unstable situation in the country.

To calculate forecast VAT revenues to the budget in 2014, 2015 and 2016 respectively we used the already mentioned formulas and made a forecast for each subsequent year by adding the forecast indicator of the previous year to the data. The forecast GDP under a pessimistic scenario is as follows: 2014 – 1574,3 bln UAH, 2015 – 1757,5 bln UAH, 2016 – 1963,6 bln UAH. The calculations are shown in Table 4.

Table 4. Calculation of forecast VAT revenues in 2014, 2015, 2016

Year	VAT' – VAT	TR' – TR	$(VAT' – VAT)^2$	(VAT' – VAT) (TR' – TR)
2014 (VAT – 1312,13 bln UAH, TR – 124,99 bln UAH)				
2010	–229,53	–22,24	52 684,02	5 104,75
2011	–10,03	5,1	100,6	–51,15
2012	96,77	13,84	9364,43	1 339,3
2013	142,77	3,28	20 383,27	468,29
∑	–	–	82 532,32	6 897,19
2015 (VAT – 1364,56 bln UAH, TR – 129,37 bln UAH)				
2010	–281,96	–26,62	79 501,44	7,505,78
2011	–62,46	0,72	3901,25	–44,97
2012	44,34	9,46	1966,04	419,46
2013	90,34	–1,1	8161,32	–99,37
2014	209,74	17,54	43 990,87	3,678,84
∑	–	–	137 520,92	11 459,74
2016 (VAT –1430,05 bln UAH, TR –134,83 bln UAH)				
2010	–347,45	–32,08	120 721,5	11 146,2
2011	–127,95	–4,74	16 371,2	606,48
2012	–21,15	4	4,47,32	–84,6
2013	24,85	–6,56	617,52	–163,02
2014	144,25	12,08	20 808,06	1,742,54
2015	327,45	28,27	107 223,5	9,257,01
∑	–	–	266 189,1	22 504,61

Source: the author's own elaboration.

Based on interim data shown in Table 4 we calculated forecast VAT revenues (see Table 5).

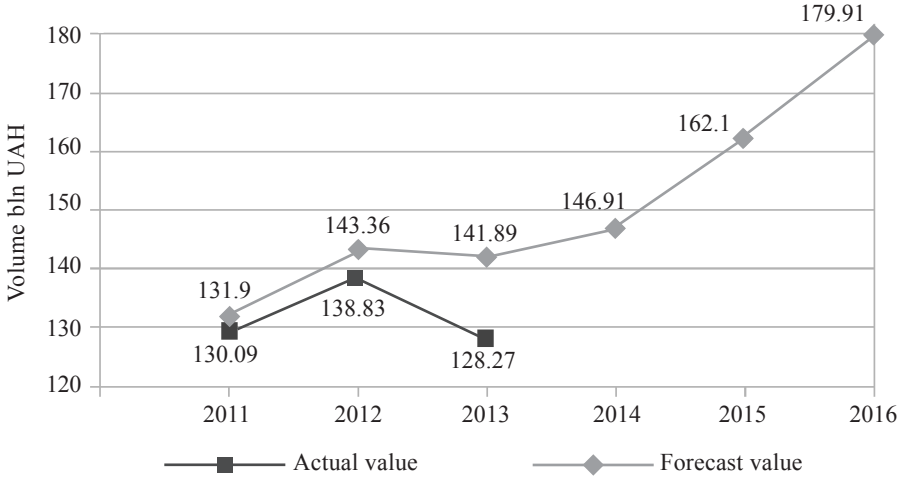
Table 5. Forecast of VAT revenues to the budget in 2014–2016

	2014	2015	2016
b	0,0836	0,0833	0,0845
a	15,3	15,7	13,99
P	146,91	162,1	179,91

Source: the author's own elaboration.

The indicators a and b are approximately the same for all the analyzed years. There is a gradual increase in VAT revenues to the forecasted level of 179,91 bln UAH in 2016. The results of the analysis of the effectiveness of the correlation and regression method and the forecast for 2014–2016 are illustrated in Figure 1.

Figure 1. Actual VAT revenues and forecast volumes by the method of correlation and regression analysis in 2011–2016



Source: the author's own elaboration.

We also analyzed the effectiveness of the method of the moving average and calculated the forecast. Table 6 shows VAT revenues and the results of our forecast for 2011–2013. It's necessary to enter the data about VAT revenues for 2005 and 2006 – 33,8 bln and 50,39 bln UAH respectively, to use this method.

Table 6. Analysis of the effectiveness of the Double Moving Average method

Year	M_t	M'_t	a_t	b_t	y_{t+p} (forecast)	Error; bln UAH	Error; %
2005	–	–	–	–	–	–	–
2006	–	–	–	–	–	–	–
2007	–	–	–	–	–	–	–
2008	47,86	–	–	–	–	–	–
2009	67,28	–	–	–	–	–	–
2010	78,69	64,61	92,77	14,08	106,85	–4,1	–3,84
2011	93,14	79,7	106,58	13,44	120,02	10,07	8,39
2012	105,81	92,55	119,07	13,26	132,33	6,5	4,91
2013	119,89	106,28	133,5	13,61	147,11	–18,84	–12,81

Source: the author's own elaboration.

After the relevant calculations were made we can see that this forecasting method is less accurate than correlation and regression analysis. However, the forecasts for 2013 are characterized by a considerable error in both methods.

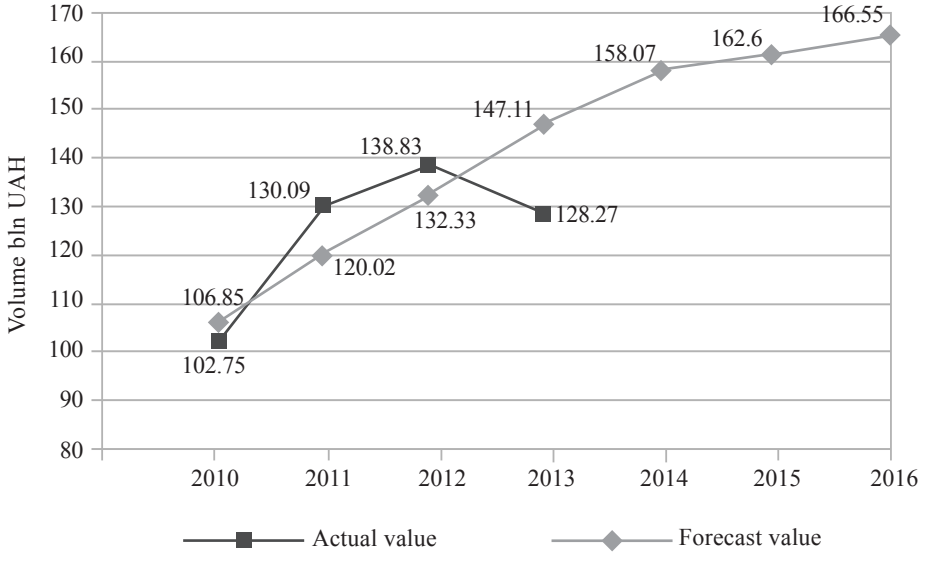
The next step is to calculate the forecast VAT revenues to the budget for 2014–2016. To calculate Mt for 2015, we introduce forecast data on revenues for 2014; and to calculate Mt for 2016, we introduce forecast data on revenues for 2015. The results are shown in Table 7. A summary of the analysis of method's efficiency and the forecast for the relevant years are shown in Figure 2.

Table 7. Forecast for 2014–2016 using dual three-term moving average

Year	M_t	M'_t	a_t	b_t	y_{t+p} (forecast)
2007	–	–	–	–	–
2008	47,86	–	–	–	–
2009	67,28	–	–	–	–
2010	78,69	64,61	92,77	14,08	106,85
2011	93,14	79,7	106,58	13,44	120,02
2012	105,81	92,55	119,07	13,26	132,33
2013	119,89	106,28	133,5	13,61	147,11
2014	132,23	119,31	145,15	12,92	158,07
2015	141,72	131,28	152,16	10,44	162,6
2016	149,65	141,2	158,1	8,45	166,55

Source: the author's own elaboration.

Figure 2. Actual VAT revenues and forecast values by the method of Double Moving Average for 2010–2016



Source: the author's own elaboration.

The forecast obtained by using the moving average method in 2014 and 2016 respectively differs from the forecast obtained by correlation and regression analysis:

1. for 2014, the difference is 11,16 bln UAH to the advantage of the moving average method;
2. for 2016, the difference is 13,36 bln UAH to the advantage of correlation and regression analysis;
3. the forecasts for 2015 coincide.

According to the State Fiscal Service of Ukraine, VAT revenue growth in 2014 was observed at 10% compared to 2013, so VAT revenues to the State budget approximate 141,9 bln USD. As you can see, warfare in Ukraine has not led to a decline in VAT revenues. Due to this, the method of correlation and regression analysis provides a more accurate prediction that differs from the actual data only by + 3,53%.

Conclusions

Experience in planning and forecasting VAT in Ukraine demonstrates the existence of a large number of risks accompanying this process. This situation leads to a significant deviation of forecast revenues from actual revenues. A partial elimination of the risks associated with planning and forecasting of budget revenues

requires approval of quantitative indicators of the maximum risk of budget planning. A legislative introduction of such indicators for tax revenues forecasting (numerical series analysis) might considerably improve budget planning.

Here are the main reasons of problems and the high level of deviations in VAT forecasting and planning. These can be divided into objective and subjective reasons. The objective reasons of the deviation of VAT revenues and refunds from the forecast ones are as follows:

1. the unstable political and economic situation;
2. extended shadow infrastructure which makes it impossible to obtain complete and accurate information – the basis for the relevant forecast;
3. the instability and low capacity of the internal market;
4. increased using of schemes of VAT evasion and illegal VAT refunds from the budget;
5. an extended list of VAT exemptions that reduces budget revenues.

The following are the subjective reasons for the low efficiency of forecasting of VAT payments and refunds:

1. neglecting the influence of inflation rates on the expected value of VAT revenues to the budget;
2. frequent changes to legislation that requires constant review of the forecasts made;
3. overvaluation of forecast indicators and too optimistic forecasts of the state of the economy;
4. imperfect methods and tools used for VAT forecasting;
5. the high degree of participation of human potential in VAT forecasting that leads to a high degree of subjectivity.

Constant analysis and monitoring are required to reduce the magnitude of error and their probability. Approaches with more detailed preparation of VAT revenues forecast should be applied in the practice of forming the indicators of revenues of the State Budget of Ukraine. Also, the information base of the forecasting does not comply with forecasting methods, namely the State Statistics Committee provides certain data with some delay.

The analysis showed that, in spite of the simplicity of the proposed approaches of forecasting VAT revenues, they observed a high degree of accuracy of forecasts. These methods can't be implemented at the state level in the way that we used in the article because they do not take into account the change in tax rates and the introduction of differentiated rates. We believe that it is necessary to take into account in formulas the effects of changing tax rates to improve the moving average method and the method of correlation and regression. Another factor that should be taken into account when calculating the forecast is the shadow economy, and the forecast should be corrected with this element.

Efficient VAT forecasting is very important at the current stage of economic development. Accurate VAT revenues forecasting will optimize fiscal policy, re-

duce the likelihood of contingencies and provide a quick and adequate response when they arise, and reduce the percentage of debt to ensure the financing of budget expenditures. The tax system reforming process which began in 2010 with the adoption of the Tax Code of Ukraine should be continued, not only to preserve the achieved level, but also to build a more effective mechanism of VAT administration which includes forecasting.

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Summary

VAT is the main indirect tax in Ukraine, among other countries, providing one of the largest items of state budget revenues. The presence of the VAT refund procedure and the need to cover public spending with the revenues from VAT administration require that an effective method of planning and forecasting VAT revenues for the new fiscal year be used.

The purpose of the article was to analyze the effectiveness of two methods of forecasting of VAT revenues, such as the moving average method and the method of correlation and regression. This was done by analysing the effectiveness of forecasts made for previous years and comparing them with actual data to make the forecast of VAT revenues using these methods for 2014–2016 years and identifying the main causes of problems in the forecasting process.

The results show that the forecasts based on two methods (correlation and regression analysis and double moving average) are sufficiently accurate. After making certain adjustments, these methods can be used at the national level.

Keywords: VAT, forecast, state budget

JEL: C53, E62, H25