# THE MODEL OF TAX EVASION, ITS CORRECTIONS AND COHERENCE TO THE PRACTICAL TAX ADMINISTRATION

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**Abstract.** *In this paper, a theoretical model of tax evasion, proposed by Allingham and Sandmo, is briefly presented. This model tries to explain the taxpayer's decision to reveal only part of the taxable income and to evade taxes in this way. The main parameters of the model are personal income, the rates of tax and penalty, probability of the tax audit. By the method of comparative statics it is possible, at least partially, to evaluate the influence of changes of the model's parameters on a person's decision to evade tax.*

*As some of the assumptions of the Allingam–Sandmo model differ from taxation rules in practice or the model's conclusions do not match the actual taxpayers' behaviour, in this paper some criticism and improvements of the proposed model are reviewed. A comparison of the model's assumptions and actual aspects of the tax administration in Lithuania is also provided.*

*This article contains also a model of tax evasion with regard for the peculiarities of tax administration in Lithuania and the possible corrections of tax audit probability function.*

**Key words:** *tax evasion, comparative statics, tax audit probability, risk management*

## Introduction

During the global financial crisis, governments faced a significant decrease of state budget revenues and a sudden need to finance major enterprises, e.g. banks, as well as to increase support of certain groups of inhabitants. These factors urged the states to review carefully the main sources of state revenues, i.e. taxes. Countries wishing to increase income not only amended the tax systems, but also began to intensify the fight against tax-evading individuals and businesses.

Although taxes have existed for centuries, only four decades ago the phenomenon of tax evasion became interesting for theoreticians of economics. The pioneers in this area are Michael G. Allingham and Agnar Sandmo. These scientists proposed a microeconomic model of tax evasion. The idea of the model is that a taxpayer before filling in a tax return has to decide how much income he will reveal knowing that there is a certain probability of tax audit. Using the method of comparative statics, some conclusions can

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be drawn; they, at least partially, explain the taxpayer's behaviour while changing the basic parameters of the model.

The purpose of this paper is to give an overview of the economic theory-based efforts to examine the phenomenon of tax evasion, paying particular attention to one of the model's parameters – the probability of tax audit. The object of the analysis is the criticisms and amendments of the Allingham and Sandmo model and a comparison of the model's assumptions and tax administration practices in Lithuania, as well as suggestions how to improve the model. The methods used are analysis of microeconomic models and legislation, and comparative statics.

The first part of the paper provides an overview of concepts related to the taxpayer's efforts, legitimate or not, to reduce the amount of tax due, and a proposition related to an alternative pattern of a taxpayer's behaviour according to the degree of its legality, as well as the main factors that influence the taxpayers' behaviour. The second and third parts of the paper contain a brief description of the Allingham–Sandmo model, its criticisms and improvements suggested by other scientists. The last part offers a discussion of how it is possible to improve the function of tax audit probability, taking into account the taxpayer's perception and the factors of actual tax administration, which determine the tax audit probability.

## 1. Concepts and factors determining tax evasion

Tax unavoidability appears to be encoded in the tax definition as "mandatory payments, defined in legislation by the state or local government, to the budget of a certain level or other non-budget funds" (Alekneviciene, 2005). Tax unavoidability was also highlighted by the US statesman Benjamin Franklin. In reality, however, the motive to increase one's financial resources (or at least not to lose them) as well as other factors are very strong and encourage part of population and enterprises to try saving or even gaining money at the expense of taxes.

While analysing the related literature, one first of all comes across a plenitude of different terms and definitions. For example, terms like "tax avoidance", "tax evasion", "tax concealment", "tax fraud", "tax mitigation", "(aggressive) tax planning", "tax optimisation" and other exist in the English language. Some of them emphasize taxpayers' willingness to plan payable tax amounts as a financial flow, while others stress tax evasion or even efforts to seize the state budget illegally. Therefore, the behaviour of taxpayers can be classified into three categories:
- planning payable taxes with the purpose to decrease them legally (attributable terms of the English language: "tax mitigation", "tax planning", "tax optimisation"; according to some authors, also "tax avoidance"), i.e. the taxpayer's legal actions corresponding to the logic of business which implements actual economic activities and has the right to decrease the payable tax amount are considered as tax

optimization / planning / minimization. For example, an enterprise uses corporate income tax concession in relation to research and development expenditures. When such an enterprise calculates the taxable profit, the latter expenses could be deducted three times from the income, actually decreasing the payable amount of tax without violating law in force;

- if a person seeks to undertake actual economic activities, provide inaccurate / false information about the activities, or, possibly, does not provide information at all, it could be entitled as tax evasion or concealment (terms of the English language "tax avoidance", "tax evasion", "tax concealment"; "tax evasion" is further used under this category). Some authors refer to "tax avoidance" as legal activities of a taxpayer, however, the word "avoidance" itself expresses unwillingness to pay taxes more than an ambition to plan financial flows. The most frequent form of tax evasion is giving inaccurate information about the tax base. The simplest example of tax evasion is an unaccountable income of goods sold and services provided;
- illegal actions of an individual (e.g., imitation of economic activities, etc.) are to be considered as "tax fraud". The latter category includes the taxpayers' actions that impose criminal responsibility.

The boundaries among the above-mentioned types of behaviour are not exact, and in particular countries the same operations of taxpayers might be differently interpreted. Further in this article it is dissociated from the phenomena of the first and third types, and situations when a taxpayer purposefully conceals the real amount of tax base are considered. However, tax administrators consider dishonest activities of the taxpayers more broadly. Such situations are:
- o an individual undertaking economic activities does not notify as a taxpayer;
- o a fraudulent declaration of the tax base (giving inaccurate data in the tax return) or a situation when information about the tax base is not provided at all,
- o overdue provision of tax return,
- o overdue or unpaid taxes.

It is worth noting that in Lithuania there are two main tax collecting authorities (tax administrators) – Customs and State Tax Inspectorate. There is also the Financial Crime Investigation Service which deals with criminal issues regarding taxes and other fees[1].

Another important question is: what are the factors that determine taxpayers' dishonest actions? Answers to this question are necessary for designing tax evasion models closest to the real situation. According to the European Commission, a taxpayer's decision to pay or avoid a tax is determined mainly by the following factors (European Commission, 2010):

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[1] According to data of Ministry of Finance of the Republic of Lithuania, the Customs and State Tax Inspectorate collected 16,46 billion litas of taxes in 2009 (http://www.finmin.lt/web/finmin/aktualus_duomenys (accessed 20.10.2010)). More than 90 percent of revenue is collected by the State Tax Inspectorate.

- a possibility to avoid taxes. E.g., an employee whose employer accounts and pays all the mandatory taxes of the employees' wage practically has no possibilities to avoid taxes, unless he / she arranges so with the employer. On the contrary, a self-employed individual has more possibilities to notify the state only about part of the income;
- comprehensible distributive, procedural and retributive justice. Comprehensible distributive justice includes taxpayer's opinion of the fair distribution of the collected taxes. If a person considers that the government dissipates his / her tax paid, the motivation for honest behaviour is considerably lower. Procedural justice is perceived as an appropriate behaviour of tax administrator with the taxpayer, e.g., whether the institution is perceived rather as a helper than a prosecutor. Retributive justice is correlated with an adequate punishment for violating tax laws. If, in the consideration of a taxpayer, the punishment is very severe, it will negatively influence his / her attitude towards the tax system;
- personal and social norms. Personal norms are particular attitudes of a taxpayer to fair tax payment / tax evasion, while social norms are society's attitudes to fair tax payment / tax evasion. Personal and social norms are interrelated since a person might absorb society's standards and turn them into personal ones;
- perception of the probability of tax audit and sanction. The higher tax audit probability and / or sanctions are conceived, the higher motivation to behave fairly is achieved.

Human behaviour (not only in the sense of tax payment) research has shown that people are likely to obey the laws when their personal standards are high, and the perception of punishment possibility and its extent are significant. If only one of the above-mentioned factors operates, an individual's motivation for fair behaviour is lower. Therefore, the tax evasion model design should at most take into account the mentioned factors. On the other hand, practical and experimental researches have shown that both in existing real tax systems and experimental conditions, there are always those who tend to cheat and those who are fair under any circumstance (Bilotkach, 2006).

## 2. The basic model of tax evasion

Theoretical analysis of tax evasion was started by Michael G. Allingham and Agnar Sandmo who proposed a microeconomic income tax evasion model (hereinafter the A-S model) in 1972. The essence of the model is a taxpayer who has to fill in tax return, needs to decide what to do, i.e.:
- indicate the whole sum of income;
- indicate only part of income. If the taxpayer chooses this path, he / she can be checked by the tax authority and punished. In this case, the situation becomes worse than in the case of being honest.

The assumptions and notations of the model (Allingham, Sandmo, 1972):

1) the taxpayer is risk-averse, the argument of his utility function is his income;
2) $W$ – total income of the person to be declared. It is an exogenous variable;
3) $X$ – the sum of personal income indicated in a tax return. It may be equal to $W$, if a taxpayer is a honest person, or below $W$, if a taxpayer decides to underreport his income;
4) $\theta$ – proportional rate of income tax;
5) $p$ – the probability that a person will be inspected by tax authorities (tax audit probability). If the taxpayer is checked, the whole sum of unreported income $(W - X)$ will be determined;
6) if the taxpayer is found to have concealed part of his income, a penalty is imposed – the amount of unreported income is taxed at rate $\pi$ which is higher than the tax rate $\theta$.

The taxpayer is considering how much revenue should be disclosed ($X$), and his decision is based on the maximisation of the utility of his revenue under the risk conditions. The von Neumann–Morgenstern utility function is chosen for this purpose:

$$\max_X E(U) = (1 - p) * U(W - \theta X) + pU(W - \theta X - \pi(W - X)). \tag{1}$$

The simplified notations:
o utility when the taxpayer is not checked:
$$U(W - \theta X) = U(Y). \tag{2}$$
o utility when a taxpayer does not disclose all income, his return is verified and a fine is imposed:
$$U(W - \theta X - \pi(W - X)) = U(Y). \tag{3}$$

When maximising (1) function the first order condition is:

$$\frac{\partial E(U)}{\partial X} = -\theta(1 - p) * U'(Y) - (\theta - \pi)pU'(Z) = 0. \tag{4}$$

By solving the fourth equation, it is possible to determine the value of $X$ to ensure that the taxpayer will maximally mind the given assumptions. The authors of the model have also stated that the taxpayer will conceal part of his income if the probable sum of taxes related to underreported income is less than the sum of tax that would have been paid if the taxpayer was honest, i.e.:

$$p\pi < \theta. \tag{5}$$

As the expression of a specific utility function is not known, by using the method of comparative statics it is possible to determine the impact of other parameters of the model on $X$. The results are presented in Table 1.

TABLE 1. **Results of comparative statics**

| Exogenous variable | Analysed effect | Expression | Sign of the impact |
|---|---|---|---|
| $W$ | $\dfrac{\partial X}{\partial W}$ | $\dfrac{\partial X}{\partial W} = -\dfrac{1}{D^*}\theta(1-p)U'(Y)\,*$ $*\left[-\dfrac{U''(Y)}{U'(Y)} + (1-\pi)\dfrac{U''(Z)}{U'(Z)}\right]$ | "+", if $\pi \geq 1$, i.e. if the income increases, reported income also increases. In other cases, there is no clear sign of the impact. |
| $\theta$ | $\dfrac{\partial X}{\partial \theta}$ | $\dfrac{\partial X}{\partial \theta} = -\dfrac{1}{D}X\theta\big[(1-p)U''(Y)+$ $+(\theta-\pi)pU''(Z)\big]+$ $+\dfrac{1}{D}[(1-p)U'(Y)+pU'(Z)]$ | The impact is not clear, since the increase of the tax rate encourages tax evasion, but the decline of income determines the lower level of risk tolerance. |
| $\pi$ | $\dfrac{\partial X}{\partial \pi}$ | $\dfrac{\partial X}{\partial \theta} = -\dfrac{1}{D}(W-X)(\theta-\pi)pU''(Z)-$ $-\dfrac{1}{D}pU'(Z)$ | „+", i.e. if the rate $\pi$ increases, the declared amount of income also increases. |
| $p$ | $\dfrac{\partial X}{\partial p}$ | $\dfrac{\partial X}{\partial p} = \dfrac{1}{D}[-\theta U'(Y)+(\theta-\pi)U'(Z)]$ | „+", i.e. if tax audit probability increases, the amount of declared income also increases. |

$*\ D = \theta^2(1-p)U''(Y) + (\theta-\pi)^2 pU''(Z)$ (the second order derivative
$$\text{of expression (1)).} \qquad (6)$$

Allingham and Sandmo also proposed a dynamic model. However, it is more complicated for presenting mathematically the decision of underreporting of the income in different periods. Besides, it requires making rather strict assumptions. So, the proposed solution did not receive much attention.

## 3. Criticism of the A–S model and its corrections

The initial A–S model allowed, employing the tools of economic theory and mathematics, only partially to explain the behaviour of taxpayers. In addition, some model assumptions did not match the actually functioning taxation systems. Therefore, the A–S model has been improved by Shlomo Ytzhaki. He took into account the fact that the penalty is usually imposed not on the concealed income, but it is rather related to the unpaid amount of tax (Ytzhaki, 1974):

$$U(Z) = U(W - \theta X - \pi\theta(W-X)). \qquad (7)$$

In this case, $\pi > 1$. $\qquad (8)$

It is more economically reasonable and just to impose a fine on the amount of the tax concealed, because the state experiences financial loss not because there is no correct data about the income, but because it does not receive part of income in the form of tax.

According to Article 139 of the Law on Tax Administration of the Republic of Lithuania, penalty is also related to unpaid taxes. More specifically, it can vary from 10 to 50 percent of the unpaid tax. The penalty rate depends on the seriousness of violations and a taxpayer's willingness to cooperate. On the other hand, the same law foresees the possibility to mitigate the penalty if both the taxpayer and the tax authority do not have sufficient proofs regarding outstanding taxes.

Another interesting thing to consider is the variety of tax audit types. For example, according to the Law on Tax Administration, there are two main types of audit – tax investigation and tax inspection. Tax inspection is a classic field audit performed at taxpayer's premises. Tax investigation was introduced at the same time when Lithuania became a member of the European Union as a result of tax law harmonisation. In 2009 State Tax Administration performed 1379 tax inspections or 2.6 times less than in 2005. This trend can be explained by more frequent tax investigations.

The main difference between tax inspection and tax investigation is that during a tax investigation, considerable tax sums can be identified but no penalty will be imposed as the taxpayer would be given a chance to correct the mistakes and pay the correct amount (there are some limitations and exceptions, of course). In case of tax inspection, if considerable tax sums are identified, a penalty will be imposed. For example, in the period 2005–2009, State Tax Administration determined approximately 173,6 mln litas of outstanding taxes every year (according to the data of the Inter-Service Tax Data Warehouse)[2]. In 2009, additionally assessed taxes accounted for approximately 1 percent of the total national budget revenue administrated by the State Tax Inspectorate.

Naturally, the change suggested by Ytzhaki fits the classic approach to tax audit. It improved the A–S model. The effect of the change in tax rate is clearly positive:

$$\frac{\partial X}{\partial \theta} = -\frac{\theta}{D}(1-p)U'(Y)\{X[-\frac{U''(Z)}{U'(Z)} - \frac{U''(Y)}{U'(Y)}] - \pi(W-X)*\frac{U''(Z)}{U'(Z)}\}, \tag{9}$$

where $D = \theta^2(1-p)U''(Y) + p(\pi-1)^2 U''(Z)$. $\tag{10}$

Interpretation of the results: when the tax rate is raised, the declared income also increases (the taxpayer acts more honestly). However, this finding contradicts the prevailing point of view that increasing tax rates cause higher incentives to evade tax. This result can be explained as follows: due to a decrease in income (since the tax rate increases) a person feels "less wealthy" and less inclined to take risks.

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[2] http://tds.ivpk.lt/files/demo/tds-ivpk-lt/lt/dok/4.1.pdf (accessed 20.10.2010).

It should be also noted that normally a cheating taxpayer must pay not only the concealed amount of tax, a fine imposed, but also an additional fine (interest) for the late payment of tax related to the concealed income. This additional payment may be explained by the fact that money has a time value, i.e. it may be possible that due to an underreported tax sum the state had to borrow additional money in order to fulfil its obligations and had to pay interest on the sum borrowed. On the other hand, the taxpayer could invest the concealed sum of money and get an additional financial gain. This is the reasoning why the taxpayer should get an additional fine. For instance, in Lithuania the interest rate on the unpaid tax is determined by the Minister of Finance. In the first quarter of the 2010, the interest rate was 0.05 percent for each day of delay[3]. The interest can be calculated for the period no longer than 180 days.

However, introduction of an additional variable of interest on the evaded amount into the A–S model is not so useful if the intertemporal choice of the taxpayer is not considered. Such variable also makes the model more complicated. Another reason for paying less attention to the interest is the fact that in Lithuania the calculated interest as well as penalty under certain legal conditions can be mitigated.

Another interesting aspect of the A–S model is its emphasis on the income tax evasion. However, how can one explain the behaviour of legal entities and how to build a model of indirect tax evasion? There are opinions that the firm is risk-neutral, but it should be noted that company owners are often individuals, and the risk-related attitudes of the enterprise managers who make corporate governance decisions may influence the company's behaviour, i.e. unwillingness to take risks. In addition, it should be noted that if companies do not disclose part of the income, it becomes an unaccounted economic benefit of individual persons (the owners and / or managers).

In case of indirect taxes, it is not appropriate to apply a proportional tax rate as in the A–S model. But, in essence, the company (the manager or the owners) has the same question – how much of income to reveal / hide? If the company decides not to reveal part of income, it avoids not only value-added tax (if the country chooses value-added tax instead of sales tax), company income tax, but it may also choose to pay part of wages informally without paying social security contributions and other fees (in Lithuania's case – compulsory health insurance contributions and contributions to the Guarantee Fund). Minding a wide variety of taxes and fees associated with the income, they can be merged into a single proportional indicator of the tax burden and used in the A–S model instead of the income tax rate (Escobari, 2004).

The authors of the A–S model themselves also paid attention to some of the assumptions that can be criticised. One of them – part of a natural or legal person's income is often known or can become known to the tax authorities. For example, if a company's clients

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[3] The rates of interest on unpaid tax. Ministry of Finance of the Republic of Lithuania. http://www.finmin.lt/web/finmin/palukanos/delspinig (accessed 02.04.2010).)

pay for the goods and services via banks, tax authority may ask the bank to provide information about transactions in a particular bank account. Another example – legal persons are often obliged to report the amount of money paid to individuals in the form of wages or for other reasons, as well as about dealings with other companies (i.e. to submit a register of invoices).

Considering the above-mentioned criticism, it could be stated that the taxpayer is aware of income which is known to the tax authorities, and certainly will not lie about it. This assumption once again stresses that tax evasion arises when there is a chance to evade.

On the other hand, the possibilities of a tax authority to identify income evaded during the tax audit can be doubtful as well, particularly if the goods or services are sold to individuals paying in cash. However, there are more reasons for the tax authority to fail in finding out the total sum of income. For example, the auditor's incompetence. This may correspond to the situation in a country's labour market: if wages in the public sector are lower than those in the private sector, the tax authority has smaller chances of attracting competent staff. The low wages and poor moral values of employees can lead to an even worse situation: corrupt auditors may cooperate with cheating taxpayers. Of course, there may be an opposite situation when the taxpayer is trying to bribe the auditor, but the auditor is honest and does not accept the bribe. In other words, the A–S model may be improved by including elements of the game theory. If the probability to cooperate with the tax auditor is equal to $g$ and the fixed sum of the bribe is $S$, the A–S model, when the penalty is associated with the amount of tax evaded, can be written as follows (Escobari, 2004):

$$\max_{X} E(U) = (1 - p) * U(W - \theta X) + p[(1 - g)U(W - \theta X - \pi\theta(W - X) +$$

$$+ gU(W - \theta X - S)]. \tag{11}$$

The taxpayer's expected utility:
o if the tax auditor does not agree to cooperate with the cheating taxpayer:
$$p(1 - g)U(W - \theta X - \pi\theta(W - X)); \tag{12}$$

o if the auditor agrees to cooperate and does not determine an outstanding income:
$$pgU(W - \theta X - S). \tag{13}$$

The A–S model may be also rewritten considering that the sum of bribe is proportional to the tax evaded (Escobari, 2004). This suggestion is reasonable as a larger amount of evaded taxes may require more financial efforts to persuade the auditor to cooperate.

A. Allingham and M.G. Sandmo considered another factor – the influence of personal character, i.e. when the detected tax evasion can ruin the reputation. So, there can be another variable influencing the taxpayer's utility – $U$ (*income, reputation*). On the other hand, the authors have concluded that this aspect is not so important.

J. P. P. Gordon adjusted the tax evasion model by including the psychological costs of tax evasion $v(W - X)$, where $v$ is the defining characteristic of a person's honesty (Gordon, 1989). A few interesting remarks by Gordon:

- taxpayers that are more likely to hide income, after increasing the tax rate will reduce the hidden sum of income;
- taxpayers that are more inclined to act honestly may start evading taxes as tax evasion does not look so immoral any more due to the higher tax rate.

Garreth D. Myles and Robin A. Naylor modified the utility function by adding the impact of society on an individual taxpayer (Myles, Naylor, 1996):

$$U = U(W[1 - t]) + bR(1 - \mu) + c. \tag{14}$$

Equation (14) describes the utility of a person who is reluctant to evade taxes. $R$ is the utility function with the argument $(1 - \mu)$, i.e. $(1 - \mu)$ represents the honest part of society. This function would show the utility arising from the fact that the taxpayer behaves in the same way as the honest part of society; $b$ is a non-negative coefficient, and the value $c$ expresses the amount of utility, which refers to the observance of social norms. Utility $bR(1 - \mu) + c$ cannot be received, if the taxpayer is cheating, but in this case he can benefit from tax evasion (Myles, Naylor, 1996).

The efforts to include the factors that are difficult to measure correspond to the work of Geert Hofstede who developed the cultural dimension theory[4]. This theory gives a quantitative expression of certain values and can be a good example of how such intangible factors are measured. In addition, one of the dimensions (masculinity, which can partially explain such a phenomenon as tax evasion) has an interesting correlation with the tax moral: Scandinavian countries have low masculinity index values, high tax rates and a high tax moral of inhabitants.

Another assumption of the A–S model that can be regarded as a shortfall is neglecting the labour supply, i.e. the taxpayer might actually work in the informal sector as well. In this case, the utility function ($L$ stands for leisure, measured in hours) (Sandmo, 2004):

$$E(U) = (1 - p)U(Y, L) + pU(Z, L). \tag{15}$$

The expected utility function should be maximised taking into account that

$$Y = (1 - t)w_0 H + w_1 h, \tag{16}$$

$$Z = (1 - t)w_0 H + (1 - \pi) w_1 h, \tag{17}$$

where $w_0$ is wage in the formal labour market, $w_1$ is wage in the informal labour market, $H$ is the official working hours, and $h$ is the hours of work in the informal sector.

The results of the above-mentioned model confirm the conclusion of Allingham and Sandmo that an increase of the penalty rate and audit probability reduces hidden income

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[4] http://www.geert-hofstede.com/ (accessed 20.10.2010).

and thus unpaid taxes. When the tax rate is raised, the taxpayer will devote less time to working in the official sector, but the model does not explain how, in this case, the taxpayer will allocate the rest of his time – he / she will work more informally or have more free time.

One of the authors of the A–S model, Agnar Sandmo, later modified the basic model in two respects: he revised the issue of the taxpayer (instead of ''how much to declare?'' he asks ''how much to conceal?''). He also took into account the amendments proposed by Shlomo Ytzhaki regarding the fine calculation.

According to A. Sandmo, the question "How much to conceal?" is more appropriate. This opinion may be based on the taxpayer's egocentric behaviour, i.e. he / she thinks of himself / herself first, and only then about the state. If $E$ would stand for the concealed income, expression (1) should be rewritten as follows:

$$\max_{X} E(U) = (1 - p) * U(W - \theta(W - E)) + pU(W - \theta(W - E) - \theta\pi E).$$ (18)

It should be noted again that in Lithuania the tax and penalty are secluded, i.e. if the auditor finds that the taxpayer has concealed some income, first of all a tax is imposed on this income and then, according to the additional tax calculated, a proportional fine is attributed. Therefore, expression (18) can be easily recorded as follows (in this case $\pi < 1$):

$$\max_{X} E(U) = (1 - p) * U(W - \theta(W - E)) + pU((1 - \theta)W - \pi E).$$ (19)

Another practical aspect of the tax system is that the taxpayer who acted unfairly and was caught in one fiscal period may be checked for previous periods as well. E.g., according to the Law on Tax Administration, a taxpayer may be checked for the current and five previous years. Therefore, a person determining how much to underreport should consider this fact. On the other hand, if the tax authority is unable to disclose fully a taxpayer's income, the intertemporal choice of tax evasion is less important.

In general, the A–S model has been amended in various ways in order to get better theoretical results which would match the taxpayer's behaviour in reality. Nevertheless, each model contains some assumptions that can be improved.

## 4. The problem of tax audit probability

In the basic A–S model, tax audit probability $p$ is exogenous and there were no other restrictions or additional comments indicated. However, the authors suggested another version of the model where tax audit probability is variable, i.e. depends on the taxpayer's income indicated in a tax return $p = p(X)$. In this case, the utility function is written as follows (Allingham, Sandmo, 1972):

$$E(U) = (1 - p(X))U(Y) + p(X)U(Z).$$ (20)

Authors posed a question regarding the function of probability – a decreasing or an increasing function, i.e. what is the sign of $p'(X)$. Considering that wealthy people are more likely to hide income, the sign of the derivative should be positive. Holding to the opposite opinion – a person who has a lower income in comparison to other similar taxpayers will be the evader – the sign of $p'(X)$ will be negative. Using the latter assumption and the method of comparative statics, the same conclusions as in the basic A–S model are reached: when the penalty rate increases, the amount of income declared also increases (although in reality the rich avoid taxes, too). When the penalty rate is increased, the amount of revealed income also becomes bigger. The higher value of the function of tax audit probability corresponds to a higher degree of taxpayer's honesty.

The indicated probability function can be questioned, since it can be rather complicated to identify the potential income of a certain taxpayer or taxpayers' group. E.g., if the entity sells goods and / or services to natural persons, it has very good conditions to conceal the income. This circumstance is understood by the whole group of taxpayers which are involved in the same type of economic activities. So, when everybody cheats, a comparison of honest and dishonest taxpayers becomes impossible.

The simplest calculation of the tax audit probability ($p$) can be defined by using the classic definition of probability:

$$p = \frac{\text{Number of possible tax audits (taxpayers to be audited)}}{\text{Total number of taxpayers}} . \qquad (21)$$

Such definition implies an equal probability for all taxpayers to be controlled, and thus there is an element of chance as each taxpayer can be audited with the probability $p$. Such practice of random audits is actually applied, but not as a tool to fight cheating taxpayers systematically, but as a way to investigate the general situation and learn whether the dishonest persons have not found new forms of tax evasion still unknown to tax authorities. On the other hand, in previous decades the tax authorities were generally seeking to control all taxpayers, because their number was not so large, and the possibilities to trace the tax evaders were more limited for technical facilities (e.g., there was no electronic data processing). For these reasons, quite often the tax administrators used to set specific "guidelines" of control frequency: a company of a certain size had to be audited at least once in $n$ years. In addition, it is very likely that the taxpayers have used to be controlled for all the tax periods that had not been checked since the last audit.

Article 114 of the Law on Tax Administration states that "the tax administrator chooses the taxpayers for control on its own". This means that in theory each taxpayer is facing a certain tax audit probability. However, both the interpretation of the mentioned article (Comentary of Law on Tax Administration, 2004) and the principles of the

modern tax administration (European Commission, 2010) state that tax authorities would be and actually are implementing modern means of compliance risk management. The main idea of compliance risk management is to treat a taxpayer according to his / her behaviour related to fulfilling tax obligations: the more risky the behaviour, the more strict measures are applied.

Hence, the tax audit probability actually depends on whether the tax authorities can (and how well) distinguish the tax evaders from the whole population and whether the institution has resources enough to perform the control of all risky taxpayers. Therefore, there are several important parameters: the accuracy of the identification (forecast) of tax evasion, the number of potential tax evaders, and the auditing capacity of tax authorities.

The accuracy of tax evasion is relevant only if the tax administrator while verifying the hypothesis related to the behaviour of a certain taxpayer (for example, the hypothesis is that the taxpayer X pays taxes honestly) makes an error of the second type, i.e. a cheating taxpayer is treated as a the honest one. Otherwise, if a honest taxpayer would be identified as an evader (the error of the first order) and then audited, it could be argued that the overall tax system has only won because the preventive effect is achieved. Of course, there can be a "bomb crater" effect when the audited person starts cheating thinking that one more audit is very unlikely (Kastlunger et al., 2009). In the opposite case, there would be an issue of the effective usage of human resources.

The number of potential cheaters and the capacity to deal with them are constantly important because there are always more dishonest taxpayers than the tax auditors. Considering the mentioned facts, it is useful to adjust the function of tax audit probability:

$$p = p(m, n, k), \tag{22}$$

where $m$ is the variable representing the tax authority's ability to identify potential tax evaders, $n$ stands for the number of potential tax evaders, and $k$ is the possible number of audits. When the values of $m$ and $k$ increase, the tax audit probability increases, and when the number of potential cheaters increases, the value of the probability function decreases. The parameter $m$ could also express the abilities of a tax administrator to set the priorities. For example, there can be two persons – potential tax evaders – identified, but one of them is a natural person who has a small garden and sells apples in a market without declaring his income, and the other taxpayer is a company which provides catering services, also concealing some of its revenue. Naturally, it is wiser to audit the company.

Involvement of the number of potential tax evaders into the function of tax audit probability connects the decision of a particular taxpayer with the behaviour of a certain society group. This quantitative value, at least partially, reflects the connection between the moral values of a certain group within society (and this group may be rather large) and the social norms of a particular taxpayer ("If everybody evades, I can evade, too").
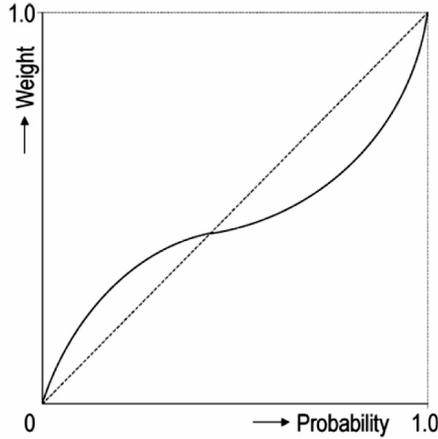
FIG. 1. **Connection befween objective and perceived (weighted) probability (Schwanen, 2008)**

It should be noted that the discussed parameters, which can influence the probability of tax audit, are known and more objectively perceived by tax authorities. In contrast, a taxpayer may not know what the views of tax authorities about his potential income are, how well the tax evaders can be detected, and whether there are sufficient resources to check all the returns. For these reasons, the taxpayer who considers cheating or not, is affected not by an objective probability, but by a perceived probability. According to the Kahneman–Tversky prospect theory, people tend to increase small probabilities and underestimate large probabilities (Kahneman, Tversky, 1992) (see Fig. 1).

Bernasconi (Bernasconi, 1998) uses the following transformation function of probability:

$$f(p) = 1 - \frac{(1-p)^\delta}{[p^\delta + (1-p)^\delta]^{1/\delta}}. \tag{23}$$

Here, the $\delta$ value falls within the range (0;1). The parameter $\delta$ determines how the probability is transformed: the smaller value of $\delta$, the greater corrected likelihood is calculated, and vice versa, when $\delta$ increases, the probability is transformed to a smaller degree.

According to this transformation function, a small probability increases, and a high probability would be reduced. That's why in Fig. 1 a smaller probability after correction (weight) is above the 45 degree line. On the contrary, a higher probability after correction is below the 45 degree line .

In 2008, the State Tax Inspectorate, according to the data of Inter-Service Tax Data Warehouse, carried out 1,545 tax audits of entities (the strictest control form of taxpayers according to the Law on Tax Administration). According to the data of Department of

Statistics under the Government of the Republic of Lithuania, in the beginning of 2008 there were 81,376 active enterprises[5]. Assuming that taxpayers have an equal possibility to be audited, the probability is around 1.9 percent[6]. In this case, the ability to identify risky taxpayers and the limited capacity of resources of the tax administrator are ignored. Choosing different values of $\delta$, the simulation results can be obtained (Table 2).

TABLE 2. **Corrections of tax audit probability**

| $\delta$ | $f(p)$ | $f(p)$ / p |
|---|---|---|
| 0.1 | 0.99 | 52.1 |
| 0.2 | 0.84 | 44.2 |
| 0.3 | 0.59 | 31.1 |
| 0.4 | 0.23 | 12.1 |
| 0.5 | 0.17 | 8.9 |
| 0.6 | 0.14 | 7.4 |
| 0.7 | 0.08 | 4.2 |
| 0.8 | 0.05 | 2.6 |
| 0.9 | 0.03 | 1.6 |

If the average value $\delta$ is chosen, the perceived (weighted) probability rises to 17 percent. This is almost 9 times higher than the actual probability value. In addition, it should be noted that the tax authorities, using advanced compliance risk management principles, are well aware of the impact of the perceived tax audit probability. So, the tax administrator uses all possible measures to produce the impression that it is dangerous to evade (European Commission, 2010).

For the reasons mentioned above, it can be concluded that the A–S model should contain the tax audit probability function that would reflect the taxpayer's perception rather as an objective value. In addition, the audit probability is partially affected by public attitudes towards tax evasion (the tolerance of this phenomenon), as well as the other characteristics that describe the aspects of the tax authority activities.

## Conclusions

The recent financial troubles forced a number of the states to pay more attention to tax evasion. Although the phenomenon itself exists as long as the taxes do, its theoretical researches started not that long time ago. Allingham and Sandmo were the first to offer a

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[5] Active businesses. Department of Statistics under the Government of the Republic of Lithuania. http://www.stat.gov.lt/lt/pages/view/?id=1573 (accessed 02.04.2010)

[6] The probability is calculated under certain conditions, i.e. the number of tax audits is considered to be equal to the number of taxpayers. In addition, it is considered that the number of checks that started prior to the year 2008 is equal to the number of audits that were started in 2008 and would be finished in later periods.

microeconomic model. The conclusions of the model minding some restrictions helped to explain the taxpayer's behaviour.

Since then, quite a number of scientists have offered various amendments of the original model. The aim, of course, was to consider more realistic aspects of tax administration, as well as some factors that are difficult to measure but are acknowledged as the important ones, for example, social norms. A good example of how the intangible values are measured is Geert Hofstede's cultural dimension theory. This example is worth a more thorough examination as it may help to improve the tax evasion models.

Nevertheless, despite these efforts, some assumptions are different from the tax system in Lithuania. For example, if underreported income is identified, first of all the regular tax is calculated and then, considering the severity of violations, a fine is imposed. Furthermore, in case of tax evasion, a taxpayer also needs to pay additional sums for not fulfilling his / her duties in time, i.e. interest.

One aspect of the tax evasion model is especially interesting. This is the probability of tax audit. In order to reflect its impact on the real behaviour of the taxpayer, it is worthwhile to correct the audit probability. According to the Khaneman–Tversky prospect theory, individuals tend to overestimate small probabilities; however, considering the limited resources of tax authorities, intuitively it could be said that the probability of tax audit is low (e.g., 1.9 percent as calculated in this paper).

On the other hand, tax authorities all over the world try to introduce modern principles of risk management, i.e. treating taxpayers according to their behaviour. Technological developments allow tax administrators to perform various types of analysis and trace cheating taxpayers. Nevertheless, there are no perfect techniques, and the capacities to deal with all evaders are limited. These are the reasons why the tax probability should be written as a function comprising the parameters such as the accuracy of detection, the number of cheaters, the resources available. Besides, tax authorities usually try to increase the perception of tax audit probability in order to reach a higher compliance.

It is worth mentioning that one aspect of tax evasion modelling is still interesting to consider and has no solid conclusions, i.e. different opinions about how the increase of the tax rate affects the taxpayer's behaviour and how to explain it. Depending on the model, different conclusions can be drawn and used to explain various real life situations.

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