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ASSESSMENT OF TAX EVASION RISKS FOR VAT PAYERS

In this paper the distribution of basic indicators (turnover, calculation and payment) of VAT payers is tested by the χ^2 criterion. The results of the test show that having asymptotic normal distribution, tax calculations and payments for VAT payers follow the exponential distribution. However, their turnover doesn't follow normal distribution, as well as any asymptotic normal distribution. Tax evasion risks that have asymptotic normal distribution by exponential distribution model and the turnover indicator that is not subject to asymptotic normal distribution are assessed by the model based on maximum and minimum prices. Tax evasion risks of VAT payers aggregated by both approaches are identified in the form of a single indicator.

Keywords: *value added tax; turnover; exponentional distribution; tax evasion risk.*
JEL Classification Codes: C19.

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ОЦІНЮВАННЯ РИЗИКІВ УХИЛЕННЯ ВІД ПОДАТКІВ ПЛАТНИКІВ ПДВ

У статті на основі вибору за допомогою χ^2 критерію протестовано розподіл основних показників платників податку на додану вартість: обсяг обігу представлених товарів і послуг, сума розрахунків податку, сума сплачених податків. Тест показав, що розрахунок та сплата податку платників ПДВ підпорядковуються експоненціальному розподілу, що є асимптотично нормальним, однак обсяг товарів і послуг, представлених платниками податку, не підкоряється ні нормальному, ані асимптотично нормальному розподілу. Ризики ухилення від податків за показниками, що підкоряються асимптотично нормальному розподілу, оцінено моделлю експоненціального розподілу, а за показником обігу, що не підкоряється асимптотично нормальному розподілу — моделлю, яка спирається на оцінки max і min. Ризики за обома підходами узагальнено і представлено у формі єдиного індикатора ризику ухилення від податків платників ПДВ. Розрахунок індикатора ризику ухилення від податків платників ПДВ з метою аудиту має практичне значення у виборі платників ПДВ.

Ключові слова: *податок на додану вартість (ПДВ); сплата податків; експоненціальний розподіл; ризики ухиляння від податку.*
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ОЦЕНКА РИСКОВ УКЛОНЕНИЯ ОТ НАЛОГОВ ПЛАТЕЛЬЩИКОВ НДС

В работе на основе выбора с помощью χ^2 критерия протестировано распределение основных показателей плательщиков налога на добавленную стоимость: объем оборота представленных товаров и услуг, сумма расчетов налога, сумма уплаченных налогов. Тест показал, что расчет и уплата налога плательщиков НДС подчиняются экспоненциальному распределению, являющееся асимптотически нормальным, однако объем товаров и услуг, представленных плательщиками налога, не подчиняется ни нормальному, ни асимптотически нормальному распределению. Риски уклонения от налогов по показателям, подчиняющимся асимптотически нормальному распределению, оценены при помощи модели экспоненциального распределения, а по показателю оборота, не подчиняющемуся асимптотически нормальному распределению — моделью,

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опирающейся на оценки max и min. Риски по обоим подходам обобщены и представлены в форме единого индикатора риска уклонения от налогов плательщиков НДС. Расчет индикатора риска уклонения от налогов плательщиков НДС с целью аудита имеет практическое значение в выборе плательщиков НДС.

Ключевые слова: *налог на добавленную стоимость (НДС); уплата налогов; экспоненциальное распределение; риск неуплаты НДС.*

Problem statement. It is known that audit inspection in tax administration is an important instrument to preclude from the cases of tax evasion. Because human, time and financial resources are limited, there is no opportunity to have all tax payers subject to tax auditing. On the other hand, auditing creates obstacles to normal activity of tax payers. Therefore, as a rule only a little part of tax payers are exposed to tax audit. Selecting tax payers accurately for auditing, we need to identify the tax payers of the highest risk of tax evasion in orser to increase considerably the efficiency of tax auditing and save human, time and financial resources. Note that at present tax payers are divided into two groups in the tax system of Azerbaijan: simplified tax payers and the value added tax payers. The legal entity, whose volume of taxable transactions during consecutive 12-month period is 150000 manats (approximately 195 ths USD) and less, and physical persons engaged in business activity without establishing a legal entity, the volume of which is 90000 (approximately 115 ths USD) manats and less, have the right to be treated as simplified taxpayers. Otherwise, being registered for VAT they become VAT payers. A person engaged in entrepreneurial activities as a taxpayer of the simplified tax, calculates the amount of tax by applying the rates of 4% in Baku and 2% in other regions to the volume of the gross proceeds received for goods and services, and are exempted from all other state taxes (with the exception of land tax). VAT payers have to pay all state taxes (tax on profit, excises tax etc). At present there are approximately 219,000 simplified tax payers and nearly 18,000 VAT payers. The amount of the taxes paid by VAT payers to the state budget is quite big in the amount of total tax revenue.

Latest research and publication analysis. Generally, there is a number of sources (Bolgun and Baris Akcay, 2009; Jorion, 2007; Khwaja, Awasthi and Loeprick, 2011) dedicated to the theoretical and practical issues of risks assessments. However, few scientific sources refer to the assessment of tax evasion risks, VAT including. One of the reasons is that such kind of works are done by government authorities and are not published openly. For example, in Turkey for the purpose of tax audit a number of models are applied to assess tax evasion risks. But their publishing is not observed in scientific journals. On the other hand, it is very difficult to obtain the information reflecting the activity of tax payers and their tax payments. Still, there are certain sources for modelling tax risks and assessment.

A. Mazeika et al. (2011) and others explored e-audit models in the most risky automobile sector of formal economy which is of great importance for Lithuania. In this case determining the risks of tax payers will increase the efficiency of the activity of tax bodies and audit companies. VAT evasion risk in Nigeria was analyzed and the strategy preventing evasion has been studied in (Aruwa, 2008). For the purpose of increasing the efficiency of audit selection the algorithm of the assesment of tax evasion risk was worked out by (Gupta and Nagadevara, 2008). J. Slemrod (2007) investigated the tax evasion in the USA, especially evasion of the tax on the personal income.

There are some studies performed in the direction of evaluation of tax evasion in the Republic of Azerbaijan (Musayev and Gharayev, 2006; Hasanli, 2008). The indicators of tax payers in the above studies haven't been tested by statistic distribution. Whereas determination of tax evasion risk hasn't been implemented based on distributions, but it has been fulfiled by other approaches. Nevertheless, the tax evasion of tax payers was evaluated on the basis of distribution law (t-distribution) in the distribution of the indicators wasn't tested. As tax evasion risks of simplified tax payers don't follow the normal or asymptotic normal distribution it has been estimated through other methods.

The research objective of this study is to determine a numerical value (rang) for each taxpayer by modelling the risks of VAT payers which deviated from taxes. In order to achieve this purpose, first of all the main indicators (turnover of goods and services, tax calculations and tax payments to budget) reflecting the activities of VAT payers and their statistical distributions were tested by the criteria of chi-square. Then, depending on the test results, the assessments were carried out based on the relevant statistical distribution by making a risk model that has normal or asymptotic normal distribution indicators, however the risks were assessed by the relevant model on the indicators that have neither normal, nor asymptotic normal distribution. In the end aggregating the results of both types of models, the single risk of tax evasion was identified for each tax payer.

Key research findings. In order to investigate the problem, the main indicators reflecting the activity of tax payers such as turnover, calculation and payment have been chosen by random sampling of 1265 VAT payers. Let's evaluate the distribution of these indicators. Initially, we should determine which distribution have been identified on tax payments to state budget.

First, let's identify the number of groups (n) by using the Stercess's formula (Newbold et al., 2010):

$$n = 1 + 3{,}322 \times \log 1265 = 1 + 3{,}322 \times 3{,}101747 = 11. \quad (1)$$

The annual payments of the tax payers involved in sampling vary from 10 to 28710 manats (1 manat = 0.78 USD).

Let's calculate the value of interval:

$$h = \frac{x_{\max} - x_{\min}}{n} = \frac{287140 - 10}{11} = 26103. \quad (2)$$

And now let's identify interval groups:

$$x_1 = x_{\min} + h = 10 + 261134 = 26113; \quad (3)$$

$$x_i = x_{i-1} + h, i = 2,3,\ldots,11. \quad (4)$$

Here, x_i indicates the sum of the tax payers payments who are involved into the ith group: x_0 = 10; x_1 = 26113; x_2 = 52215; x_3 = 78318; x_4 = 104421; x_5 = 130524; x_6 = 156626; x_7 = 182729; x_8 = 208832; x_9 = 234935; x_{10} = 261037; x_{11} = 287140.

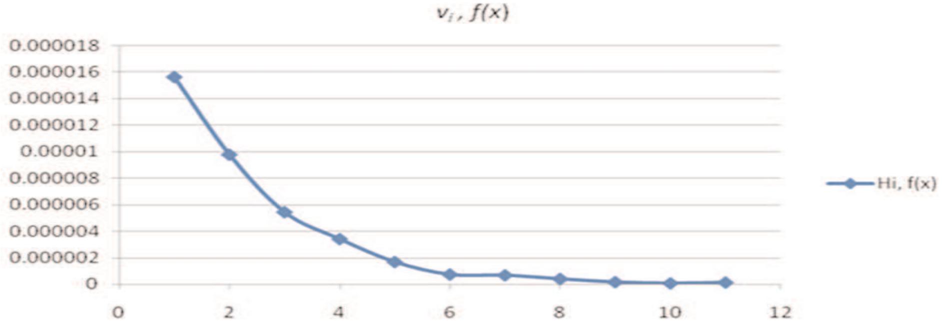
So, according to the sum of annual payments, VAT payers are divided into the following groups (Table 1).

With the reference to the information in Table 1, let's describe graphically the empirical distribution of indicators of tax payments (Figure 1).

Table 1. **The division and frequency of the annual payments of value added tax payers on groups**

Order number of groups	Amount of paid tax, in manats. $[x_{i-1};x_1]$-interval of groups	Number of tax payers, n_i – frequency
1	[10;26113]	516
2	[26113;52215]	323
3	[52215;78318]	180
4	[78318;104421]	113
5	[104421;130524]	54
6	[130524;156626]	25
7	[156626;182729]	23
8	[182729;208832]	14
9	[208832;234935]	6
10	[234935;261037]	5
11	[261037;287140]	5

Source: The Ministry of Taxes of Azerbaijan Republic data and calculations by the authors.



Source: With reference to the information in Table 1.

Fogure 1. **Density of payments of VAT payers in groups**

In Figure 1, the abscissa axis represents the intervals $[x_{i-1};x_1]$ on payments, and the ordinate axis represents the tax payers density (v_i) appropriate to these intervals.

On the graph, Figure 1, we could see that it is more similar to the graph of exponential function. If the graph is similar to the exponential graph, then we can assume that in the parent population the density distribution function of the tax payment indicator is an exponential function:

$$f(x) = \lambda e^{-\lambda x}. \quad (5)$$

Then it is neccesary to examine the assumption whether it is a correct.

Note that exponential distribution is an asymptotic normal distribution. That is, if the number of observations in the sample is quite big then it would become closer to normal distribution (Newbold et al., 2010).

For the purpose of determining the distribution law of the indicators of the tax payments of VAT payers to the budget the results of χ^2-chi-square test are given in Table 2.

$$\chi^2 = \sum_{i=1}^{11} \frac{(n_i - np_i)^2}{np_i} = 9{,}505. \quad (6)$$

If the distribution law in the X parent population is chosen properly, then the experimental value $\chi_{experimental}$ calculated on the sample will not be so big.

Table 2. **Calculation of χ^2-chi-square on the payments of VAT payers to the budget**

$[x_{i-1};x_1]$	p_i	np_i	n_i	$n_i - np_i$	$(n_i - np_i)^2/np_i$
[10;26113)	0,4196	530,42	516	-14,89	0,42
[26113;52215)	0,2435	307,79	324	15,96	0,83
[52215;78318)	0,1413	178,60	186	1,26	0,01
[78318;104421)	0,0820	103,64	113	9,29	0,83
[104421;130524)	0,0476	60,14	54	-4,18	0,29
[130524;156626)	0,0276	34,90	25	-9,92	2,82
[156626;182729)	0,0416	20,25	23	2,74	0,37
[182729;208832)	0,0093	11,75	14	2,24	0,43
[208832;234935)	0,0054	6,82	6	-0,82	0,10
[234935;261037)	0,0031	3,96	3	-0,96	0,23
[261037;287140]	0,0018	2,30	5	2,70	3,18
TOTAL	$\sum p_i = 0{,}9973$	$\sum np_i = 1261$	$\sum n_i = 1265$		$\chi^2 = 9{,}505$

Source: Calculated by the authors.

The hypothesis which we put forward about the distribution law in *X* parent population practicaly impossible in a big value of χ^2 random variable. It is considered that, the values of χ^2 random variable in $(\chi^2_{critic}, \infty)$ interval are practically impossible. Here, χ^2_{critic} number is found by the following condition.

$$p(\chi^2 > \chi^2_{critic}) = \alpha. \tag{7}$$

In reference to the specifically designed table for the χ^2 distribution it is found that $\chi^2_{critic} = 16{,}9$. The experimental value calculated on the sample is $\chi^2_{experimental} = 9{,}505$. It means that $\chi^2_{critic} < \chi^2_{experimental}$. So it is considered that *X* random variable has an exponential distribution with the parameter λ = 0,000021. The hypothesis which we put forward is accepted, that is to say the payments of VAT payers have the exponential distribution (asymptotic normal distribution).

Note that, with the appropriate test it was determined that tax calculations indicator of VAT payers and total tax calculations with payment are distributed by exponential law. However, the turnover of goods and services (the total amount of activities carried out by tax payers) doesn't follow the exponential distribution, generally doesn’t have normal or asymptotic distribution.

There are some reasons why the turnover indicator of VAT payers is not subject to normal or asymptotic distribution. There is a need for additional investigations in order to identify the reasons. Because these analyzes are out of the objective of this study, it has not considered in a wide range. At the same time, we can note that in some cases because VAT payers can not get appropriate documents to compensate for their purchased intermediate consumption of goods and services, VAT payers avoid registering officially a part of their turnover in order to avoid double tax. As a result, it may lead to the violation of distribution law on turnover indicator. For two reasons VAT payers can not get appropriate documents to compensate their purchased intermediate consumption of goods and services: Firstly, there are officially operated simplified tax payers in the country. And VAT payers can not give appropriate documents in order to offset VAT when they buy goods and services from simplified tax payers for intermediate consumption. Thus, according to 176.4 article of the Tax Code of the Azerbaijan Republic (2011) in order to offset VAT only VAT payers during purchasing of goods and services have the right to submit the relevant documents. Secondly, the existence of illegal economy. If VAT payers buy goods and services sold illegally, naturally they can not get documents for the VAT offset. As a result, this can lead to some variations from the normal or asymptotic distribution of VAT payers turnover.

Assesment of the risks of tax evasion on the indicators which have asymptotic normal distribution. We have noted above that the indicators of tax calculations and payment are distributed exponentially. The sum of the same indicators is distributed exponentially too. However, the turnover of goods and services (the amount of transactions carried out by tax payers) follows neither the exponential distribution, nor the normal and any asymptotic normal distribution.

Therefore, applying the methods based on normal or asymptotic normal distribution in order to assess tax evasion risks on calculation and payment indicators of VAT payers is relevant, however, applying other methods to assess risks on turnover indicators are more relevant for our purposes.

First of all, let's assess the risk of tax evasion by the distribution method (exponential distribution function) on turnover and payment indicators which have asymptotic normal distribution.

Tax evasion risk on calculations and payments has been assessed individually and totally by exponential distribution and standard Z-normal distribution. Risks were determined for each indicator, then they were generalized as an arithmetic mean. It became known that the value of unit risk which is generalized like the algebraic (numerical) mean of risks determined on seperate indicators does not differ so much from the value of risk for total indicators. Therefore, for simplicity, the assessment of risks was conducted on the total indicator of calculations and payments. However, it should be noted that, the results of risks assessment of the same indicators based on Z-distribution and exponential distribution were very different. Because of small risk diversification (almost 50% of tax payers deviated from taxes) on Z-distribution, we preferred the assesment of exponential distribution.

Exponential distribution is widely applied in statistical models on mass scaled economic processes, as well as for the continious works in time. This distribution plays an important role in reliability theory. If we consider it that tax evasion as a rule is observed in suspended and small businesses. Then, we can conclude that, it is relevant for our purposes to assess the tax evasion risk by exponential distribution. In this case, λ parameter in (5) density function can be interpreted as the intensity of tax evasion. It is generally believed that, tax payers in accordance to distribution of indicators indicated tax payers activity as subject to exponentional distribution. It is considered that risky tax payers in accordance to the distribution of indicators reflecting their activities are subject to exponentional distribution. As it is shown above, the average indicator on tax payments is $\overline{x} = 47961$ manat. Then, according to formula (9) the intensity of tax evasion is $\lambda = 1/\overline{x} = 0{,}000021$. It is obvious that, according to the x_i which is characterizing tax payment of every tax payers, the tax evasion risk is determined by the following expression in $(0,x)$ interval.

$$P(x;\lambda) = 1 - F(x;\lambda) = \lambda e^{-\lambda x}, \qquad (8)$$

where $F(x;\lambda)$ is integral function of exponential distribution.

$$F(x;\lambda) = \int_0^x \lambda e^{-\lambda t} dt = 1 - e^{-\lambda x}. \qquad (9)$$

For instance, according to the formula (9) the tax evasion probability (risk) of tax payer who have paid the amount of tax 40000 manat to government budget is equal to 0.4317. That is to say, 43.17% deviate from taxes, and 56.83% do not.

The outcomes of exponentional distribution function in EXCEL system

$$EXPONDIST\,(x;\ \lambda\ ;\ cumulative) \qquad (10)$$

is calculated by standard function.

Here, x is the value of exponentional distribution estimation; λ is the parameter of distribution; cumulative is a logical value for determining the picture of function. If cumulative = 1, than, function EXPONDIST is calculated by (10) integral formula, if cumulative = 0, than, function EXPONDIST is calculated by differential distribution formula (5).

On the basis of the sample observation the probability of risks of the tax evasion of VAT taxpayers with (9) has been transformed (Table 3) to 5-scored system in Table 4.

Table 3. **The schedule of risks of tax evasion of VAT payers**

Tax evasion risks (probability)	Level of tax evasion	Risk score
[0.0;0.2)	the highest risk	5
[0.2;0.4)	high risk	4
[0.4;0.5)	average risk	3
[0.5;0.6)	small risk	2
[0.6;0.8)	the smallest risk	1
[0.8;1.0]	no risk	0

Source: Calculated by the authors.

Table 4. **The structure of risk scores of tax evasion of VAT payers (with the exponentional distribution)**

Number of VAT payers	Share of VAT payers, %	Risk score
201	15.9	5
218	17.2	4
143	11.3	3
148	11.7	2
255	20.2	1
300	23.7	0
1265	100.0	

Source: Calculated by the authors.

As it is seen in Table 4, according to the level of tax evasion 15% of VAT payers belongs to the highest risk score 5, however 23.7% do not have any risk score at all.

Assesment of the risks of tax evasion on the turnover indicator which is not subject to asymptotic normal distribution. Now let's assess the risks of tax evasion of VAT payers on turnover which is not subject to any asymptotic normal distribution, and normal distribution.

The assessment of tax evasion of VAT payers will be realized in different ways from the above said model. Thus, on the basis of sample observation we determine that, the turnover which is one of the main indicators shows activities of VAT payers do not have normal and asymptotic distribution. We can conclude that the assesments of tax evasion risks on this indicator with distribution laws (normal distribution, t-distribution, χ^2 chi-square distribution, Puasson distribution and etc.) could give biased results. Therefore, the suggested method does not require normal or asymptotic distribution of indicators. This approach is based on the model that is applied on the calculation of country development rank in the UN development programme (1999).

Let's consider the following notation: j indicates the series number of VAT payers; TRN_j – the turnover indicator of j^{th} VAT payer; TRN_{min} – the mimimum level of turnover among all VAT payers; TRN_{max} – the maximum level of turnover among all VAT payers; $VATTEI^j_{trn}$ – the tax evasion index on the turnover of j^{th} VAT payer

$$VATTEI^j_{trn} = \frac{\ln(TRN_j) - \ln(TRN_{\min})}{\ln(TRN_{\max}) - \ln(TRN_{\min})}. \quad (11)$$

It is obvious that the indicator of $VATTEI^j_{trn}$ will get the values within the scale 0 and 1. If this index close to zero, it indicates that tax evasion (risk) is high, and closes to 1 indicates low risk.

The values $VATTEI^j_{trn}$ index on the sample of VAT payers in the segment [0,1] relatively has been transformed to 5-scored scale according to the system given in Table 3.

If $VATTEI^j_{trn}$ get the zero score, then this taxpayer is considered to be risk-free. If the risk score for a taxpayer is 5, that is to say, the calculated value of $VATTEI^j_{trn}$ is greater than 0 and less than 0.2, then this tax payer is considered to be the most risky one and such tax payer should be selected the first for tax auditing.

On the basis of the above mentioned approach, the risks on turnover – which is one of the key indicators which reflects the activity of VAT taxpayers has been evaluated on the basis of the sample observation among 1265 VAT taxpayers in the Republic of Azerbaijan. The results are shown in Table 5.

Table 5. **The Structure of tax evasion risk scores on the turnover of VAT payers**

Intervals characterizing the level of tax evasion	The level of tax evasion	The number of VAT payers	Share of VAT payers, %	Risk score
[0;0.2)	The highest risk	68	5.4	5
[0.2;0.4)	High risk	269	21.3	4
[0.4;0.5)	Average risk	158	12.5	3
[0.5;0.6)	Small risk	169	13.3	2
[0.6;0.8)	The smallest risk	295	23.3	1
[0.8;1]	No risk	306	24.2	0
Total	-	1265	100	-

Source: Calculated by the authors.

From Table 5 it is obvious that the number of VAT payers with the smallest risk of tax evasion is 306. The share of them in the total taxpayers is 24.2%. The number of taxpayers with the highest risk score is 68. The share of them in the total taxpayers is 5.4%.

Table 6. **Structure of the tax evasion risk scores of VAT payers (turnover + calculation + payment)**

Intervals of ratio	Level of tax evasion	Number of VAT payers	Share of VAT payers, %	Risk score
[0.0;0.2)	The highest risk	118	10.6	5
[0.2;0.4)	High risk	265	19.2	4
[0.4;0.5)	Average risk	143	11.9	3
[0.5;0.6)	Small risk	159	12.5	2
[0.6;0.8)	The smallest risk	280	21.7	1
[0.8;1.0]	No risk	302	24.0	0
Total	-	1265	100.0	-

Source: Calculated by the authors.

Conclusion. With the reference to the tax evasion score shown in Tables 5 and 6, according to the risk level of tax evasion the unit risk score of tax payers is calculated by the weighted average (Table 6).

As it is seen in Table 6, the number of VAT payers with the highest risk of tax evasion is 118. However, the share of it in total taxpayers is 10.6%. The number of tax payers with the smallest risk score, in other word, taxpayers with no tax evasion is 302. Their share in total taxpayers is 24%.

For the purpose of audit it is expedient to conduct the on-site tax inspection first on the taxpayers with the highest risks of tax evasion. As we noted above besides it prevents from the irrelevant interference in the activity of tax payers, it will also increase the efficiency of tax administration work.

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