Research Article

Modeling the Detection Process of Tax Evasion Under Uncertainty

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Abstract

In contrast to the classical approaches of the standard model of tax evasion based on game theory, our manuscript has considered the detection of tax evasion as one of the main function of tax administration and has proposed a model for assessing the probability of tax evasion. This investigation has been carried out on the basis of research methods such as scientific abstraction and systematic analysis, expert evaluation, logical generalization, statistical analysis. The level of tax administration, as well as the probability of detection of tax evasion in the Republic of Azerbaijan has been assessed with the proposed model and depend on the results, recommendations have been consulted for improving appropriate tax system. Proposed model drives practical significance as a providing effective activity of tax institutions by defining the level of tax administration, as well as, as an impacting remarkably the revenue of state budget by determining the probability of tax evasion's detection.

Keywords: *Probability of Detection of Tax Evasion; Tax Administration Efficiency Index; Allingham-Sandmo Model; Expert Evaluation; Uncertainty; Fuzzy Inference System*

Introduction

Tax evasion is an illegal activity in which an economic entity deliberately evades paying a real tax liability, and by its nature is an extremely difficult process to observe. Many literatures distinguish two forms of tax evasion: tax evasion and tax avoidance. While tax avoidance occurs due to loopholes in tax legislation, tax evasion occurs as a result of violation of tax legislation. Tax avoidance is a different declaration of economic activity to the tax authority in order to reduce the real tax liability, however tax evasion characterizes all illegal activities involving the hidden or shadow economy, unmeasured economic activity (online trade and etc). Therefore, they cannot be confused to each other. Since this global problem is wide spreading all around the world and could not eliminate yet, its theoretical and practical research has been one of the main interests of economists and politicians for many years. For this reason, a wide range of research and assessment mechanisms are exist on reducing the level of tax evasion, its origin, its detection and other similar issues. Let's look through some research on tax evasion.

Related literature

Thomas M. Porcano's study was one of the researches that to reduce the level of tax evasion in the period of increasing tax evasion in the United States. In his study, he analyzed the impact of 18 variables that could affect tax evasion. Special attention was paid to the use of these variables as independent variables in discriminant analysis to determine their relationship with tax evasion. However, the results showed that these variables affected distinctly to the

different types of tax evasion and that not all variables significantly affected tax evasion [1]. Using rich administrative information and convex political changes, investigating and enforcing the shift between illegal tax evasion and legal tax avoidance forced some wealthy people in Norway to disclose their previously assets that hidden abroad. From the moment they were revealed, increasing of the taxes paid by these individuals by 30% and that continuing of growth was observed over time. The results of the study showed that the detection of tax evasion by some wealthy people could be an effective way to increase tax revenues and reduce inequality in the country [2]. Charles T. Clotfelter explored the relationship between marginal tax rates and tax evasion. The data used in the study consisted of observations of the actual tax return information of individuals obtained as a result of a request from the Internal Revenue Service's Taxpayer Compliance Measurement Program (TCMP) for 1969. Overall, the results showed that excessive tax rates had a significant effect on the amount of tax evasion [3]. Tanzi, who tried to explain illegal activities in his research using aggregate information, had investigated the shadow economy in the United States. He proposed an econometric model that took into account the ratio of foreign currency deposits to the money supply as an indicator of hidden transactions - interest rates, the distribution of wages and salaries in personal income, per capita income and the average tax rate [4]. The impact of the tax rate on tax evasion in China was investigated by examining the relationship between the tariff schedule and the "evasion gap" by determining the difference between Hong Kong's declared level of exports to China and China's declaration of goods imported from Hong Kong. As a result, a one percent increase in the tax rate was revealed a 3 percent increase in tax evasion [5]. An empirical analysis of income tax discrepancy was conducted in Switzerland based on a standard model of tax evasion. Modification of that model revealed that the incompatibility was positively correlated with inflation. As a result, the discrepancy is significantly lower when there is direct control over citizens or taxpayers, and in contrast when there is no control [6].

As numerous theoretical and empirical analyses exist related with the tax evasion, it is feasible to expand further the review of the literature.

Evaluation models for detecting tax evasion

When have a look the literature, we have observed that several specific assessment models have been used to detect tax evasion.

One of the first and most widely used models for assessing tax compliance was proposed by Allingham M., Sandmo A. The classic model of rational choice of the taxpayer was based on the assumption that the taxpayer's decision to evade tax depends on the tax rate, the probability of detection of tax evasion and the rate of penalties. At the same time, this model assumed that in the circumstances of uncertainty the compliance of taxpayer's behaviors with the axioms of the Von Neumann-Morgenstern utility function and determined the expected utility of the income according to the reporting decision. The general expression of this model is as follows:

$$E[U] = (1 - p)U(W - \theta X) + pU(W - \theta X - \pi(W - X)) \ (1)$$

Where, W — is the real income of the taxpayer that unknown to the tax authority; X — declared income; θ — tax rate; p — the probability of detection of tax evasion and was assumed to be exogenous for the individual taxpayer in the model under consideration; π — penalty imposed when hidden income $(W - X)$ is discovered; $E[U]$ — indicates the maximum utility of the taxpayer [7].

This model has been accepted by many scholars as a standard model of tax evasion and various modifications have been developed to take into account the changing tax system, socio-economic situation, taxpayers and other factors. As an example, let us consider a few of them: In Lectures on Public Finance book chapter, the taxpayer's max utility function was defined by equation (1) and the probability of tax evasion was determined due to the penalty rate to be applied [8]. Theoretical and empirical analysis of the model of the first application of game theory to tax evasion was studied by James Andreoni and his co-authors, its shortcomings were identified and suggestions for the development of the model were made [9]. Modifications with the addition of labor force to the generalization of the simple Allingham-Sandmo model include studies by Sandmo [10], Pencavel [11], Cowell [12], Weiss [13] and others. One of the extended modifications of the standard model belongs to John H. Pencavel. He developed three modifications of the standard model and examined the robustness of these results. The first modification involved the assumption of a simplification of linear income tax schedules, the second involved considering an alternative form of the existing penalty function in the model, and the third surrounded the considering the consequences of a taxpayer's decision to declare joint hourly earnings [11]. According to Laurence Weiss 'Fraudulent tendencies encourage individuals to work harder to insure themselves against penalties that may arise

from audits, which in turn can lead to increased fraud' [13]. Another modification of the Allingham-Sandmo model is to take into account the iteration nature of the reporting decision. One of the very few studies the examining the dynamics of tax compliance belongs to Engel and Hines [14]. In their study, a model was proposed that influenced the response of individual and collective tax evasion to changes in the economic environment.

Materials and Methods

Detection of tax evasion as a main function of tax administration

Two important results are claimed in the existing literature on income tax evasion:

- Higher tax rates result to pay more taxes by declaration,
- An increase in gross income causes a decrease in its declared part of it.

In general, most investigations related with tax evasion, its detection and etc. have been conducted on income taxes or fines. In the existing analyzes the probability of the detection of tax evasion are accepted as either an exogenous variable or the edges of it are identified by related with the penalty that occurs in case of detection. Actually, no specific assessment of the probability of detection of tax evasion has been made. Therefore, this study attempts to measure the probability of tax evasion's detection through the efficiency of tax administration, which is one of the main function of tax administration. For this purpose, we have proposed a special model for the efficiency of tax administration, on this base of which the index of efficiency of tax administration has been determined and appropriate calculations have been made.

For this, in the first stage, tax administration and its functions have considered. Taking into account its impact on economic development and the formation of the state budget, we can mention that the improvement of tax administration is one of the most crucial conditions for the effective organization of public policy. Therefore, the main tasks of the tax administration, their improving by investigated each of them seperately, is one of the essential issues facing the state.

The main functions of tax administration are below [15]:

- Registration of taxpayers, including detection of non-registration and false registration;

- Processing of tax returns, withholdings and third-party information;
- Verification or examination of the correctness and completeness of received information (including audit activities);
- Assessment of taxes due;
- Process of enforced debt collection;
- Handling of administrative appeals and complaints;
- Provision of service and assistance to taxpayers;
- Detection and prosecution of tax fraud; and
- İmposing of penalties and interest payments.

When looking through the functions of tax administration, we observe that its main purposes are to involve taxpayers to the paying taxes in the manner prescribed by law, and to prevent tax evasion, fraud. In this sense, providing of effective activity of tax administration primarily leads to a reduction of tax evasion or detection of these types of circumstances , in other words, higher level of tax administration in the country can cause to less cases of tax evasion or avoidance. The reduction of tax evasion may occur by public awareness, severe financial sanctions, the applying of fines, the professionalism of tax administrators and other administrative measures. In this sense, by measuring the effectiveness of tax administration, we can determine the probability (p) of detection of tax evasion, avoidance or other similar frauds.

Modeling the assessing process of the probability of detection of tax evasion under uncertainty

It is known that the effectiveness of tax administration depends on the level of factors that characterize it. In contrast to the classical methodologies for measuring the effectiveness of tax administration, our previous study substantiated that not only the internal environment but also external micro and external macro-environmental factors also impact the effective activities of tax administration, and developed an efficiency index based on these factors [16]. In general, it is expressed as follows:

$$I = \frac{\sum_{i=1}^{3} I_i}{r_t}, i = \overline{1,3} \quad (2)$$

Herein, I —is the efficiency index of tax administration;

r_t — the rank of the under investigated country for tax liability;

I_i —is a parameter that characterizes the impact of all 3 groups of factors on tax administration, determined by the internal environment, external microenvironment and external macroenvironment, using expert assessments for the country under study. And accordingly for each of the 3 groups is calculated as follows:

$$\begin{cases} I_1 = \sqrt[n_1]{\prod_{j=1}^{n_1}\left(\frac{\Sigma_{k=1}^{f} v_{1j}^k}{f}\right)} \\ I_2 = \sqrt[n_2]{\prod_{j=1}^{n_2}\left(\frac{\Sigma_{k=1}^{f} v_{2j}^k}{f}\right)}, i = \overline{1,3} \ (3) \\ I_3 = \sqrt[n_3]{\prod_{j=1}^{n_3}\left(\frac{\Sigma_{k=1}^{f} v_{3j}^k}{f}\right)} \end{cases}$$

Where, $\mu_M(I_i)$ — are the membership functions (impact degrees) of the quantities $(i = \overline{1,3})$, which characterizes the state of tax administration in accordance with the mentioned three-direction factors in the fuzzy set of M;

$\alpha, \beta, \gamma, \theta, \pi$ —are the parametres of $\mu_M(I_i)$.

Using fuzzy inference system, we can assess the probability of detection of tax evasion by defining the parameters of the və $\mu_M(I_i) \, (i = \overline{1,3})$

Results and Discussion
Calculations

In order to check the adequacy of the proposed model to the process under investigation, the assessment of the administrative efficiency index for the tax system of the Republic of Azerbaijan has been carried out by a small group including 10 experts by taking into account above-mentioned percentage. In the first stage of implementing research, the objectivity of the results that obtained from experts, of the study was checked on the basis of the methodology mentioned in [16], the level of tax administration on the internal environment, external micro, and external macro-environment was determined:

$I_1 = 0.52$, $I_2 = 0.54$, $I_3 = 0.67$;

The next step, as mentioned above, consists of the finding of the μ_1, μ_2 and μ_3 impact degrees of , and quantities which affect to the detection of tax evasion. Using the fuzzy program package of Mathwork Matlab R2018b, μ_1, μ_2 and μ_3 were found as follows:
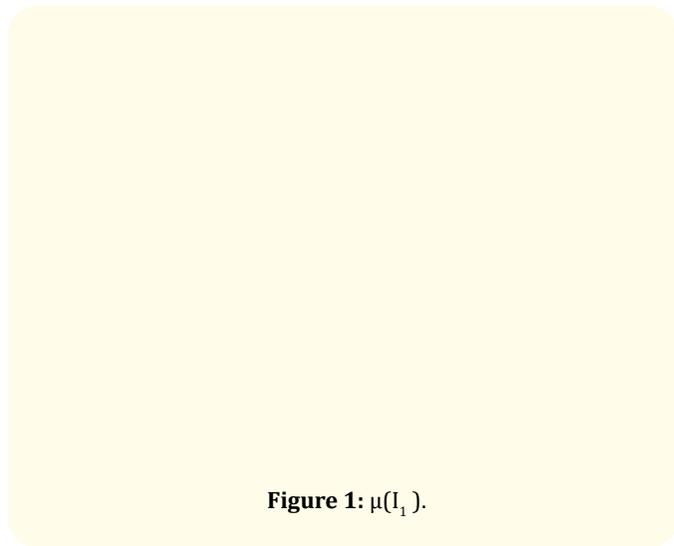
Figure 1: $\mu(I_1)$.
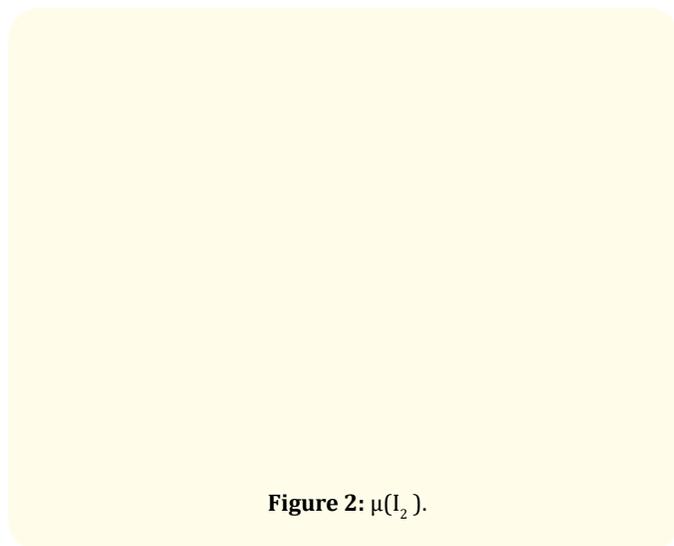
Figure 2: $\mu(I_2)$.

$\mu(I_1) = 0.57, \mu(I_1) = 0.57$, $\mu(I_1) = 0.71$

By evaluating I_1, I_2, I_3 that characterize the impacts of the internal environment, external micro, and macro-environmental factors to the tax administration and $\mu(I_1), \mu(I_2), \mu(I_3)$ which express the impact degrees of these factors to the detection of tax evasion, the probability of detection of tax evasion can be estimated by using fuzzy inference method as follows.
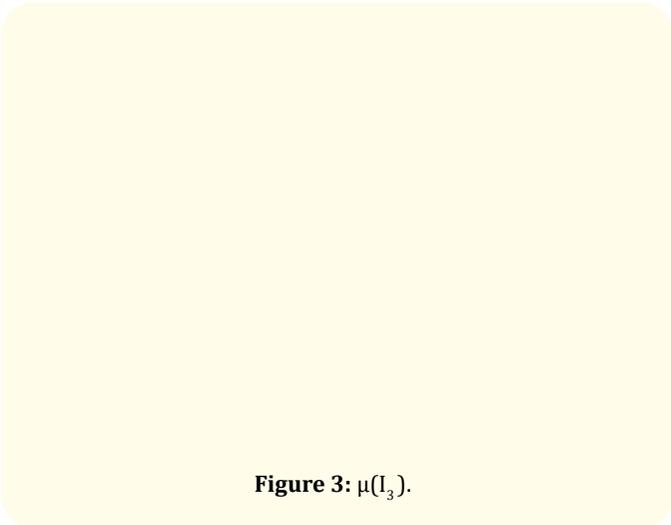
Figure 3: $\mu(I_3)$.
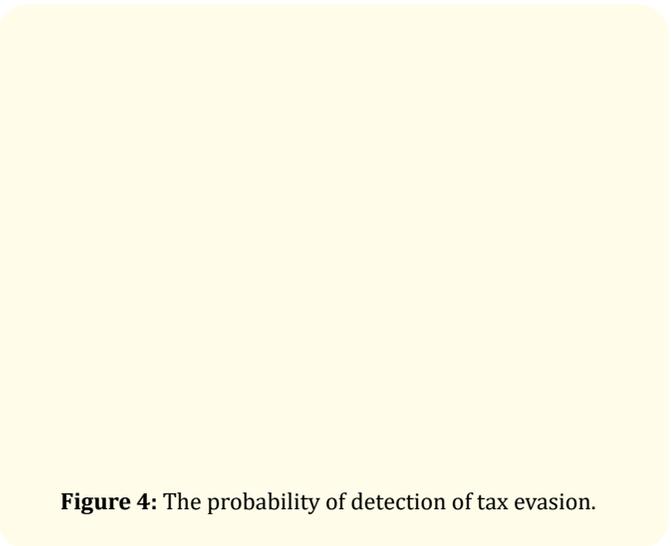
Figure 4: The probability of detection of tax evasion.

As can be seen from figure 4, the probability of detecting tax evasion by the applicating of a fuzzy decision-making system is 27%.

Conclusion

This manuscript is devoted to assessing the probability of detecting tax evasion depending on the level of tax administration, its functions, the factors that ensure its effective operation. The proposed approach was implemented by creating the necessary information base for the assessment in the tax system of the Republic of Azerbaijan using an expert survey, and consequently, the

tax administration of the country under study provides the detection of tax evasion and tax avoidance with 27 percent probability.

Conflict of Interest

There is not any financial interest or conflict of interest exists.

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