

## Factors modelling of tax administration: the international assessment

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**Annotation.** The article includes economic and mathematical models which bring to light the connection between the factors of taxing process and the resulting indicator – the national tax systems rating based on the example of European Union countries and the Post-Soviet ones. Formed models revealed the main efficiency making factors (resulting factors) of tax administration systems of European Union countries and the Post-Soviet ones.

**Keywords:** *tax administration factors, international indicators, tax systems rating, economic and mathematical model, tax administration efficiency.*

**Introduction.** Large-scale tax reforms being carried out from the end of XX century till nowadays have the purpose to both increase the fiscal efficiency of national tax systems and decrease state finance misbalancing including the expense of the tax administration improvement. It is explained with the inconvenient conditions and the much debt accumulation of many countries that leads to active governments' search of tax reserves. Since taking the sole fiscal oriented actions in the economic uncertainty not always meets the needs, the innovative technologies introduction in the field of tax administration in the framework of the reforms carried out has become permanent.

Worldwide trend of tax administration improvement in the framework of tax reforms implemented creates the need for a study the key factors and the impact of those factors on the tax systems' efficiency, particularly in the part of tax administration.

### **The analysis of latest researches and publications.**

Both theoretical and practical questions of tax administration have been studied by known foreign and domestic scientists, in particular: Z. Varnalii, O. Voronkova, Ju. Ivanov, T. Kalinesku, A. Krisovatyj, V. Melnyk, L. Olejnikova, K. Proskura, A. Sokolovskij, K. Shvabii, J. Slemrod, [1-9] and others. In spite of the diversity of scientific views about the essence, theory and practice of tax administration, these questions still remain actual in domestic financial science. The assessment of the factors' impact on the efficiency (effectiveness) of the functioning the tax systems, in particular in the area of tax administration, needs further research.

**Setting objectives.** The purpose of the study is to establish a relationship between the factors of the taxation process and the resulting indicator (rating) on the example of the countries of the European Union and the post-Soviet space.

**Materials and methods.** Methodological and informational basis of work are scientific works, materials of periodicals, Internet resources. The information base of the study is the data of the taxation rating, which are defined within the framework of the Index of Business Ease (Doing Business-2017 report). In the course of the research, methods of structural-logical analysis, graphical, tabular, grouping, comparison and generalization, the method of averages, correlation-regression analysis were used.

**Results and discussion.** The administration of taxes is the basis for the effective functioning of the tax system in

order to ensure the completeness and timeliness of tax revenues to the budgets of all levels. That is why in the context of the dynamic changes of various tax instruments in the economy of most countries that are used by them in the process of tax administration, it is important to find out what factors have a decisive influence on the efficiency (effectiveness) of the tax administration system and the tax system as a whole.

The necessity of involving the study results published by international organizations and rating agencies for the purpose of this study is due to a number of factors. Among the most influential of them, in our opinion, are the differences that exist between national tax systems, in particular, in terms of tax classification; the inequality of statistical data of the countries of the European Union and the post-Soviet countries; the lack of tax authorities' monitoring of tax administration expenses (especially at the level of taxpayers and tax agents); mainly the occasional nature of open tax information in many post-Soviet countries, which does not allow us to make a conclusion about the efficiency of the tax system functioning and the administration of taxes in these countries. Therefore, the inclusion of tax indicators of international indices for the assessment of tax administration processes will allow them to make comparative analysis between countries (their groups) and to evaluate the efficiency (effectiveness) of the tax systems functioning and the administration of taxes on the basis of reliable and unbiased information.

In the previous studies [10] we found out that in order to assess the tax systems functioning and, in particular, tax administration efficiency at the level of individual countries, it would be useful to use the data published in the framework of the Index of Business Ease (Table 1).

The rating of the tax system, which is the result of the interaction of factors of the taxation process, each of which is given its place in the rating, is determined within the Index of ease of doing business.

According to this index, experts estimate countries by the following indicators: the number of tax payments per year "tax payments (number per year)"; Time required for the calculation and payment of taxes "time to comply (hours per year)"; Total Tax Rate (% of commercial profits), postfilling index [11] after reporting and payment.

In order to reflect the measure of factors influence (the number of tax payments, the time to comply, the total tax rate (as a percentage of a commercial profits) and

postfiling index) the resulting indicator – the rating of taxation – adequately, it is necessary to perform a certain analysis procedure. This procedure meets the needs of modern statistics and econometrics and is coherent to elements of correlation-regression analysis. At the first stage of the study, we formalize the problem – define the endogenous characteristic and exogenous parameters. The indicator of tax rating is chosen to be the resulting indicator (Y) and reveals the result of the factors interaction.

**Table 1.** Taxation process analysis by country groups in 2015 (the last round of meetings ended in June 2016)

| Countries  | Taxation rating, Y | Tax payments (number per year), X <sub>1</sub> | Time to comply (hours per year), X <sub>2</sub> | Total Tax Rate (% of commercial profits), X <sub>3</sub> | Postfiling index (0-100), X <sub>4</sub> |
|--|--------------------|--|---|--|--|
| EU countries-15                                  |                    |  |   |  |  |
| Austria  | 42                 | 12   | 131   | 51,6   | 98,5                                     |
| Belgium  | 66                 | 11   | 161   | 58,7   | 88,3                                     |
| UK   | 10                 | 8  | 110   | 30,9   | 87,4                                     |
| Netherlands                                      | 20                 | 9  | 119   | 40,4   | 93,4                                     |
| Greece   | 64                 | 8  | 193   | 50,7   | 79,3                                     |
| Denmark  | 7                  | 10   | 130   | 25   | 92,6                                     |
| Ireland  | 5                  | 9  | 82  | 26   | 92,7                                     |
| Spain  | 37                 | 8  | 152   | 49   | 92,6                                     |
| Italy  | 126                | 14   | 240   | 62   | 48,4                                     |
| Luxembourg                                       | 16                 | 23   | 55  | 20,8   | 89,9                                     |
| Germany  | 48                 | 9  | 218   | 48,9   | 97,5                                     |
| Portugal   | 38                 | 8  | 243   | 39,8   | 92,7                                     |
| Finland  | 13                 | 8  | 93  | 38,1   | 93,1                                     |
| France   | 63                 | 8  | 139   | 62,8   | 92,4                                     |
| Sweden   | 28                 | 6  | 122   | 49,1   | 90,8                                     |
| Average  | 38,9               | 10,1   | 145,9   | 43,6   | 88,6                                     |
| EU countries – new members                       |                    |  |   |  |  |
| Bulgaria   | 83                 | 14   | 453   | 27   | 73,3                                     |
| Estonia  | 21                 | 8  | 84  | 48,7   | 98,6                                     |
| Cyprus   | 34                 | 28   | 127   | 24,7   | 91,5                                     |
| Latvia   | 15                 | 7  | 168,5   | 35,9   | 98,1                                     |
| Lithuania  | 27                 | 11   | 171   | 42,7   | 97,6                                     |
| Malta  | 33                 | 8  | 139   | 43,8   | 86                                       |
| Poland   | 47                 | 7  | 271   | 40,4   | 92,2                                     |
| Romania  | 50                 | 14   | 161   | 38,4   | 79,6                                     |
| Slovakia   | 56                 | 8  | 192   | 51,6   | 89,9                                     |
| Slovenia   | 24                 | 10   | 245   | 31   | 95                                       |
| Hungary  | 77                 | 11   | 277   | 46,5   | 75,8                                     |
| Croatia  | 49                 | 31   | 206   | 20,9   | 97,9                                     |
| Czech Republic                                   | 53                 | 8  | 234   | 50   | 94,3                                     |
| Average  | 43,8               | 12,7   | 209,9   | 38,6   | 90,0                                     |
| Post-Soviet countries (except the Baltic states) |                    |  |   |  |  |
| Azerbaijan                                       | 40                 | 6  | 195   | 39,8   | 81                                       |
| Belarus  | 99                 | 7  | 176   | 54,8   | 50                                       |
| Armenia  | 88                 | 14   | 313   | 18,5   | 49,1                                     |
| Georgia  | 22                 | 5  | 270   | 16,4   | 87,2                                     |
| Kazakhstan                                       | 60                 | 7  | 178   | 29,2   | 49,1                                     |
| Kyrgyzstan                                       | 148                | 51   | 225   | 29   | 36,9                                     |
| Moldova  | 31                 | 10   | 181   | 40,4   | 91,4                                     |
| Russia   | 45                 | 7  | 168   | 47,4   | 87,6                                     |
| Tajikistan                                       | 140                | 12   | 258   | 65,2   | 41,8                                     |
| Uzbekistan                                       | 138                | 46   | 192,5   | 38,1   | 47                                       |
| Ukraine  | 84                 | 5  | 355,5   | 51,9   | 79,3                                     |
| Average  | 81,4               | 15,5   | 228,4   | 39,2   | 63,7                                     |

Compiled by the author based on [12].

Such choice is due to being the most actual representative of the taxation situation. Based on the economic logic of the research we choose the following explanatory variables for the analysis:

- X<sub>1</sub> – Tax payments (number per year);
- X<sub>2</sub> – Time to comply (hours per year);
- X<sub>3</sub> – Total Tax Rate (percentage of commercial profits);
- X<sub>4</sub> – Postfiling index.

It should be noted that considering the taxation rating to be the resulting indicator needs taking into account the interpretation of the analysis results (the inverse dependence is used – the largest value is assigned the value of rank 1).

The information base of the study is given in Table 1. Detailed analysis is illustrated by the example of a group of post-Soviet countries.

Applying the correlation-regression analysis, we take into account that its technology does not pretend to be an absolute reflection of all the aspects of the subject being studied. It is clear that all the factors influencing the resultant characteristic cannot be taken into account. As well as the linear structure of the model is not always able to take into account all the aspects. In spite of this, the proposed technology can be used at the initial stages of the study, and if necessary, enhanced by additional factors or a change in the structure of the model to the nonlinear.

We construct a linear multiple regression model. In this case, in the linear multiple regression equation, the factors must be significant and linearly independent, that is, there should be no multicollinearity, which worsens the quality of the model. Particular information for analysis is provided by correlation matrices (Table 2).

**Table 2.** Pair correlation coefficients

|                | X <sub>1</sub> | X <sub>2</sub> | X <sub>3</sub> | X <sub>4</sub> | Y        |
|----------------|----------------|----------------|----------------|----------------|----------|
| X <sub>1</sub> | 1              | -0,11986       | -0,18996       | -0,58044       | 0,72003  |
| X <sub>2</sub> |                | 1              | -0,11818       | -0,00845       | 0,13958  |
| X <sub>3</sub> |                |                | 1              | -0,04376       | 0,30735  |
| X <sub>4</sub> |                |                |                | 1              | -0,85937 |
| Y              |                |                |                |                | 1        |

Analyzing the matrix of pair coefficients, we can make some preliminary conclusions:

- The first and fourth factors have a close linear relationship with the resulting index ( $r_{xy} \geq 0,72$ ), the second and third factors are linearly independent of the endogenous characteristics;
- Small values of the coefficients of the pair correlation between the factors indicate a lack of multicollinearity.

To confirm the absence of multicollinearity, the initial factors were tested according to the Farrar-Globet criterion.

Then we build an economic-mathematical model in the form of a linear multiple regression

$$Y = a_0 + a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4, \tag{1}$$

where  $a_0, a_1, a_2, a_3, a_4$  – unknown parameters of the model that we find using the least squares method. We get the next model:

$$Y = 44,57 + 1,41 \cdot X_1 + 0,18 \cdot X_2 + 1,24 \cdot X_3 - 1,17 \cdot X_4 \tag{2}$$

Check the model for adequacy and accuracy. The regression equation and all its parameters are statistically significant. The model has significant approximation properties, as evidenced by the graph (Fig. 1), the

determination coefficient (99.7%), the average relative error of approximation is 5.97%.

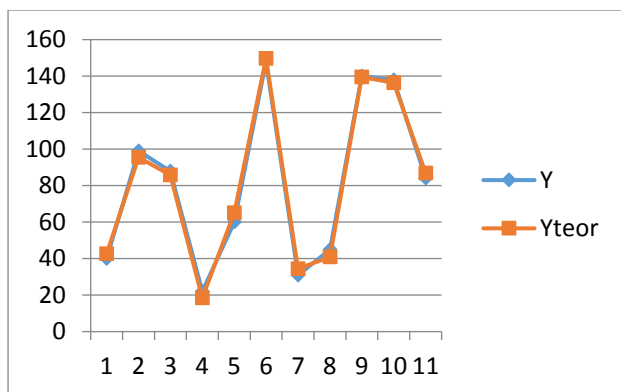


Fig.1 Schedule of actual (real) and theoretical (calculated) indicators of taxation rating for Post-Soviet countries

Here is an economic interpretation of the coefficients of multiple linear regression. With an increase in the number of tax payments per unit, the taxation rating is reduced by 1.41; an increase in the time of one hour leads to a deterioration of the rating by 0.18 positions; with an increase in the tax rate by 1%, the taxation rating is reduced by 1.24 points; an increase in the index of procedures after reporting and paying taxes per unit leads to an improvement in the tax rating of 1.17 positions. That is, if the first, second and third factors have a reverse effect on the resulting sign, then the fourth one has direct effect.

In order to assess the impact of these factors on the resultant characteristic, similar calculations were made for the groups of new EU member states and EU-15 countries.

The resulting regression equation for the new EU member states is:

$$Y = -5,79 + 2,16 \cdot X_1 + 0,18 \cdot X_2 + 1,72 \cdot X_3 - 0,9 \cdot X_4; \quad (3)$$

The average relative error of approximation is 7.43%. For the EU-15, the resulting regression equation is:

$$Y = 19,54 + 2,01 \cdot X_1 + 0,15 \cdot X_2 + 1,46 \cdot X_3 - 0,97 \cdot X_4; \quad (4)$$

The average relative error of approximation is about 18%

Comparing the influence of factors on the resultant characteristic of the three models, we can conclude:

- the second factor (time to comply) has the least impact on the rating of taxation. The value of the coefficient in the analyzed groups of countries varies within the range of 0.15-0.18;

- the first (the number of tax payments), the third (the total tax rate as a percentage of the company's commercial profit), and the fourth factor (postfiling index) have a significant impact on the outcome, but this impact differs across groups of countries.

In particular, comparing the results obtained by the analyzed groups of countries, it was found that for the new EU member states and the EU-15, the resultant indicator (rating of the tax system) is most affected by the number of tax payments (coefficients are respectively 2.16 and 2.01). Also, the total tax rate as a percentage of the company's commercial profit is a significant factor influencing them (coefficients equal respectively 1.72 and 1.46). The fourth factor has the relatively less influence - the postfiling index (the coefficients are respectively -0.9 and -0.97). At the same time, for the newly-acceded EU Member States, the influence of these factors (apart from the fourth) is not only decisive, but also significantly stronger compared to other groups. For the Post-Soviet countries, the influence of these factors is lower compared to other groups of countries, except the postfiling index (the coefficient has the highest value -1.17).

It can be explained by the significant changes in tax administration that have taken place in recent years in these countries and have been aimed not only to improve and simplify tax legislation, improve electronic payment of taxes, but also to reduce the number of tax payments, in particular as a result of the introduction of electronic forms statements, the nominal rates of budget-forming taxes (in particular, corporate income tax) with a simultaneous expansion of the tax base, as a result of the impact, significantly decreased in globalization and integration processes.

**Conclusion.** Comparing the factors influence the resultant characteristic of the three models, we can make the following statements:

- the second factor (time to comply) has the least impact on the tax rate. The indicator of the coefficient in the analyzed groups of countries varies within the range of 0.15-0.18;

- the first factor (the number of tax payments), the third (the total tax rate as a percentage of the commercial profit) and the fourth factor (postfiling index) have a significant effect on the result - the tax system rate (efficiency of the functioning of the tax system, in particular part of tax administration), but this effect differs across groups of countries;

- for the new EU member states and the EU-15, the number of tax payments is considered to cause the most significant effect, the total tax rate is also an influential factor and the fourth factor – the postfiling index - has a relatively lower impact. At the same time, for the new EU member states, the influence of these factors (apart from the fourth) is not only decisive, but also significantly stronger, compared with other groups. For Post-Soviet countries, the impact of these factors is lower compared to other groups of countries, except for the postfiling index.

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#### Моделирование факторов администрирования налогов: международная оценка

**О. В. Рудь**

**Аннотация.** В статье построены экономико-математические модели, позволяющие установить взаимосвязь между факторами процесса налогообложения и результирующим показателем - рейтингом национальных налоговых систем на примере стран Европейского Союза и постсоветского пространства. На основе построенных моделей выяснены основные факторы обеспечения эффективности (результативности) систем администрирования налогов стран Европейского Союза и постсоветского пространства.

**Ключевые слова:** факторы администрирования налогов, международные индексы, рейтинг налоговых систем, экономико-математическая модель, эффективность налогового администрирования.