

REPUBLIC OF AZERBAIJAN

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ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

**DEVELOPMENT OF ECONOMIC-MATHEMATICAL
EVALUATION METHODS OF THE EFFICIENCY OF TAX
ADMINISTRATION OF THE REPUBLIC OF AZERBAIJAN**

Speciality: 5302.01 – Econometrics, Economic statistics

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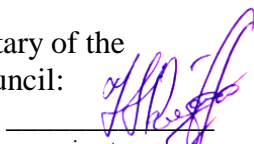
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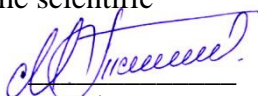
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GENERAL CHARACTERISTICS OF THE STUDY

Actuality and processing of the topic. Tax administration is a system of management of tax relations formed by the state on the basis of tax acts and laws approved in the country. It is also one of the key components of the state's economic strategy and one of the important factors shaping tax policy, which significantly affects the economic development and social welfare of the country. Tax administration involves the investigation and assessment of the tax compliance of any individual or legal entity, the organization of inspections, the detection of irregularities, etc. Tax administration is considered perfect (effective) when there is no difference between the confirmed tax laws and the actual practice. Even the best law can lose its importance in the inefficient organization of administration. That is why most of the researches in taxation in the world are aimed at developing of methods and tools to achieve effective administration. On the other hand, if tax administration is organized effectively, it plays a crucial role in eliminating or reducing tax evasion, which is one of the main causes of the shadow economy. However, given that more than 30% of the world economy is a hidden activity, it can be mentioned that not only in Azerbaijan, but also in developed countries, tax systems have not achieved effective organization of administration yet. In this reason, the necessity to define a indicators system that characterize the activities of the tax administration, to develop new methodologies and to build models for measuring efficiency, has remained actually for many years.

The importance of tax administration and its effective organization is clearly reflected in the following statement:

"Public policy exists when economic policy is effective (strong), economic policy exists when fiscal policy is effective, and fiscal policy exists if tax administration would be held effectively." That seems from this statement not only the economic development of the country, but also its social welfare directly depends on the organization of tax administration.

Due to the political nature of tax administration, its research and development of methodologies for improvement covers the interests of

not only economists and politicians individually, but also states. In this purpose, essential affairs have been implemented in the world, as well as in Azerbaijan, reforms have been carried out, various organizations have been established. There are numerous organizations around the world that measure the activity of tax administration in different countries according to various criteria, and reflect the results in their annual reports. The Organization for Economic Cooperation and Development (OECD) stands out among them. Since 2004, the OECD: Comparative Tax Administration Information Series has investigated the key elements of modern tax administration in 58 countries using a wide range of data, analysis and examples, and has reflected the main trends, the latest innovations and best practices for improving tax administration in their annual report. One of the tools to provide comparative measurement of tax administration worldwide is the Tax Administration Diagnostic Assessment Tool (TADAT). TADAT identifies the strengths and weaknesses of countries' tax system management through objective and standard assessments.

In addition, there are some organizations (TIGTA, CIAT, IOTA, etc.) formed by the United States, the European Union, as well as individual countries to improve tax administration. The Treasury Inspector General for Tax Administration (TIGTA) promotes efficiency in the management of internal revenue laws, ensures the disclosure and prevention of fraud, waste and abuse in related institutions.

The Inter-American Center of Tax Administrations (CIAT) is a non-commercial international public organization specializing in training and information exchange among 42 countries' national tax administrations that supports specialized technical aid to improve and strengthen tax administration. Intra-European Organization of Tax Administrations (IOTA) is an intergovernmental non-profit organization established to improve the financial functions of 44 member countries. The organization has supported by the European Union, the International Monetary Fund, the OECD, CIAT and the United States.

After independence, the Republic of Azerbaijan carried out radical reforms and made serious alterations in the tax system. The vast

majority of these reforms are related to the improvement of tax administration. Thus, the approval of the “State Program” covering 2005-2007, “Directions of tax reforms in 2016” and the Order of the President of the Republic of Azerbaijan on improving tax administration, the preference directions of State Program on “Enhancement of digital payments in the Republic of Azerbaijan in 2018-2020” such as “Expansion of the efficiency of the tax system” and “Further improvement of the tax administration”, amendments to the Tax Code, etc. serve to achieve effective tax administration.

As we have mentioned, taxation is one of the main research objects of economists who conduct exploration in the country and around the world. A.F. Musayev, Y.A. Kalbiyev, T.M. Humbatov, M.M. Sadigov, Z.H. Rzayev, I.M. Rzayev, B.A. Aslanbeyli, J.A. Ismayil are the well-known Azerbaijani economists who are the authors of valuable researches and monographs, not only on the tax administration, but also on the entire taxation. Their implemented affairs and researches in this field have played an important role in the effective formation of the tax system, including tax administration. Azerbaijani economists such as Y.H. Hasanli, M.C. Huseynov, T.A. Sadigov, E.M. Hajizade, A.A. Alakbarov and others have also devoted some of their research to taxation.

Taxation, as well as the management of tax relations and the organization of effective administration have been studied deeply by numerous foreign scientists such as V. Tanzi, A.V. Koren, A.V. Tatuiko, M. Yu. Orlov, I.A. Mayburov, C.T. Clotfelter, R. Fishman, S.J. Wei, W.W. Pommerehne, H. WeckHannemann, A. Sandmo, A.V. Koren, T.A. Efremova, I.A. Peronko, A.Z. Dadashev, A.V. Lobanov, M. Alink, C. Silvani, K. Baer, W. Crandall, G. Jakštonytė, L. Giriūnas and others.

All this proves the importance of tax administration and its effective organization, as well as the necessity for new researches to reach more effective administration.

Purpose and duties of the research. The purpose of the study is to investigate the existing tax administration in the Republic of Azerbaijan, to measure its effectiveness by developing various economic-mathematical methods and tools for its improvement, and

thus to identify its strengths and weaknesses. The purpose of the research was achieved by performing the following duties:

- Study of the existing tax system in the Republic of Azerbaijan, its stages of development;
- Investigation of the current situation on tax administration in the Republic of Azerbaijan and analysis of the results of purposeful reforms;
- Large-scale research of theoretical and methodological bases of tax administration, methodologies of its effective organization;
- Study of experience in selecting efficiency indicators characterizing tax administration;
- Comprehensive research of economic-mathematical methods, mathematical methods, survey methods and software programming, study of local and foreign practices related to their application in order to develop effective methodologies and assessments;
- Development of methodology and tools to provide the efficiency of tax administration;
- Evaluation of the proposed methodology and tools on the example of the tax system of the Republic of Azerbaijan.

Research methods. The targets of this research were implemented by using economic-mathematical modeling and programming, as well as, multi-criteria decision-making methods, methods based on fuzzy theory, statistical methods, numerical methods, Delphi survey method, functional analysis, comparative analysis, graphical representation, analysis, etc.

The main provisions of the defense. The following main provisions are defended in this research:

- The efficiency of tax administration was assessed taking into account quantitative and qualitative indicators, being the internal environment, the external micro and macro environment of the system;
- The matter that detection of tax evasion is one of the main tasks of the tax administration was substantiated and the probability of detection of tax evasion was assessed;
- The role of information in the activities of the tax authority and taxpayers, which is important for the effective implementation of the

administration, was investigated and an acceptable awareness level was assessed for both parties;

- The effectiveness of tax administration was analyzed in terms of measuring the level of professionalism of tax officials, which is particular importance to it and the professionalism level was evaluated;

- Tax collection was examined as one of the main factors determining the effectiveness of tax administration, taking into account quantitative and qualitative indicators, and the level of tax collection per employee of a tax authority was assessed;

- Taking into account the importance of paying the tax arrears for taxpayers, the period of Loss-Carryforward caused by emergencies was assessed;

- Software was developed for the proposed methodology and tools by using MathWorks MATLAB 2018b universal package and C# programming language, calculation experiments were implemented to the assessment of tax administration on the example of the Republic of Azerbaijan and recommendations were prepared according to the obtained results.

Scientific novelty of the research. The scientific novelty of the research consists of the following:

- For the first time, tax administration efficiency indicators were formed as a system characterizing its comprehensive activity being internal environment, external micro and macro environment, and on this basis an analytical expression of the tax administration efficiency index was proposed;

- A method was proposed to estimate the probability of detection of tax evasion in the utility theorem of Von Neumann-Morgenstern;

- A method was proposed to evaluate the awareness level of the tax authority and the taxpayer, which being the particular importance for the efficiency of tax administration, taking into account the information exchange process between them;

- In order to measure the efficiency of tax officials, methods were proposed to assess their professionalism levels and tax collection per employee, in contrast to traditional calculation methods;

– A scheme was proposed to tax debts carryforward to the next stages of affected taxpayers in “force majeure” cases.

Theoretical and practical significance of the research. Since dissertation work consists of new approaches, mathematical models and methodologies to measure the effectiveness of tax administration activities, it has great theoretical importance. The proposed system of efficiency indicators, the tax administration efficiency index, the methodology for detecting the probability of tax evasion, the model of awareness of the tax authority and taxpayers, the methodology for measuring the performance of tax officials and the loss carry-forward methodology contain its theoretical importance.

The practical significance of the research is the evaluation of the proposed approach, models and methodologies on the example of the tax system of the Republic of Azerbaijan. Thus, crucial results were obtained from these assessments, such as the level of administration of the existing tax system in our country, the impact of quantitative and qualitative indicators on the tax collection, the detection level of tax irregularities, etc. Important measures can be realized to improve tax administration by using these results in the Republic of Azerbaijan.

The proposed methodological approaches can be used not only in the Republic of Azerbaijan, but also in research on measuring the effectiveness of tax administration worldwide.

Approbation and application. Several results of the research were presented in the following conferences and reports.

– 13th International Conference on “Applications of Fuzzy Systems and Soft Computing”, 28-29 August 2018, Warsaw, Poland;

– International scientific-practical conference on "Economic growth and social welfare" dedicated to the 60th anniversary of the Institute of Economics of Azerbaijan National Academy of Sciences, October 18, 2018, Baku, Azerbaijan;

– Tenth World Conference “Intelligent Systems for Industrial Automation”, 25-26 October 2018, Tashkent, Uzbekistan;

– “Round table” held by the Institute of Economics of ANAS and the Georgian Fund for Strategic and International Studies with the participation of young economists, December 13, 2018, Tbilisi, Georgia;

– 10th international conference on “Theory and Application of Soft Computing, Computing with world and Perceptions”, 27-28 August 2019, Prague, Czech Republic;

– Important scientific achievements of the Azerbaijan National Academy of Sciences in 2018;

– Important scientific achievements of the Azerbaijan National Academy of Sciences in 2019;

Name of the organization where the dissertation work is performed. Azerbaijan National Academy of Sciences, Institute of Economics.

The total volume of the dissertation with a sign, indicating the volume of the structural units of the dissertation separately.

The dissertation is in the volume of 164 pages (by taking into account the requirements - 200171 characters) consisting of introduction (12916 characters), 3 chapters (Chapter I - 81036 characters, Chapter II - 73922 characters, Chapter III - 27949 characters), conclusion (4348 characters), 56 pictures, 7 graphs, 6 tables, 148 references and appendixes.

The total volume of the abstract is **37342** characters by taking into account the requirements

THE STRUCTURE OF DISSERTATION

Introduction

Chapter I. Theoretical investigation of tax administration and its effectiveness

1.1.Theoretical and methodological bases of tax administration

1.2.Stages of development of the tax system and tax service in

Azerbaijan, the current situation and its impact on economic development

1.3.Reforms to improve tax administration in the Republic of Azerbaijan

1.4.Analysis of the modern assessment arsenal of the effectiveness of tax administration

Chapter II. Methodology and instrumentations for the effectiveness of tax administration

2.1. Formation of efficiency indicators of tax administration

2.2. Efficiency model of tax administration process (efficiency index)

2.3. Modeling the process of detection of tax evasion

2.4. Modeling the level of awareness of the tax authority and taxpayers

2.5. Mechanism for assessing the professionalism level

2.6. Mechanism for assessing tax collection per employee of the tax authority

2.7. Modeling the process of fulfillment of the loss obligation

Chapter III. Assessment of the effectiveness of tax administration in the Republic of Azerbaijan

3.1. Evaluation of the tax administration efficiency index

3.2. Assessment of the probability of detection of tax evasion

3.3. Evaluation of the effective awareness level of the tax authority and the taxpayer

3.4. Assessment of the level of professionalism

3.5. Estimation of tax collection per employee of the tax authority

3.6. Assessment with the "Loss Carry-forward" methodology

Conclusion

References

Appendixes

BRIEF DESCRIPTION OF THE DISSERTATION

In the introduction part of the dissertation, the actuality of the topic was substantiated, the processing of topic was investigated, the goals, objectives and scientific novelties of the research were mentioned.

The first chapter of the dissertation, namely **“Theoretical investigation of tax administration and its effectiveness”** theoretical foundations of tax administration were explored extensively, the tax system and its formation stages in Azerbaijan, service and structural reforms to improve tax administration, its socio-economic results were looked through. At the same time, the existing methodologies for measuring the effectiveness of tax administration and the results of their application were studied thoroughly and analyzed.

In order to ensure the effective organization of tax administration, it is important to fully understand it and clarify what it means as a term. For this purpose, the theory of administration was analyzed separately, and different types depending on the field of application was proposed, in the first chapter [4].

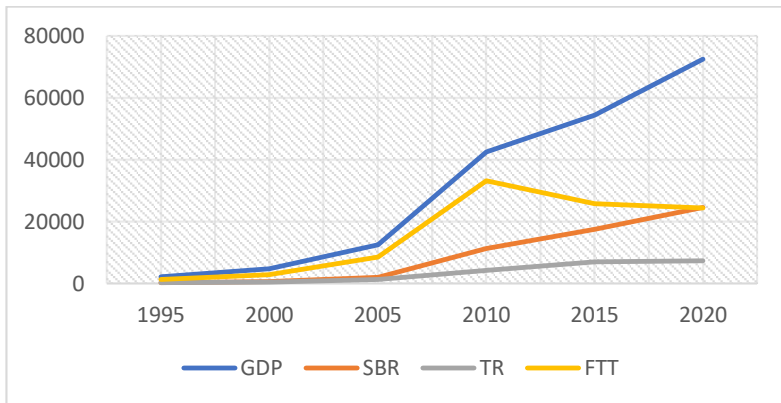
One of the main objects of the reforms that aim to improve the tax administration is economic development. To investigate this effect, tax administration reforms and changes in some tax rates have been analyzed, since 1991 (Figure 1).

Taxes	1991 - 2001	2001 - 2018	after 2019
Corporate Income Taxes	35%	27%, 25%, 24%, 22%, 20%	20% (in micro business is 5%)
Individual Income Taxes	12–55%	12%, 14% 35%, 30%, 25%,	0%, 14%, 25%
Value-Added Taxes	0 - 28%, 0-20%	0%, 18%	0%, 18%
Simplified tax	did not apply	4-6%, 4-8% 2-6%, 2-8%	2%, 8 %

Figure 1. Analysis of tax rates¹

As a result of these reforms, there is an increasing dynamics in the indicators characterizing economic development, such as gross domestic product (GDP), tax revenues (TR), state budget revenues (SBR), foreign trade turnover (FTT), etc. (Graph 1).

¹ Tax Code of the Republic of Azerbaijan // Entered into force on January 1, 2001 (amendments and additions on February 1, 2019). - Baku: Law, - 2019. – 276 p.



Graph 1. Analysis of economic activity²³

Various approaches were proposed to measure the activity of tax administration and to assess its effectiveness, methodologies were developed in the second chapter of the dissertation entitled “**Methodology and instrumentations for the effectiveness of tax administration**”.

First of all, it was justified that the effective organization of tax administration does not depend only on the internal environmental indicators characterizing the tax system such as provided services, tax officials, etc., depends on the external environmental indicators such as the business environment and related factors, as well as income levels, technological development and others. Therefore, a system of efficiency indicators was formed consisting of the internal environment indicators that characterize the internal activities of the tax authority and directly affects the administration, external micro-environment indicators which characterize the activities of taxpayers and directly or indirectly affects the administration, and external macro-environment indicators that characterizes the changes in the country, reflecting the impact of macro indicators [7]. Another crucial and distinctive feature of this system is the consideration of the indi-

²SSCRA. National Accounts System and Balance of Payments: [Electronic resource] / URL: https://www.stat.gov.az/source/system_nat_accounts/

³ State Tax Service under the Ministry of Economy of the Republic of Azerbaijan: [Electronic resource] / URL: <https://www.taxes.gov.az/az>

cators of all three environments in terms of quantitative and qualitative nature. The proposed efficiency indicators are given in Figure 2.

Using these efficiency indicators, an efficiency index of the tax administration process was prepared. The general expression of the index is as follows:

$$I_1 = \sqrt[n_1']{\prod_{j'=1}^{n_1'} (s_{1j'}^{\dot{q}y})^*} * \sqrt[n_1'']{\prod_{j''=1}^{n_1''} (v_{1j''}^{\ddot{q}f'})} \quad (1)$$

$$I_2 = \sqrt[n_2']{\prod_{j'=1}^{n_2'} (s_{2j'}^{\dot{q}y})^*} * \sqrt[n_2'']{\prod_{j''=1}^{n_2''} (v_{2j''}^{\ddot{q}f'})} \quad (2)$$

$$I_3 = \sqrt[n_3']{\prod_{j'=1}^{n_3'} (s_{3j'}^{\dot{q}y})^*} * \sqrt[n_3'']{\prod_{j''=1}^{n_3''} (v_{3j''}^{\ddot{q}f'})} \quad (3)$$

$$I = \sum_{i=1}^3 I_i \quad (4)$$

Herein,

I_1, I_2, I_3 – measures the efficiency of the internal environment, external micro and external macro environment, depending on their quantitative and qualitative nature, respectively;

I – the index of tax administration efficiency;

i – the groups of factors;

q – whether the indicators are quantitative (\dot{q}) or qualitative (\ddot{q});

j – factors that included in groups, by taking into consideration of being quantitative and qualitative then : $j = j' + j''$;

m – the number of groups;

n_i – the number of factors that in group i , by taking into consideration of being quantitative and qualitative then: $n_i = (\dot{q} + \ddot{q})n_i = n_i' + n_i''$;

$(s_{ij'}^{\dot{q}y})^* \vee v_{ij''}^{\ddot{q}f'}$, $i = \overline{1,3}$, $j' = \overline{1, n_{\dot{q}3}}$, $j'' = \overline{1, n_{\ddot{q}3}}$ – expresses normalized prices on quantitative and qualitative indicators.

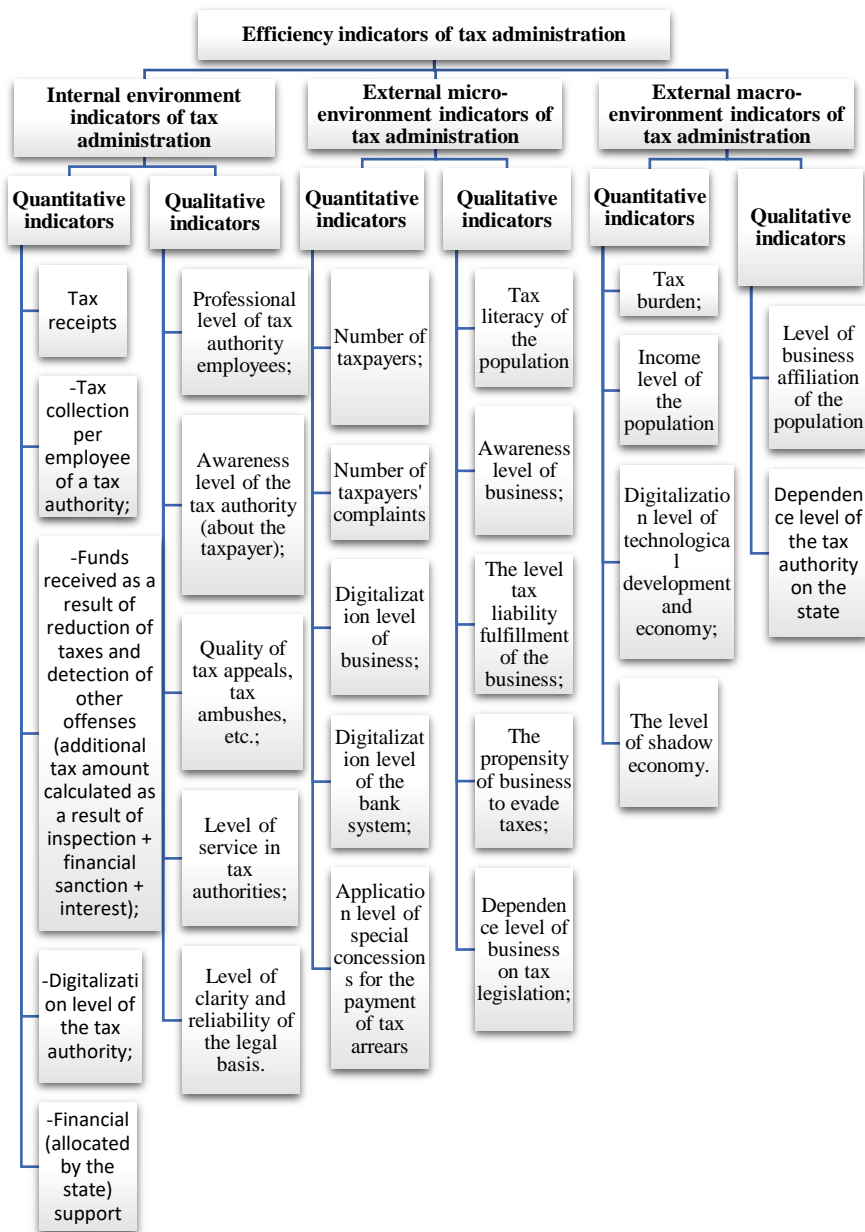


Figure 2. Tax administration efficiency indicators

This chapter also examines methods and tools for detecting irregularities such as tax evasion and avoidance, which are important tasks of tax administration, and develops a methodology for assessing the probability of tax evasion in the utility function of Von Neumann-Morgenstein, using the proposed efficiency index. For this purpose, $\mu(I_i)$, $i = \overline{1,3}$ - the impact of the quantity $I_i, i = \overline{1,3}$, which characterizes each environment separately in the detection of tax evasion was determined and the probability of evasion was estimated by applying the fuzzy inference system as follows.

If Input 1 is $(I_1 \mu(I_1))$ and Input 2 is $(I_2 \mu(I_2))$ and input 3 is $(I_3 \mu(I_3))$, then Output is p (5)

Herein, $(I_1 \mu(I_1))$, $(I_2 \mu(I_2))$, $(I_3 \mu(I_3))$ – the inputs of system, p – while the output variable of the system is the probability of detecting tax evasion.

Information, which is an important impetus of decision-making, is also one of the main conditions for the effective organization of management. Tax policy, which plays an particularly important role in ensuring economic development and prosperity, can be implemented more effectively if both the tax authority and taxpayers have the necessary information. For this purpose, a methodology was developed to determine the effective awareness level by examining the role of information and its impact on administration in the activities of both tax authorities and taxpayers.

The mathematical expression of the process "Tax authority - Awareness level - Taxpayer" is proposed as follows.

$$\frac{\partial I}{\partial t} = \varepsilon^2 \frac{\partial^2 I}{\partial x^2} - \alpha(I - \omega_1)(I - \omega_2)(I - \omega_3) + (T_a + T_p)/2 \quad (6)$$

$$\begin{cases} \frac{dT_a}{dt} = (\gamma_{11}(\vartheta_1 + \vartheta_2)T_a + \gamma_{12}T_p) \\ \frac{dT_p}{dt} = (\gamma_{21}(\tau_1 + \tau_2)T_p + \gamma_{22}T_a) \end{cases} \quad (7)$$

$$\left. \frac{\partial I}{\partial x} \right|_{x=0} = \left. \frac{\partial I}{\partial x} \right|_{x=1} = 0 \quad (8)$$

Herein, $\varepsilon \ll 1$; $I(x, t)$ – the effective awareness level that is satisfactory to both sides under the influence of the tax administration;
 x – is the mass of information;
 $-\alpha(I - \omega_1)(I - \omega_2)(I - \omega_3)$ – expresses the reaction of taxpayers.
 As clarify from here, $\frac{\partial I}{\partial t} = 0$ in balance and since ε is infinitesimal, equation (6) will be as below:

$$\alpha(I - \omega_1)(I - \omega_2)(I - \omega_3) = 0$$

And the three-order equation has three roots such as $I_1(x), I_2(x)$ and $I_3(x)$

$$I_1(x) < I_2(x) < I_3(x)$$

In other words, the first case expresses a satisfactory level of information of the taxpayer, the third case belongs to the tax authority, and the second case expresses the effective level of information for both.

T_a – the volume of information obtained by the tax authority;

T_p – the volume of information obtained by the taxpayers;

ϑ_1 and ϑ_2 – types of information obtained by the tax authority;

τ_1 and τ_2 – types of information obtained by the taxpayers;

γ_{11} – the weight of importance of the information obtained by the tax authority for itself;

γ_{12} – the weight of importance of the information obtained by the taxpayer for the tax authority ($\gamma_{11} + \gamma_{12} = 1$);

γ_{21} – the weight of importance of the information obtained by the taxpayer for itself;

γ_{22} – the weight of importance of the information obtained by the tax authority for the tax payer ($\gamma_{11} + \gamma_{12} = 1$).

The quality of the activities of tax employees is one of the factors that directly affect the effective organization of tax administration. Therefore, an evaluation mechanism was developed to measure the level of professionalism of tax officials.

The assessment of the level of professionalism was investigated as a multi-criteria decision-making on the indicators of quantity, quality, creativity and work ethics, and provides a measure of the performance

of each employee on the basis of these indicators. The mathematical expression of the proposed model is as follows:

$$A_j = \sum_{k=1}^K \overline{c_j^k} w_j^{ks} \quad (9)$$

Herein, $\overline{c_j^k}$, $k = \overline{1, K}$, $j = \overline{1, m}$ – the average value of the criteria; A_j , $j = \overline{1, m}$ – alternatives (employees or staff); w_j^{ks} , $k = \overline{1, K}$, $j = \overline{1, m}$, $s = \overline{1, 5}$ – the weights for each interval. $\sum_{k=1}^K w_j^{ks} = 1$, $w_j^{ks} \geq 0$. According to the obtained results, the professionalism level of staff was evaluated as follows, in the range $[0, 1]$, at four levels $[0, P_1]$; $(P_1, P_2]$; $(P_2, P_3]$; $(P_3, 1]$.

- If $0 \leq A_j \leq P_1$ is not a professional;
- If $P_1 < A_j \leq P_2$ the professionalism level should be improved;
- If $P_2 < A_j \leq P_3$ the professionalism level is satisfactory;
- If $P_3 < A_j \leq 1$ the professionalism level is high.

Tax collection is considered to be the most important factor in characterizing the effectiveness of tax administration in the world, and in some cases the effectiveness of administration is assessed by its amount. The study examined tax collection as an internal environment factor of administrative activity and developed an assessment methodology that takes into account the impact of the quantitative and qualitative indicators that play significant role in this process, in contrast to traditional calculation methods. The following formulations were proposed to assess the tax collection per employee of a tax authority:

$$\tau = \frac{VD}{\frac{\sum_{i=1}^m \hat{c}_i}{m}} = \frac{VD}{\frac{\sum_{i=1}^m (\sum_{j=1}^n \hat{c}_{ij} w_j)}{m}}, \quad (10)$$

$$\tau = \frac{VD}{\frac{\sum_{i=1}^m \hat{c}_i}{m}} = \frac{VD}{\frac{\sum_{i=1}^m (CFC_i * [X * OFC_i + (1-X)SFC_i]}{m}}, \quad i = \overline{1, m}, \quad j = \overline{1, n} \quad (11)$$

Herein,

τ – “tax collection for per a tax employee”;

- \hat{c}_i – Measure for an alternative i ;
- CFM_i – Critical factor measure;
- OFM_i – Objective (quantitative) factor measure;
- SFM_i – Subjective (qualitative) factor measure;
- X – Objective factor decision weight;
- $(1 - X)$ – Subjective factor decision weight.

Our analysis of improving and increasing the efficiency of tax administration shows that the problem of detection and payment of tax debts are one of the main weaknesses of tax administration. Tax arrears arise for various reasons. In particular, problems arising in the activities of an economic entity, regardless of its will, do not allow it to fulfill its tax liability. The application of various forms of incentives to improve the performance of economic entities is important in ensuring economic development.

Therefore, a methodology was developed to apply concessions to taxpayers affected by accidents.

The process was carried out in two stages as follows:

- The first stage was dedicated to assess the situation of the affected economic entities and select the most suitable entity for the application of the concession;
- The second stage consisted of the changing the repayment period of the most suitable economic entity selected for the application of the concession, that means resolving the issue of transferring the debt obligation to the following years in the period of time determined by law, depending on its activities.

The third chapter of the dissertation entitled “**Assessment of the effectiveness of tax administration in the Republic of Azerbaijan**” consists of the application of the methodology and tools proposed in the second chapter on the example of the Republic of Azerbaijan.

The normalized values of the efficiency indicators used in the calculation of the index by various methods are given in Table 1 (given in detail in the Section 3.1 of the dissertation).

Table 1. Prices calculated for 2020 on the sample of the Republic of Azerbaijan

№	Indicators	Estimate
1.	Internal environment indicators of tax administration	
1.1	Tax receipts	0.9
1.2	Tax collection per employee of a tax authority	0.54
1.3	Funds received as a result of reduction of taxes and detection of other offenses (additional tax amount calculated as a result of inspection + financial sanction + interest)	0.54
1.4	Digitalization level of the tax authority	0.48
1.5	Financial (allocated by the state) support	0.87
1.6	Professionalism level of tax authority employees	0.51
1.7	Awareness level of the tax authority (about the taxpayer)	0.91
1.8	Quality of tax appeals, tax ambushes, etc.	0.29
1.9	Level of service in tax authorities	0.5
1.10	Level of clarity and reliability of the legal basis	0.295
2.	External micro-environment indicators of tax administration	
2.1	Number of taxpayers	0.22
2.2	Number of taxpayers' complaints	0.014
2.3	Digitalization level of business	0.62
2.4	Digitalization level of the bank system	0.64
2.5	Application level of special concessions for the payment of tax arrears	0.33
2.6	Tax literacy of the population	0.21
2.7	Awareness level of business	0.513
2.8	Dependence level of business on tax legislation	0.7
2.9	The level tax liability fulfillment of the business	0.71
2.10	The propensity of business to evade taxes	0.512
3	External macro-environment indicators of tax administration	
3.1	Tax burden	0.1; 0.4
3.2	Income level of the population	0.7
3.3	Digitalization level of technological development and economy	0.66
3.4	The level of shadow economy	0.08; 0.45
3.5	Level of business affiliation of the population	0.19
3.6	Dependence level of the tax authority on the state	1

As can be seen from the table 1, some indicators (3.1 and 3.4) will be indexed separately for both local and foreign statistics, as they have different values.

1. According to the information received from the State Statistics Committee of the Republic of Azerbaijan (SSCRA):

$$I = 0.73 \text{ or } 73\%$$

2. According to the information obtained from external statistical resources:

$$I = 0.67 \text{ or } 67\%$$

The proposed approach to the tax administration efficiency index was published in [8].

The probability of detection process of tax evasion using the efficiency index was estimated 45% by using proposed methodology. The proposed approach and the obtained results were published in [9], [10].

Three different situations are considered to assess the awareness level of the tax authority and taxpayers under the impact of the administration.

The effective awareness level based on the different values of $\gamma_{ij}, i, j = 1, 2$ and all three conditions, as well as the options that are ineffective for both parties with different simulations were also estimated and presented graphically in the dissertation (Fig. 3.3.4-3.3.6). Thus, in the case of $t = 0$, the awareness level of the tax authority and taxpayers is effective and in the interval of $[0.15; 0.2]$, do not depending on the different values of $\gamma_{ij}, i, j = 1, 2$ and each of the 3 conditions. However, when $t \neq 0$, significant changes in the level of awareness occur as a result of the influence of the tax administration and the level of information that is satisfactory to both parties is almost unavailable or close to it, depending on the effectiveness of the information obtained by the tax authority and the taxpayer. The results show that $[0.35; 0.58]$, $[0.5; 0.61]$, $[0.4; 0.58]$, $[0.38; 0.67]$, $[0.43; 0.62]$, $[0.4; 0.66]$, $[0.42; 0.51]$, $[0.45; 0.55]$ and other intervals indicate the effective level in different simulations. Taking into account the obtained results (intervals), we can mention that the awareness level is an effective in the range of $0.43 \leq I \leq 0.51$ that equally preserve the interests of both the tax authority and taxpayers (Fig. 3.3.1-3.3.3.),

(Appendix 22,23). An example of an effective solution is given in Figure 3.

$$\gamma_{11} = 0.5, \gamma_{12} = 0.5, \gamma_{21} = 0.5, \gamma_{22} = 0.5$$

Condition II.

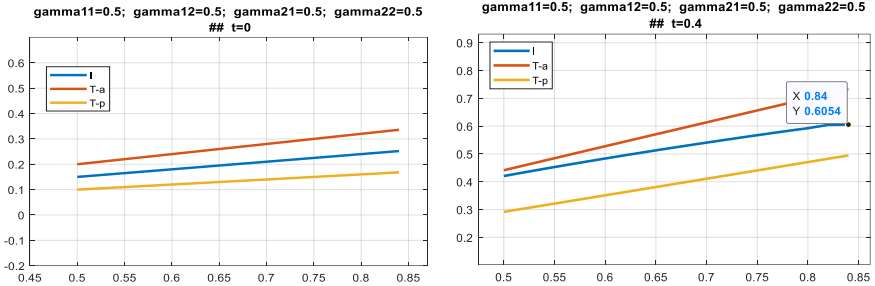


Figure 3. Effective awareness level

The required indicators and information to assess the professionalism level are summarized in Table 2. The assessment based on the proposed methodology shows that the professionalism level is in the range (0.25, 0.5], that means there is a need for improvement.

Table 2. Information required to assess the level of professionalism

No	Indicators	Volume	Mark
Quantitative indicators			
1	Number of taxpayers (legal entities) to mobile tax audit in the last reporting year	8	0.5
2	Number of taxpayers (legal entities) who have been detected as a violations of tax legislation	7	0.25
3	Number of taxpayers for whom the protocol has been drawn up	7	0.25
4	The amount of administrative imposed fines Paid part of imposed administrative fines	3000 2100	0.5
5	During a mobile tax audit of an average taxpayer in the reporting year: - The amount of additional assessed tax - Applied financial sanctions - The paid part of the additional accrued funds and the applied sanction	220000 70000 100000	0.6
Qualitative indicators			
1	Planning		0.5

2	Organization		0.75
3	Management and control		0.5
4	Making decision		0.25
Creativity indicators			
1	Ability to think innovatively		0.25
2	Ability to analyze.		0.75
3	Ability to investigate work interactions with other fields and assess potential impacts		0.75
Indicators of professional ethics			
1	Protection of service honor and professional reputation.		0.25
2	Fulfillment of rules of behavior and courtesy with citizens.		0.5
3	Prioritization of state and public interests over personal interests.		0.5

Using this methodology, the following results are obtained:

- Efficient and competitive activity of enterprises, organizations or government agencies increases;
- Allows employees to protect their interests, advance in their careers, and be rewarded according to their results;
- Through this assessment, subjectivity is prevented, bias and injustice in the decisions made by the leaders are eliminated;
- Helps key management make the right decisions.

The proposed methodology and the obtained results were published in [2].

Quantitative and qualitative indicators were taken into account in the assessment of tax collection per employee of the tax authority, and the results showed that:

- Tax collection per employee varies due to the impact of quantitative and qualitative indicators;
- In the case of equal effect of both (0.5), very close results are obtained with traditional estimation;
- Improvement of quality indicators leads to an increase in tax collection.

The proposed methodology and assessments are published in [6].

The process of Loss Carry-Forward, which is the last methodology of the study, was practically evaluated according to the mentioned stages by selecting the most deserving taxpayer to get concession among the 6 affected economic entities, and assessment showed the concession could be applied for 2,5-3 years. The application of the methodology is important for both the tax authority, the taxpayer and the economic development of the country:

- Allows to estimate the victims in the most transparent conditions without unfairness and to apply concessions by choosing the economic entity in the most difficult situation;

- Evaluates the duration of the discount depending on the severity of the damage;

- Helps reduce potential risks and economic losses.

The proposed methodology and assessments were published in [1], [3] and [5].

The main results and proposals of the dissertation

The results of the study are as follows:

1. It has been considered appropriate to divide the system of indicators into relevant subgroups, including internal, external micro and external macro environment, in order to improve the quality of assessment taking into account these indicators used in assessing the effectiveness of tax administration differ in their contribution to the overall result (Section 2.1). We have developed an appropriate index to assess the effectiveness of tax administration (Section 2.2).

2. In addition to the quantitative indicators used in the assessment of the effectiveness of tax administration, the importance of taking into account the quality indicators, has been substantiated and it has been assessed that the proposed approaches increase the adequacy of the overall result of the quantitative expression of quality indicators.

3. Experience shows that the same indicator that characterizes the performance of the tax system is expressed in different numbers in local and foreign statistical sources. It would be appropriate to evaluate the effectiveness of the proposed efficiency index, separately (in both cases) and compare the results in order to assess the effectiveness of the tax administration. This has been confirmed by evaluating via the

proposed efficiency index in the example of the Azerbaijani tax system, which was found to be 73% for local sources and 67% for foreign sources (Section 3.1).

4. A new approach has been proposed to assess the probability level of detection of tax evasion by considering the its high level is one of the main criteria reflecting the effectiveness of tax administration. The assessment of the Azerbaijani tax system (45%) confirms that there is a serious need for improvement in this area and the using of the proposed approach would be appropriate. (Sections 2.3 and 3.2).

5. It has been identified as a result of assessments when the mutual awareness level of tax authorities and taxpayers is unsatisfactory the disagreements between them and administrative conflicts cause to reduce the efficiency of tax administration, and a special tool has been proposed to determine the awareness level that satisfies both parties and has proven itself as a result of specific evaluations (Sections 2.4 and 3.3).

6. It should be considered that there is no effective approach to assessing the mutual awareness level between taxpayers and the tax authority, the effectiveness of tax administration depends on the level of awareness and it is important to increase the mutual awareness level of taxpayers and tax authorities. To this end, the tax authorities should raise the level of awareness and enlightenment, and taxpayers should improve the quality of tax compliance (Section 3.3).

7. An advanced methodology has been developed to assess the professionalism level tax officials that eliminates subjective factors affecting their career advancement and financial incentives and allows them to make effective use of existing human resources. The practical use of Azerbaijan in the tax system would be expedient (sections 2.5 and 3.4).

8. The need of using not only quantitative indicators in the assessment of tax collection per employee, which is one of the main indicators of tax administration efficiency but also the impact of qualitative factors, as well as their usefulness is not less in comparison with quantitative indicators in increasing tax revenues has been confirmed by assessments based on the proposed approach. It would

be expedient to apply it to the tax system of Azerbaijan (sections 2.6 and 3.5).

9. Effective management of tax relations is not matter only about increasing tax revenues, preventing tax evasion, etc., but also related to the ability of making decisions about taxpayers based on their financial situation. For this purpose, a tool has been developed to provide tax concession for taxpayers to change the period of fulfillment of tax obligations. It would be appropriate to apply it in Azerbaijani tax system (sections 2.7 and 3.6).

The main content of the dissertation is reflected in the published works as below:

1. Musayev, A.F. Evaluation of the Impact of the Loss Carry - Forward to the Tax Inclusion by the Fuzzy Inference System / A.F Musayev, A.A Musayeva, M. Kh Gazanfali // ASERC Journal of Socio-Economic Studies, Baku: – 2018. №1, – p. 73-81.

2. Musayev, A.F., Guliyev, H.H., Efendiyev, G.M., Gazanfarli, M.Kh. Evaluation of the staff's professionalism level by modified weighted sum model // Tenth World Conference “Intelligent Systems for Industrial Automation”, Tashkent, Uzbekistan, – 2018, – p. 111-112.

3. Musayeva, A.A. Evaluation of the impact of the changing the term of tax liability performance on tax receipts by Minmax composition method / A.A Musayev, T.M. Musayev, M. Kh Gazanfali // Advances in Intelligent Systems and Computing 896, Springer Nature, Switzerland AG, – 2019. – p. 378-385.

4. Gazanfarli, M. Kh. The role of "soft computing" in increasing the efficiency of tax administration // Personality, society, state: modern approaches to mutual relations Republican scientific conference, - Mingachevir, – 2019, – p. 463-465.

5. Musayev, A.F., Musayeva A.A., Gazanfarli, M.Kh. Assessment of the stages of fulfillment of the loss obligation by fuzzy methods // International scientific-practical conference on "Economic growth and social welfare", – Baku, – 2019, – p. 18-28.

6. Musayev, A.F. Evaluation of tax administration using brown-gibson model / A.F Musayev, A.G.Aliyev, A.A Musayev, M. Kh

Gazanfali // *Advances in Intelligent Systems and Computing* 1095, Springer Nature, Switzerland AG, – 2020. – p. 221-228.

7. Gazanfarli, M.Kh. Tax administration and organization of its effective activity // – Baku: News of Azerbaijan National Academy of Sciences, Economics series – 2020. №1, – p. 113-120.

8. Gazanfarli M.Kh. The effectiveness model of tax administration process / M.Kh. Gazanfarli // *Scientific Reviews in UNEC*, – Baku: – 2020. – p. 92-102.

9. Musayev, A.F. Modeling the Detection Process of Tax Evasion Under Uncertainty / A.F. Musayev, M.Kh Gazanfarli // *Acta Scientific Computer Sciences*, –Telangana: – 2020. №10, – p. 3-8.

10. Musayev, A.F. Modeling the probability of the detection process of tax evasion taking into account quality and quantity indicators / A.F. Musayev, M.Kh Gazanfarli // *Asian Journal of Economics, Business and Accounting*, - Hooghly: – 2020. №4, – p. 28-37.

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