

# A QUANTITATIVE ANALYSIS OF THE MAIN LITHUANIAN TAXES AND THEIR OPTIMISATION DURING THE CRISIS

**Miroslav Švabovič\*, Algirdas Miškinis**

*Vilnius University, Lithuania*

---

*Abstract.* Seeking to contribute to the analysis of anti-crisis economic policy decisions, the authors of the current article have developed an economic analysis modelling system of the main tax rates, which makes it possible to carry out research into modelling economic scenarios in order to determine the variables of optimal tax rates. By applying this modelling system in practice, it is possible to measure the maximum probability rates of Value Added, Profit, and Personal Income Taxes for the collection of necessary revenues to the state budget. This method presents a possibility to accurately evaluate the impact of fiscal policy measures on the state budget as well as to reflect economic processes more comprehensively and model accurate short- and long-term projections.

**Keywords:** budget revenue, fiscal policy, tax rates, model projections, economic policy.

---

## 1. Introduction

In 2008, the world was shaken by an economic crisis whose negative effects had impact on the economic situation in most countries. The crisis evoked debates that still continue among different economic schools even today, and unanimous opinion has not been reached. The problem of the economic policy of the state during the crisis remains acute; therefore, the research presented in this article on the optimisation of economic policy measures remains relevant in order to analyse the economic policy measures introduced during the crisis as well as to determine the relevance of their impact on the economic system.

In contemporary specialist publications (Bachmann, Jinjui, Bai, 2011; Benetrix, Lane, 2011; Frankel, Vegh, Vuletin, 2011; Karazijienė, 2009; Karpavičius, 2008; Lakštutienė, 2008; Nowak, 2013; Ravenhill, 2011; Weale, 2009, etc.), the impact of the economic crisis on the economy is usually researched by applying regression analysis methods or/and occasional statistical research, such as the determination of the elasticity of fiscal policy

\* *Corresponding author:*

Faculty of Economics, Vilnius University. Saulėtekio al. 9, LT-10222 Vilnius, Lithuania.

E-mail: [mirsva@gmail.com](mailto:mirsva@gmail.com)

on tools for economic indicators. The authors of the current article hold the view that such research is fragmentary and does not provide the opportunity to evaluate economic policy measures optimally and comprehensively.

**The subject of the scientific research.** The quantitative analysis and optimisation of the main tax rates in Lithuania during the crisis.

**The aims of the study.** To carry out an analysis of the economic situation in Lithuania during the 2008-2010 crisis and the economic policy measures introduced by the Government; to evaluate their optimum impact and establish possible alternatives while modelling economic situations.

**The research problem.** According to Ahrend, Cournède, Price (2008); Alesina, Campante, Tabellini (2008); Allen, Gale (2007); Atesoglu, Emerson (2008); Bachmann, Jinjui (2013); Barrell, Holland (2010); Beležentis, Vijeikis (2010); Benetrix, Lane (2011); Bratčikovienė (2014); Castro (2010); Cicek, Elgin (2010); Forni, Monteforte, Sessa (2009); Galinienė, Melnikas, Miškinis (2011); Gyllys (2009); Harvey (2010); Hennessey, Chairman (2010); Isaac (2008); and others, in the crisis phase of the economic cycle, it is prudent to apply certain measures of fiscal and monetary policy that stimulate the economic system to enter the recovery phase as soon as possible. Nonetheless, even today substantiated arguments are scarce as to what should be done differently in order to lessen the negative outcomes of an economic crisis. Researchers agree that the 2008-2010 economic crisis is the basis in the scientific sense for conducting both qualitative and quantitative scientific research, as well as for defining problems and finding ways to tackle future crises.

**The proposed solution to the problem.** The authors of this article have proposed an economic analysis model of the key tax rates, making it possible to conduct research by modelling economic scenarios and determine the variables of optimal tax rates. While applying the experimental research model, it is possible to calculate the optimal Value Added, Profit, and Personal Income tax rates that would enable the Government to collect the desirable revenue to the state budget. This method provides the opportunity to precisely evaluate the impact of the application of fiscal policy tools on the state budget, reflect economic processes more comprehensively and model accurate short- and long-term projections. It is worthwhile paying attention to the fact that the application of this model can acquire a wider scope and encompass more indicators for which standard time series modelling methods do not produce the desired results.

**Research methods.** The current article is based on the research conducted in M. Švabovič's doctoral thesis, titled *Modelling state economic policy decisions during the crisis* and written under the supervision of A. Miškinis. The quantitative research carried out in the thesis comprises a regression analysis, the verification and validation of the received data, the coefficient of determination analysis, the Durbin-Watson statistical analysis, an autocorrelation analysis, a p-value analysis, Fisher's statistical analysis, the

null hypothesis verification, a standard error analysis, a correlation strength analysis, a factorial analysis, the Spearman's rank correlation matrix, the formation of various statistical models (ARIMA, linear trend function, etc.), a model analysis by various information criteria, the formation of a quantitative model for optimal tax rate variations, forecasting, etc. The *Statgraphics Centurion*, *Gretl* and *SPSS* software programs were used while conducting the quantitative research.

## 2. Changes in the main tax rates in Lithuania during the crisis

*Personal Income Tax* (PIT) is one of the key taxes in most countries that is levied on the income earned by the population. In 2008, the overall/aggregate Personal Income Tax rate in Lithuania was 27%, and consisted of the Personal Income Tax rate (24%) and the State Social Insurance payments (3%). When the crisis broke out at the end of 2008, the Government of Lithuania made the decision to alter the rates of this tax. On 1 January 2009, the Personal Income Tax was split into the Personal Income Tax rate (15%) and the compulsory health insurance payment (6%), whereas the state social insurance payment remained the same (3%). The overall evaluation of the tax change reveals that although the PIT rate was reduced, due to the redistribution, all the inhabitants – including the population that had no income – were obliged to pay a 6% health insurance payment. Such redistribution did not change the level of taxation on personally earned income, and therefore the 24% rate on PIT has remained relevant until 2016.

*Profit (Corporate) Tax* (PT) is also one of the core taxes in most countries. This tax is levied on the income of business companies, after deducing expenses, depreciation, and in certain cases, investment, charitable contributions, etc. – in other words, it is exclusively profit that is taxed. The development of the Profit Tax is presented in Table No. 1.

Table No. 1. The development of Profit Tax rates in 2001-2010

Period	Tax rate as a percentage
1 Jan 2001 – 31 Dec. 2008	15
1 Jan 2009 – 31 Dec. 2009	20
1 Jan 2010 – present	15

Source: M. Švabovič, A. Miškinis (2016).

In 2009, the Profit Tax rate was increased from 15% to 20%. The increase in the tax rate reveals that the Government imposed a curbing fiscal policy, which means that the Government sought to collect a larger income to the state budget and thus to reduce the budget deficit. However, according to the theory of economic cycles, the increase in the tax rate was introduced at the wrong time; in 2009, the crisis in Lithuania had reached contraction, and, according to economic theory, it is a stimulating rather than a curbing fiscal policy that should be conducted in this phase of the cycle. Consequently, the Profit

Tax rate should not have been increased, but conversely – it should have been reduced. The increase in the Profit Tax rate did not meet the expectations and subsequently the previous 15% rate was re-established in 2010.

*Value Added Tax* (VAT) is also one of the main taxes in most countries. This tax is imposed on the additionally created value. The development of Value Added Tax is presented in Table 2, which illustrates how this tax was also increased during the crisis and triggered the increase in prices for goods and services, and the subsequent decrease in consumption.

TABLE NO. 2. The development of Value Added Tax rates in 2002-2010

Period	Tax rate as a percentage
1 Jan 2002 – 31 Dec. 2008	18
1 Jan 2009 – 31 Dec.2009	19
1 Jan 2009 – present	21

Source: M. Švabovič, A. Miškinis (2016).

The changes in the researched taxes demonstrate that in the period of 2008-2010, the Government of Lithuania – while redistributing Personal Income Tax rates and concurrently increasing the rates on Value Added and Profit taxes – was conducting curbing fiscal policy. As the period of 2008-2010 was the crisis phase, stimulating fiscal policy should have been implemented because only in the recovery phase is it feasible to consider the option of introducing a curbing fiscal policy or a non-discretionary fiscal policy. The Government of Lithuania could have reduced the negative effects of the crisis only by reducing rather than increasing the tax rates, since it would have increased aggregate demand, consumption, employment, company investments, etc. According Klyvienė (2014) and other Lithuanian scientists (Gylis, 2009; Liesionis, Račkauskas, 2012; Melnikas, 2011 etc.), this could have triggered the faster stabilisation of the economic situation and gained greater trust of the population and company representatives in the actions taken by the Government.

Naturally, even if a stimulation of fiscal policy had been implemented, it might still have resulted in negative outcomes due to the fact that the revenue from taxes could decrease and governmental expenditure and the budget deficit could have increased. It goes without saying that it was these negative effects that the Government of Lithuania was attempting to avoid but these negative effects should have been treated from a different perspective; furthermore, other economic policy decisions should have been made. While reducing the main tax rates, the state budget revenue would have decreased and the state budget deficit would have increased; nonetheless, aggregate demand and supply would have increased, which would have had a positive effect on economic growth and, concurrently, on the budget revenue. The Government’s stimulation of the economy and the market would have resulted in favourable conditions for:

1. A greater consumption due to the fact that a larger revenue would have been collected from Value Added Tax to the state budget;
2. A growth in construction, industry and other sectors of the economy, which would have generated more revenue from Profit and Excise taxes to the state budget;
3. A greater labour productivity and employment because the revenue from the Personal Income Tax to the state budget would have increased, while the expenditure from the state budget on unemployment benefits, public social protection, etc. would have decreased;
4. A greater trust in the Government.

This predetermines that the abovementioned factors would have created more economic benefit for both the Government and the budget, which would have led to the macroeconomic multiplier effect:

$$m_{ij} = \frac{\Delta Y_i}{\Delta x_j} \quad (1)$$

Where:  $\Delta Y_i$  – change in the Gross Domestic Product;

$\Delta x_j$  – change in the variable of a certain operating economic policy;

$m_{ij}$  – multiplier/coefficient which shows the correlation between one response variable and another determinant variable.

In other words, the application of a stimulating fiscal policy can be treated as an ‘investment’ in economic welfare, which would be beneficial to the state budget; and the larger the investments are (i.e., more favourable the tax rates), the greater the return on investment should be. Even if the returns on investment were negative, i.e., the revenue collected from taxes were lesser than necessary to cover the difference in reduced tax rates, the resultant budget deficit could be balanced by the possibility to borrow more cheaply, for instance, from the International Monetary Fund, as the neighbouring countries did.

### **3. Modelling and optimisation of the main tax rates during the crisis**

The basic method chosen for quantitative research in the current article was the standard deviation model, because it demonstrates clear results and is often applied in experimental research. Mathematically, standard deviation equals the square root of random value dispersion which is the square average of value deviations from the mean (Čekanavičius, 2011). In other words, it is a value which defines the dispersion of the acquired values of a random variable around the mean. On the basis of the conducted research, it was assumed that a response value is significantly affected by three state budget indicators: government revenue, budget deficit (surplus), and debt. Thus, model can be extended and into the basis of the model could be involved other economic principles. However,

of these indicators, the government revenue indicator has the greatest impact, as it directly depends on the fiscal policy measures conducted by the government. The set aim was to determine, on the basis of economic analysis tools, the optimal Value Added, Profit, and Personal Income Tax rates in order to collect a revenue of 12,500 m EUR. Such a choice was determined by the fact that the government budget revenue in Lithuania grew every year until 2008 when it reached 11,446.3 m EUR. However, due to the deep economic crisis in 2009, it plunged to 9,638 m EUR. As the state expenses reached 12,090.6 m EUR, the subsequent budget deficit accounted for 2,452.6 m EUR. Seeking to balance the finance of the government sector, the Government of Lithuania should have attempted to reduce or liquidate the state budget deficit. In such a case, government expenses should not have exceeded the government tax revenue. If that had been successfully implemented in 2009, the negative effects of the crisis would have been milder, and the economy would have recovered in a shorter period, which was the case, for example, in Estonia.

*The first stage of the research – the selection of response data.* The targeted response indicator (name) was  $Y = 12,500$  m EUR in revenue. The statistical state budget revenue of 2005-2014 was chosen for the value based variation of the indicator. The minimal state revenue variation value for the response indicator  $Y$  equals 9,600 m EUR (approximately corresponding to the 2009 state budget revenue), while the selected maximum variation value for the response indicator  $Y$  is 13,000 m EUR, i.e., the optimal targeted state budget revenue. In order to achieve the most accurate data, two response indicators are included in the model:

$Y_j$  – state revenue in aggregate expression;

$$\bar{Y}_j = \frac{\sum_{i=1}^m Y_{ij}}{m} \quad (2)$$

Where:  $m$  – the number of values;

$Y_{ij}$  –  $Y$  received from  $Y_1$  and  $Y_2$ .

$Y_2$  – state revenue in the logarithmic expression of standard deviation.

$$s_j = \sqrt{\frac{\sum_{i=1}^m (Y_{ij} - \bar{Y}_j)^2}{m-1}} \quad (3)$$

Where:  $s_j$  – standard deviation;

$m$  – the number of values;

$Y_{ij}$  –  $Y$  received from  $Y_1$  and  $Y_2$ .

**Step No. 1: Define the response variables to be measured**

Name	Units	Analyse	Goal	Target	Impact	Sensitivity	Low	High
State revenue	m EUR	Mean	Hit target	12 500	1.0	High	9 600	13 000
State revenue (SD)	m EUR	Std. deviation	Minimise		1.0	High	0.0	10.0

$Y_2$  is necessary here as a stabilising indicator which makes indicator  $Y_1$  more precise; that is, it reduces the possibility of error. In such a way, the aim of the included  $Y_2$  is to minimise standard deviation. The value of precision of both response indicators  $Y_1$  and  $Y_2$  is selected as possibly the highest and equals 1.0. Having determined the response indicator, the next step was to select factorial indicators.

*The second phase of the research – the selection of factorial data.* It has already been mentioned that in 2009 the Government of Lithuania imposed a curbing fiscal policy, which is reflected by the increased tax rates: the Value Added Tax rate was increased from 18% to 19%, and later to 21%, the Profit Tax rate increased from 15% to 20%, while the Personal Income Tax rate was redistributed but the rate value did not change and remained at 24%. For the objectivity of research, the changed value of every analysed tax rate was deducted from the main rate prior the change, and also added to the changed tax rate, thus receiving the smallest and the largest rate intervals. In other words,  $VAT_{21-18}=3$ , therefore  $VAT_{min}=18-3=15$  and  $VAT_{max}=21+3=24$ . The smallest and largest values for PIT correspond to 6 and 33 respectively.

**Step No. 2: Define the experimental factors to be varied**

Name	Units	Type	Role	Low	High	Levels
A:VAT	As a percentage	Continuous	Controllable	15.0	24.0	
B:PT	As a percentage	Continuous	Controllable	10.0	25.0	
C:PIT	As a percentage	Continuous	Controllable	6.0	33.0	

Thus, various tax rates ordered from the determined smallest to the largest rates will be used for calculations, for instance,  $PIT=22.3(\dots)$ ,  $PIT=22.4(\dots)$ ,  $VAT=18.5(\dots)$ ,  $VAT=18.6(\dots)$ ,  $PT=16.3(\dots)$ ,  $PT=16.4(\dots)$ , etc., corresponding to equilibrium. For the objectivity of the research, the 2005-2014 GDP was selected as another basic indicator which characterises changes in the state revenue.

*The third stage of the research – the selection of experimental runs.* Taking factorial variation into consideration, 27 runs per 1 block were determined. In this case, that would be  $27 \times 3$  factors. The runs were selected with the possibility of random walk, for example, having determined the relevant  $VAT=23.6(\dots)$ , the corresponding values of PT and PIT would be sought for by variation.

**Step No. 3: Select the experimental design**

Type of	Design	Centerpoints	Centerpoint	Design is	Number of	Total	Total	Error
Factors	Type	Per Block	Placement	Randomized	Replicates	Runs	Blocks	D.F.
Process	Multilevel factorial	0	Random	Yes	0	27	1	17

Number of samples per run: 30

Every run consists of 30 samples; therefore, the overall number of factors will reach  $27 \times 3 \times 30 = 2070$  units of VAT-PT-PIT combinations; for example, VAT=18.3(...) with PT=12.4(...) with PIT=16.9(...), et cetera.

*The fourth stage of the research – selection of the model from several models applied in the research.* The mean model is the simplest one and is used to analyse the impact of one factor on the response value. Another, the linear model, is slightly more complex and is applied for the analysis of the impact of several factors on the response value. The two-factor interactions model is yet more complex and is used for the analysis of the impact of several interrelated factors on the response value. The most complex, and concurrently the most objective one, is the quadratic model, which analyses the impact of all the factors and the interrelated factors on the response value. In order to achieve the most precise research results possible, the authors selected the quadratic model for the research.

**Step No. 4: Specify the initial model to be fit to the experimental results**

<i>Factors</i>	<i>Model</i>	<i>Coefficients</i>	<i>Excluded effects</i>
Process	Quadratic	10	none

*The fifth stage of the research – conducting experimental research.* After the results have been compiled, *the sixth stage – the optimisation of the model* is carried out. In essence, it is the same procedure of experimental research (recalculation) – once more eliminating the irrelevant combinations of factors. The data received at this stage are as follows:

**Step No. 6: Analyse the experimental results**

<i>Model</i>	<i>State income</i>
Transformation	none
Model d.f.	6
P-value	0.0476
Error d.f.	3
Stnd. error	0.779
R-squared	98.15
Adj. R-squared	92.46

As the adjusted data of the research demonstrate, there were no transformations within the model, which means that the model was selected correctly. The P-value of the model is smaller than the acceptable 0.05 limit, which proves that the data of the model are correct. Three numbers of degree of freedom and one small standard error were determined. The  $R^2$  value is 98.15 per cent (or 0,9815 of index measure), and the adjusted  $R^2$  reaches 92.46 per cent (or 0,9246 of index measure), which proves that the accuracy of the model results approximates 100%. Therefore, the model is relevant and of high quality. The data below demonstrate the relevance of every run of the research observation.



TABLE NO. 3. Leverage

Run	Leverage	Location			
1	0.592983	Factorial	13	0.27267	Face-centre
2	0.687589	Factorial	14	0.340637	Face-centre
3	0.27267	Face-centre	15	0.353069	Other
4	0.367686	Other	16	0.372166	Other
5	0.687589	Factorial	17	0.299686	Face-centre
6	0.372166	Other	18	0.367686	Other
7	0.360173	Other	19	0.377084	Other
8	0.360173	Other	20	0.265555	Centre
9	0.519096	Factorial	21	0.299686	Face-centre
10	0.519096	Factorial	22	0.353069	Other
11	0.340637	Face-centre	23	0.592983	Factorial
12	0.512926	Factorial	24	0.512926	Factorial

Average leverage = 0.416667

As the data demonstrate, the minimal limit of the average relevance of runs reaches 0.416667. This demonstrates how the data of every run are distributed in the model: factorial data are above the 0.416667 limit, whereas the centred and other data applied for the matrix are below this limit. However, these data are the information of a more general character and demonstrate varied data distribution. The runs when factorial data were received are as follows: 1r.= 0.592983, 2r.= 0.687589, 5r.= 0.687589, 9r.= 0.519096, 10r.= 0.519096, 12r.= 0.512926, 23r.= 0.592983, 24r.= 0.512926. They point to the fact that factorial data from the whole set of data were selected not only from the first runs but also from the interim and the last runs; this means that the selected factorial data are adequate and relevant during the entire process of runs.

Figure No. 1 presents the variation matrix of VAT and PT factorial data distribution when GDP=22.9939.

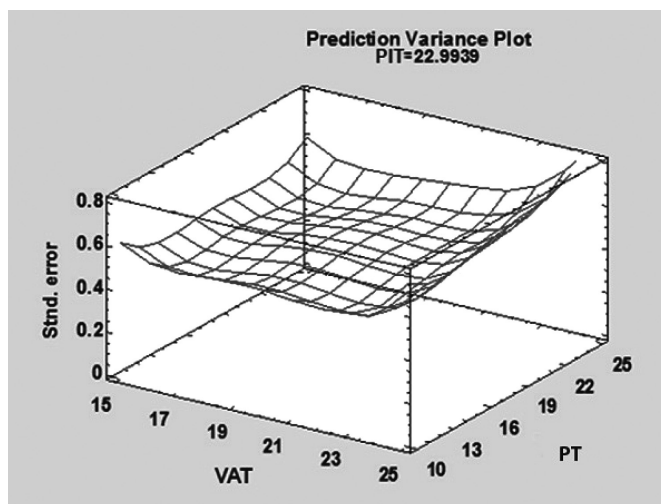


Fig. No. 1. The variation matrix of VAT and PT factorial data distribution when GDP=22.9939

Source: M. Švabovič, A. Miškinis (2016).

The data in Figure No. 1 demonstrate, as it was determined in the second phase of the research, that the variance of VAT rates comprises the rates from 15% to 25%, while the PT rates – from 10% to 25%. Figure No. 1 also demonstrates that response PIT rate selected in the experimental research equals 22.9939. At this stage of research, the authors make the assumption that it is this PIT rate which would be necessary in order to collect the 12,500 m EUR revenue to the state budget. The visual interpretation of Figure No. 1 makes it possible to see the interrelated combinations of other rates – the smaller the standard error is, the more accurate the data are. Accordingly, it is possible to see that the most relevant instances of variation are between VAT [15;17] and PT [10;16], between VAT [21;25] and PT [10;16], between VAT [15;17] and PT [22;25]. Thus, the lower the grid is, the more relevant the inter-variance of the taxes.

*The seventh stage of the research – the interpretation and evaluation of the achieved optimised tax rate response values.*

TABLE NO. 4. Optimise Response

Factor	Low	High	Optimum
VAT	15.0	24.0	17.2342
PT	10.0	25.0	15.2815
PIT	6.0	33.0	22.9939

Optimum value = 12500.0

The research demonstrates that in order to achieve the 12,500 m EUR revenue to the state budget during the crisis – the macroeconomic indicators and economic policy measures being constant – the following tax rate combination should be applied: VAT=17%, PT=15%, and PIT=23%.

As the response value of 12,500 m EUR was the one suggested by the authors, it was necessary to verify what most probable average value of the state revenue could be achieved in the nearest upcoming period (see Figure No. 2).

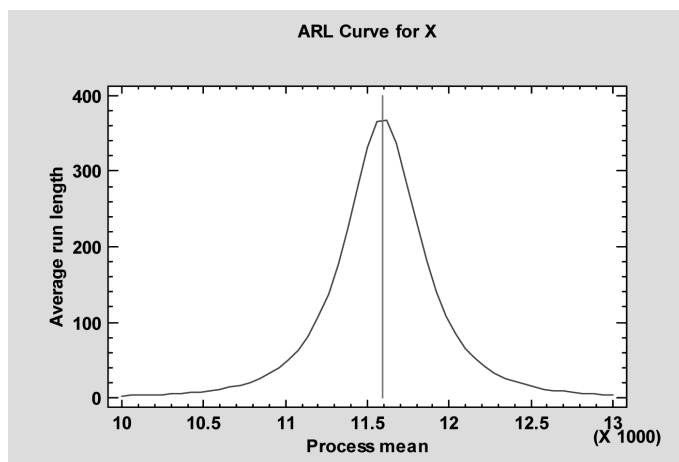


Fig. No. 2. The most probable state revenue value in the short term

Source: M. Švabovič, A. Miškinis (2016).

Figure No. 2 is presented in the shape of the ARL curve, which determines the dispersion of factorial values around the average state revenue value of 11,600 m EUR. The data reveal that as far as the process is concerned, this value has the highest probability; therefore, if the value is smaller or larger, the level of achievement decreases. From the point of view of the authors of this article, the response value is presented correctly because, statistically, it is more likely to achieve the response value closer to the research data average. This, however, does not have impact on the present study, because it only determines more precisely what value should be sought in the nearest period while applying the tax rates established earlier: VAT=17%, PT=15%, and PIT=23%.

In order to verify the prospects of the achieved rates, while applying the same tax rates VAT=17%, PT=15%, PIT=23%, a long-term forecast was drawn up (see Figure No. 3).

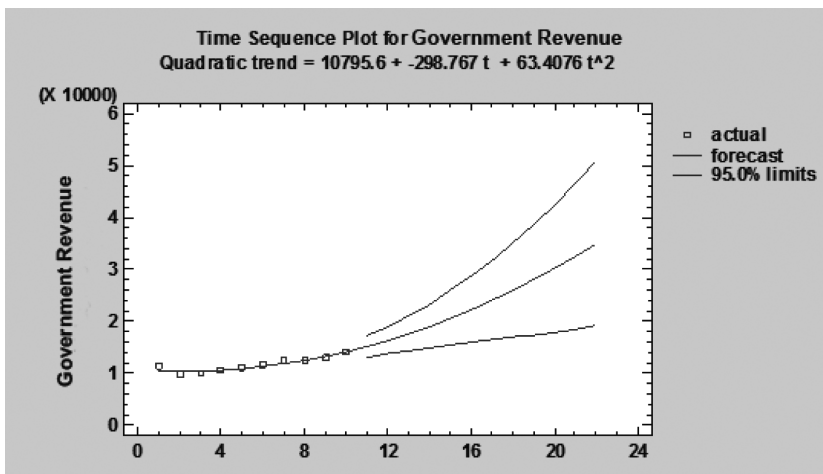


FIG. NO. 3. Long-term projection/forecast on government revenue, applying VAT=17%, PT=15%, PIT=23%

Source: M. Švabovič, A. Miškinis (2016).

The projection presents the quadratic trend function equal to  $10795.6 + -298.767 t + 63.4076 t^2$ . The forecast encompassed a twelve-year period. This forecast is aimed at the information of a more general character in order to determine whether it is worthwhile to change tax rates and whether they have the tendency to generate less revenue in the long term or not. The blue dots in Figure No. 3 represent the adjusted relevant data concerning state revenue; starting with mark 12, the forecast demonstrates that, in the long term, if these tax rates remain constant, state revenue tends to increase, which was also demonstrated by the previous research.

Our suggested experimental model of standard deviation partly corresponds to the RMSM.X model, designed by the World Bank, and is aimed to analyse the govern-

ment budget revenue by extrapolation method. The main similarities of the two models consist in the fact that the response value  $Y$  or  $T$  is the Government budget revenue, while the PIT, VAT and PT tax rates (whose basic tax rate is based on the value of GDP) are selected as determinant  $x$  or  $t$  indicators. However, the economic analysis tools and fields of research of these models are different. The basis of the model proposed by the authors of the current article is a standard deviation variants factorial analysis through experimental research based on statistical analysis verification methods, whereas the basis of the RMSM model consists of extrapolation elasticity analysis methods. In other words, the methods of the RMSM.X model are aimed more at the analysis of changes in the government budget revenue and at modelling projections, whereas the methods of a standard deviation experimental model aim more at the analysis of tax rate values in order to reach a certain government budget revenue. To date, such research, by applying the RMSM.X model, has not been conducted in Lithuania. Both in Lithuania and in other countries, when similar research is conducted, it does not perform a tax rate analysis but rather the analysis of the change in aggregate revenue from taxes.

#### **4. Conclusions**

The research demonstrates that during a crisis, the VAT rate ought to be reduced in order to conduct a stimulating fiscal policy. If, during a crisis, the tax rate is increased, the effects are reversed and the collected revenue decreases. For instance, until the end of 2008, the 18% VAT rate was applied in Lithuania despite the negative impact of the crisis, and the VAT revenue in 2008 (compared to 2007) increased by 18.1%. When in 2009 the rate increased to 19%, and later to 21%, the revenue from VAT decreased by 26.4%.

The Profit Tax rate must be reduced during a crisis in order to impose a stimulating fiscal policy. If during the crisis the tax rate is increased, the effect is the opposite, and the revenue yet again decreases. The 15% rate was applied in Lithuania until the end of 2008, and in spite of the crisis, the revenue from Profit Tax in 2008 increased by 41.7% compared to 2007; moreover, when in 2009 the rate was increased to 20%, the revenue decreased by 41.3%, compared to 2008.

The results received by modelling the state's main tax rates revealed that in 2008-2010, in order to collect the budget revenue of 12,500 m EUR, which would have covered the budget deficit, the following tax rates should have been applied: VAT=17%, PT=15%, and PIT=23%.

The introduction of tax reforms in 2009 was erroneous. The research demonstrates that the 15% Profit Tax rate should not have been altered, whereas instead of increasing the VAT rate from 18% to 21%, it should have been reduced to 17%.

Concerning the prospects for the state revenue growth, it should increase if the VAT=17%, PT=15%, and PIT=23% rates are applied.

It is concluded that the modelling system of the state's main tax rates used by the authors and the RSMS.X model complement each other; therefore, it is suggested that they both be applied for the analysis of economic policy tools and for the prevention of economic crises.

## REFERENCES

- Ahrend, R., Cournède, B., Price, R. (2008). Monetary Policy, Market Excesses and Financial Turmoil. OECD Economics Department Working Papers, No. 597, OECD.
- Alesina, F., Campante R., Tabellini G. (2008). Why Is Fiscal Policy Often Procyclical? Journal of the European Economic Association.
- Bachmann, R., Jinjui, H. Bai, N. (2013). Public Consumption Over the Business Cycle. Quantitative Economics 4/3.
- Benetrix, A. S., Lane, P. R. (2011). Financial Cycles and Fiscal Cycles. Trinity College Dublin.
- Čekanavičius, V. (2011). Taikomoji regresinė analizė socialiniuose tyrimuose [Applied Regression Analysis in Social Research]. Kaunas, 2011. SFMIS Nr. VP1-3.1-ŠMM-02-V-02-001.
- Design of Experiments Wizard. STATGRAPHICS – Rev. 5/14/2010.
- Forni, L., Monteforte, L., & Sessa, L. (2009). The General Equilibrium Effects of Fiscal Policy: Estimates for the Euro Area. Journal of Public Economics, 93(3-4).
- Frankel, J., Vegh, C. A., Vuletin G. (2011), Fiscal Policy in Developing Countries: Escape from Procyclicality.
- Galinienė, B., Melnikas, B., Miškinis, A. (2011). Ekonomikos modernizavimas: efektyvumo paieškos šiuolaikiniai prioritetai [Modernisation of the Economy: Search for Effectiveness; Contemporary Priorities]. Vilniaus universitetas.
- Gylys, P. (2009). The macroeconomic policy trap: Lithuanian case. Ekonomika, - 2009, Nr. 88.
- Harvey, T. J. (2010). Modeling Financial Crises: a Schematic Approach. Journal of Post Keynesian Economics, No. 33 (1).
- Hennessey, K., Douglas, H.E., Chairman, B.T. (2010). Causes of the Financial and Economic Crisis.
- Isaac, A. G. (2008). Monetary and Fiscal interactions: Short-run and Long-run Implications. Metroeconomica. Vol. 60, Blackwell Publishing Ltd.
- Karazijienė, Ž. (2009). Modelling of the Effect of the Public Sector Borrowing on the Lithuanian Economy. Inžinerinė Ekonomika - Engineering Economics (4).
- Karpavičius, S. (2008). Kalibruotas Lietuvos ekonomikos dinaminis stochastinis bendrosios pusiausvyros modelis [The Calibrated Dynamic Stochastic Model of General Equilibrium]. Pinigų studijos 2008/2.
- Klyvienė, V. (2014). Daktaro disertacija: Fiskalinės politikos įtaka Lietuvos, Latvijos ir Estijos makroekonominiam stabilumui [Macroeconomic effects of fiscal policy in Lithuania, Latvia and Estonia]. Vilniaus Universitetas, Ekonomikos fakultetas.
- Kindsfaterienė, K., Lukaševičius, K. (2008). The Impact of the Tax System on the Business Environment. Inžinerinė Ekonomika - Engineering Economics (2).

- Kvedaras, V. (2005). Taikomoji laiko eilučių ekonometrija [Applied Time Series Econometrics].
- Lakštutienė, A. (2008). Correlation of the Indicators of the Financial System and Gross Domestic Product in European Union Countries. Inžinerinė Ekonomika. Kaunas, 2008.
- Lapinskas, R. (2008). Ekonometrija su kompiuteriu II. Laikinės sekos [Econometrics with the Computer II. Time Sequences], Vilniaus universitetas.
- Liesionis, V., Račkauskas, M. (2012). Produktyvios valstybės išlaidos ir jų poveikis ekonomikos augimui. Taikomoji ekonomika [Productive State Expenses and Their Impact on the Growth of the Economy], Sisteminiai tyrimai: Kaunas, 2012.
- Melnikas, B. (2011). Transformacijos [Transformations]. Vilnius, Vaga.
- Miškinis, A., Novikevičius, V. (2005). The Reform of the Lithuanian Tax System. Current questions of the Efficiency of Public Finance, Financial Law and Tax Law in the Countries of Central and Eastern Europe. IVth international scientific conference. Košice, 2005.
- Miškinis, A., Augustauskas, M. (2011). Ekonomikos augimas: teoriniai požiūriai ir šiuolaikinė praktika. Ekonomikos modernizavimas. Efektyvumo paieškos ir šiuolaikiniai prioritetai [Growth of the Economy: Theoretical views and Contemporary Practice]. Vilnius: Vilniaus universiteto leidykla.
- Nowak, W. (2013). The World Bank Revised Minimum Standard Model: Concepts and Limitations. University of Wrocław. *Ekonomia* 19/2.
- Perron, P., Qu, Z. (2005). Estimating and Testing Structural Changes in Multivariate Regressions.
- Ravenhill, E. J. (2011). Global Political Economy. Oxford University Press.
- Ranaweera, T. (2012). The Revised Minimum Standard Model Extended (RMSM-X). Development – Vol. 1., World bank, USA.
- Russo, B. (2009). Innovation and the Long-run Elasticity of Total Taxable Income. *Southern Economic Journal*, 75 (3).
- Statgraphics Centurion XV. User manual. STATPOINT, Inc.
- Studenmund, A. H. (2005). Using Econometrics. A practical guide. Addison-Wesley.
- Šidlauskienė, B., Šeputienė, J. (2008). Bendros pinigų politikos optimalumo poveikis fiskalinei politikai. *Ekonomika ir vadyba: aktualijos ir perspektyvos* [The Optimum Impact of General Monetary policy on Fiscal Policy]. Vilnius, 2008, Nr. 3(12).
- Švabovič, M. (2016). Daktaro disertacija: Lietuvos ekonominės politikos priemonės krizės sąlygomis [Modelling State Economic Policy Decisions During the Crisis]. Vilniaus Universitetas, Ekonomikos fakultetas, Ekonominės politikos katedra.
- Uhlig, H. (1999). A Toolkit for Analysing Nonlinear Dynamic Stochastic Models Easily. Computational Methods for the Study of Dynamic Economies. Oxford: Oxford University Press.
- Valkauskas, R. (2005). Statistika [Statistics]. Vilnius: Vilniaus vadybos aukštoji mokykla.
- Weale, M. (2009). Commentary: fiscal and the fiscal position. *National Institute Economic Review*, 2009, Nr. 208.