MARKET AND GOVERNMENT FAILURES RELATED
TO THE INTRODUCTION OF TAX INCENTIVES REGIME

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The paper deals with problem of effectiveness of tax incentive regimes. The main purpose of this paper is to define causes, factors and measures aimed to prevent and neutralize failures of introduction of tax incentives. In order to examine the behavior of economic agents we used game theory tools, notably the "principal-agent" model, similar to the Allingham-Sandmo model. To solve a problem of inefficient interaction, when investors unreasonably pretend on tax incentives and government ignore that by granting them incentives, we proposed to use Nash-equilibrium in pure strategies. Finally we defined factors of improvement of efficiency of tax incentive regimes, particularly mechanisms of their implementation and termination.

Keywords: *tax incentives, transition economies, economic behavior of investors, "principal-agent" model, Nash-equilibrium, inefficient interaction.*

În prezentul articol este cercetat problema unui eficient regim privind scutirile de taxe. Scopul acestui articol const în identificarea cauzelor, factorilor i m surilor care vizeaz prevenirea i neutralizarea e ecul de a introduce stimulente fiscale. Pentru a evalua comportamentul metodelor teoriei jocurilor contribuabililor au fost folosite, cum ar fi: modelul "principal-agent", modelul Allingham-Sandmo. Astfel, se propune utilizarea unui echilibru Nash în strategiile pure pentru a rezolva problema interacţiunii ineficiente în cazul în care investitorii susţin în mod greşit avantajele fiscale, iar guvernul le ofer aceste beneficii, ignorând faptul nefondat. Drept rezultate au fost identificaţi factorii de îmbun t ţire a eficienţei modului de oferire a scutirilor fiscale, în special mecanismele de aplicare i de întrerupere.

Cuvinte-cheie: *scutiri fiscale, economia tranzitiv , comportamentul economic al investitorilor, modelul "principal-agent", echitatea conform Nash, interacţiune ineficient .*

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Introduction. Paper deals with problem of effectiveness of tax incentive regimes. Support of priority industries remains currently important for transition economies. At once, such countries more often than developed ones face the imperfection of tax incentive mechanisms. Notably, such problems are common to Ukrainian and Moldavian economies, where the legislative support or its implementation in the area of preferential taxation of innovative enterprises which contribute essentially to sustainable development is absent.

Tax incentives can be the way of government's attracting investment in favored industries, sectors and areas or restructuring their investment vehicle by providing by state certain economic benefits for companies or corporate groups. So, let's define tax incentives as any deviation from current tax system, which can be applied to certain types of investment aimed to reduce investor's tax liabilities.

There is a popular opinion that financial incentives bust the state budget, wherefore it's not common for governments of developing countries to allow those incentives to foreign investors; instead they tend to use tax incentives, which do not require the preliminary (advance) use of government funds.

Different aspects of tax incentives and problems of their application were investigated by Auerbach & Hines Jr. [2], Easson & Zolt [4], Holland & Vann [5], Klemm [6], Tanzi & Zee [9], te Velde [12] and also by experts of EU [3], UNCTAD [8; 10] and OECD [1; 10].

But the mechanism of response of tax incentive regimes is insufficiently studied; that leads to ambiguity and weak predictability of its results: some countries benefit from increase of investment while others bear losses due to reduced tax revenues or arrival of weak investors.

So, the main purpose of this paper is to define causes, factors and measures in order to prevent and neutralize failures of introduction of tax incentives. To do this we structured paper as follows. Section 2 presents both methodology of analysis and developed game "principal-agent" model with Nash-equilibrium in pure strategies. In Section 3 we discuss the obtained results. Finally, Section 4 presents some concluding remarks.

Methodology and model

The methodology of analysis of subject area except standard methods involves modeling of objects and processes in this area. Specifically, we used optimization models and game models.

Initially we classified types of tax incentive regimes; as a result we obtained the following:
  – two targets of tax incentives:
  – increase of budget revenue (state is the recipient);
  – product market expansion (customers are recipients);
  – and also
  – two strategies of providing tax incentives:
  – broadly-based;
  – targeted;
  – individual.

General analysis of reasons for decision-making and behavioral factors of investors and government showed that tax incentive regime can lead to non-achievement of targets, which form the basis for its implementation:
  – deterioration of general level of efficiency of economic sector;
  – partial budget payment due to reduced tax burden;
  – baseless provision of tax incentives for investors, who are not able to deliver on government targets;
  – baseless non-provision of tax incentives for investors, who are able to deliver on government targets;
  – shake out of *a priori* more efficient investors by less efficient ones.

The first evident disadvantage of tax incentive regime is the deterioration of general level of efficiency of economic sector (market, industry, territory), where it is implemented, since investors who can profit under current tax regime are accompanied with less efficient ones, who can make a profit only under tax incentive regime.

Provision of tax incentives aimed only to increase budget revenue can lead to non-compensation of reduced tax burden (as a result of tax incentives) by tax base broadening due to appearance of new investors. So, the implementation of tax incentive regime should be carefully calculated. We should note that unalloyed successful realization of this approach are almost absent in the world, consequently developed countries reject it, and experts caution against it for other countries.

The implementation of tax incentive regime in order to negotiate the market incompleteness is more feasible. But the analysis shows that:

– provision of tax incentives for all agents can lead to free-rider problem, when agents who do not produce required benefit can use tax incentives;

– however, targeted tax incentives can lead to problems both of identification of investors (it is not always possible to define if and how far certain investor satisfies the requirements) and possibility of adverse selection, when due to tax incentives a priori less efficient investors are more productive (compared to more powerful investors, working under current tax regime) and they shake out more efficient ones. Finally, market is not filled by benefits because new investors change (but not add) the present ones; now market is filled with deterioration of general efficiency, since the more powerful investors abandon the market.

Also it can be noted the possible inefficiency of such competition: present investors can allocate their funds in order to create barriers to entry (instead of quality and quantity input); this leads to both averting complementary investment and reducing their own productivity. Consequently product assortment and total output will decrease.

Mentioned elements can be combined into general pattern of tax incentive regimes and their consequences (Fig.1).
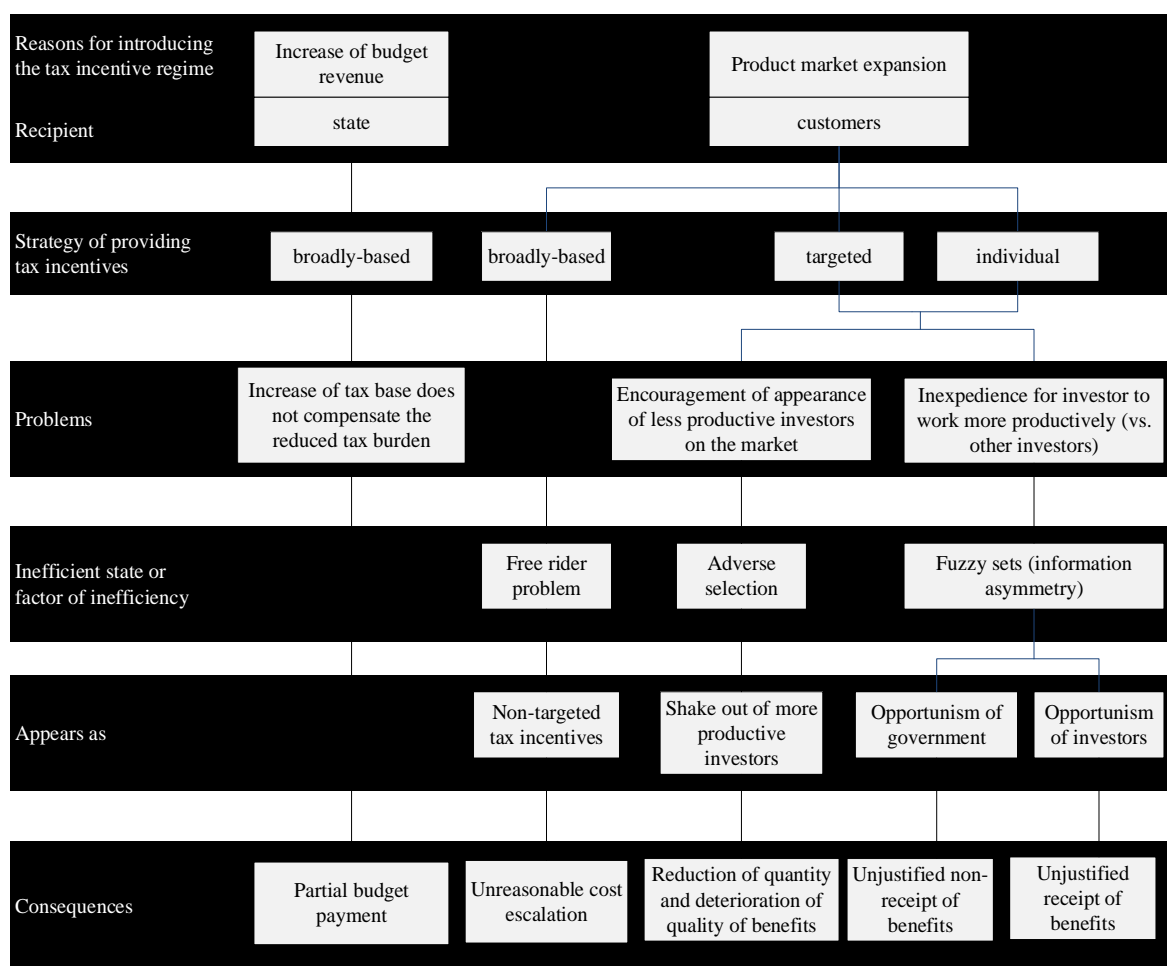

Fig.1. General pattern of providing tax incentives and its consequences
Source: Author's development.

Elements of tax incentive system for which it is expedient to develop economic and mathematical models are the following (Table 1):

– analysis of increase and/or decrease of tax revenues resulting from introduction of tax incentives;

- changes in set of investors resulting from implementation of targeted tax incentives and eventual appearance of new investors; rise of adverse selection;
- "government – investors" relations, arising when investors tend to hoodwink the government in order to obtain preferential treatment;
- analysis of strategy of broadly-based tax incentives; likelihood of free-rider problem;
- principles of allocation of tax incentives as limited resource; economic behavior of investors in this case.

Table 1

Elements of tax incentive system for which it is expedient to develop economic and mathematical models

Purpose	Type of model	Model character
Analysis of tax revenues arising due to variation of tax burden	optimization	analytical
"Government – investors" relations, notably analysis of opportunistic behavior of related parties	game	analytical
Changes in set of investors resulting from implementation of targeted tax incentives; adverse selection	evolutionary, population, genetic	analytical, simulation
Analysis of strategy of broadly-based tax incentives; a rise of free rider problem	set-theoretical	analytical
Principles of allocation of tax incentives as limited resource; economic behavior of investors in this case	set-theoretical; game	analytical

Source: Author's development.

Now we obtained in closed form conditions under which the implementation of tax incentive regime leads to increase or decrease the tax revenues (Fig. 2).
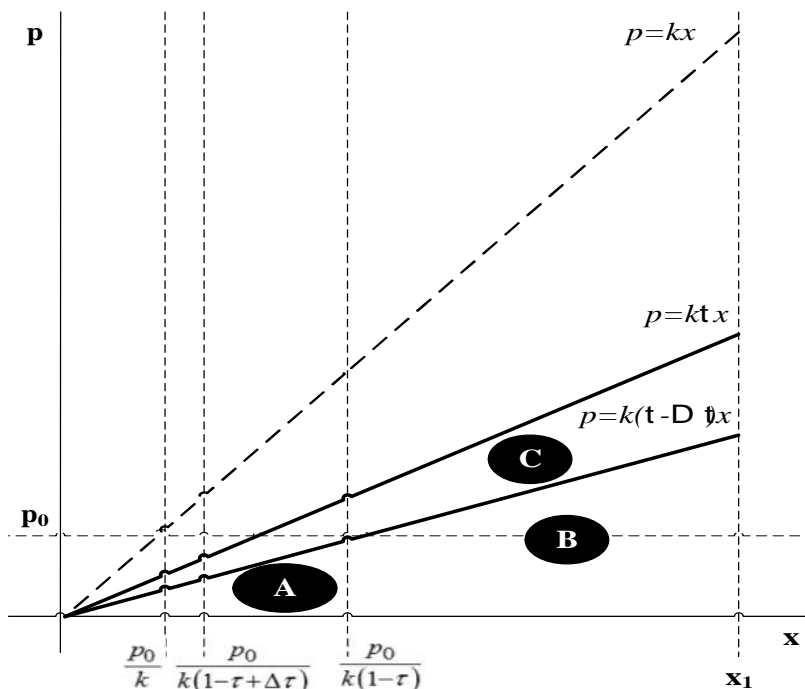

Fig. 2. Tax revenues in cases of standard and reduced tax rate
Source: Author's development.

Based on those calculations we can conclude that providing tax exemptions only for possible increase of budget revenues is doubtful and risky.

Tax revenues under current tax regime:

$$P(\ddagger) = \ddagger \int\limits_{p^{-1}\left(\frac{p_0}{1-\ddagger}\right)}^{x_1} p(x)dx ; \qquad (1)$$

tax revenues under tax incentive regime:

$$P(\ddagger - \Delta\ddagger) = (\ddagger - \Delta\ddagger) \int\limits_{p^{-1}\left(\frac{p_0}{1-\ddagger+\Delta\ddagger}\right)}^{x_1} p(x)dx ; \qquad (2)$$

where, p_0 is the level of replacement;

$p(x)$ is the productivity of investment in economics, ordered according to high values;

x_1 is the maximum level of normalized profitability (in industry or region).

$$P(\ddagger) < P(\ddagger - \Delta\ddagger) \Leftrightarrow \frac{\int\limits_{p^{-1}\left(\frac{p_0}{1-\ddagger}\right)}^{x_1} p(x)dx}{\int\limits_{p^{-1}\left(\frac{p_0}{1-\ddagger+\Delta\ddagger}\right)}^{x_1} p(x)dx} < \frac{\ddagger - \Delta\ddagger}{\ddagger};$$

$$\frac{\Delta\ddagger}{\ddagger} < 1 - \frac{\int\limits_{p^{-1}\left(\frac{p_0}{1-\ddagger}\right)}^{x_1} p(x)dx}{\int\limits_{p^{-1}\left(\frac{p_0}{1-\ddagger+\Delta\ddagger}\right)}^{x_1} p(x)dx}.$$

Let's consider simple and widely known case $p = kx$:

$$P(\ddagger) = \ddagger \int\limits_{p^{-1}\left(\frac{p_0}{1-\ddagger}\right)}^{x_1} kx\,dx = \frac{\ddagger k}{2} x^2 \Big|_{\frac{p_0}{k(1-\ddagger)}}^{x_1} = \frac{\ddagger k}{2}\left(x_1^2 - \left(\frac{p_0}{k(1-\ddagger)}\right)^2 \right) =$$

$$= \frac{\ddagger k}{2} x_1^2 - \frac{\ddagger k}{2}\left(\frac{p_0}{k(1-\ddagger)}\right)^2 = \frac{\ddagger}{2k}\left(p_1^2 - p_0^2 \frac{1}{(1-\ddagger)^2} \right);$$

$$P(\ddagger - \Delta\ddagger) = \frac{\ddagger - \Delta\ddagger}{2k}\left(p_1^2 - p_0^2 \frac{1}{(1-\ddagger+\Delta\ddagger)^2} \right),$$

where: $p_1 = kx_1$.

So implementation of tax incentive regime will lead to increase the tax revenue on condition that:

$$P(\ddagger) < P(\ddagger - \Delta\ddagger) \Leftrightarrow \frac{\ddagger}{2k}\left(p_1^2 - p_0^2\frac{1}{(1-\ddagger)^2}\right) < \frac{\ddagger - \Delta\ddagger}{2k}\left(p_1^2 - p_0^2\frac{1}{(1-\ddagger+\Delta\ddagger)^2}\right);$$

$$\frac{1}{2k}\left(\ddagger\left(p_1^2 - p_0^2\frac{1}{(1-\ddagger)^2}\right) - (\ddagger - \Delta\ddagger)\left(p_1^2 - p_0^2\frac{1}{(1-\ddagger+\Delta\ddagger)^2}\right)\right) < 0;$$

$$\ddagger\left(p_1^2 - p_0^2\frac{1}{(1-\ddagger)^2}\right) - \ddagger\left(p_1^2 - p_0^2\frac{1}{(1-\ddagger+\Delta\ddagger)^2}\right) + \Delta\ddagger\left(p_1^2 - p_0^2\frac{1}{(1-\ddagger+\Delta\ddagger)^2}\right) < 0;$$

$$p_1^2\Delta\ddagger - p_0^2\left(\frac{\ddagger}{(1-\ddagger)^2} - \frac{\ddagger - \Delta\ddagger}{(1-\ddagger+\Delta\ddagger)^2}\right) < 0;$$

$$p_1^2\Delta\ddagger - p_0^2\left(\frac{\ddagger}{(1-\ddagger)^2} - \frac{(\ddagger - \Delta\ddagger)}{(1-\ddagger+\Delta\ddagger)^2}\right) < 0;$$

$$p_1^2\Delta\ddagger < p_0^2\left(\frac{\ddagger}{(1-\ddagger)^2} - \frac{(\ddagger - \Delta\ddagger)}{(1-\ddagger+\Delta\ddagger)^2}\right);$$

$$\frac{p_1^2}{p_0^2} < \frac{1}{\Delta\ddagger}\left(\frac{\ddagger}{(1-\ddagger)^2} - \frac{(\ddagger - \Delta\ddagger)}{(1-\ddagger+\Delta\ddagger)^2}\right);$$

$$\frac{p_1^2}{p_0^2} < \frac{1}{\Delta\ddagger}\left(\frac{\ddagger(1-\ddagger+\Delta\ddagger)^2 - (1-\ddagger)^2(\ddagger - \Delta\ddagger)}{(1-\ddagger)^2(1-\ddagger+\Delta\ddagger)^2}\right);$$

$$\frac{p_1^2}{p_0^2} < \frac{\ddagger - 2\ddagger^2 + 2\ddagger\Delta\ddagger + \ddagger^3 - 2\ddagger^2\Delta\ddagger + \ddagger\Delta\ddagger^2 - \ddagger + 2\ddagger^2 - \ddagger^3 + \Delta\ddagger - 2\ddagger\Delta\ddagger + \ddagger^2\Delta\ddagger}{(1-\ddagger)^2(1-\ddagger+\Delta\ddagger)^2\Delta\ddagger};$$

$$\frac{p_1^2}{p_0^2} < \frac{-\ddagger^2\Delta\ddagger + \ddagger\Delta\ddagger^2 + \Delta\ddagger}{(1-\ddagger)^2(1-\ddagger+\Delta\ddagger)^2\Delta\ddagger};$$

$$P(\ddagger) < P(\ddagger - \Delta\ddagger) \Leftrightarrow \frac{p_1^2}{p_0^2} < \frac{1 - \ddagger^2 + \ddagger\Delta\ddagger}{(1-\ddagger)^2(1-\ddagger+\Delta\ddagger)^2}; \tag{3}$$

For other cases models are under development. Thus, for relations between government and investors, which can contain an opportunistic component, we suppose to use the advanced game model "principal – agent" (similar to Allingham-Sandmo model):

$$\Gamma = \left(SA,\ SP,\ (G,H)(SA \times SP)\right);$$

$$(G,H) = \begin{pmatrix} \left\{\begin{array}{l}0;\\ p-\epsilon\end{array}\right\} & \left\{\begin{array}{l}\ddagger p;\\ (1-\ddagger)p-{\sim}\end{array}\right\} \\[2em] \left\{\begin{array}{l}q_1(v,f)(1+\varkappa)\ddagger p - f;\\ (1-q_1(v,f)(1+\varkappa)\ddagger)p-\epsilon\end{array}\right\} & \left\{\begin{array}{l}(1+q_2({\sim},f)(1+\varkappa))\ddagger p - f;\\ (1-(1+q_2({\sim},f)(1+\varkappa))\ddagger)p-{\sim}\end{array}\right\} \end{pmatrix} \tag{4}$$

where: p is the agent productivity;

is the part of income, which is obtained by principal according to contract;

q_1, q_2 are frequencies of detection of real and false non-compliance of contract terms respectively;

, , μ are resources, spending on control of agent activity, concealment of his evasion and maintenance of transparency of agent own activity respectively;

is the penalty coefficient for non-compliance of contract terms by contractor (agent).

It can be shown [15] that for group of investors with certain productivity under certain conditions one can pick out the tax burden representing the pattern of interaction between investors and government: investors will unreasonably pretend on tax incentives and government will ignore that by granting them incentives. Such situation certainly can be considered as an inefficient interaction.

We propose to solve this problem by shifting the interaction between state and investors in one of Nash equilibriums in pure strategies (depending on both values of parameters of interaction and investor's individual features). Conditions of the Nash equilibrium in pure strategies for the game (4) are the following:

$$E_{00} : \quad \text{€} - \sim \, < \ddagger \, p < \frac{f}{q_1(v,f)(1+x)}; \tag{5}$$

$$E_{01} : \quad \ddagger \, p < \min\left(\text{€} - \sim; \ \frac{f}{q_2(\sim,f)(1+x)}\right); \tag{6}$$

$$E_{10} : \quad \ddagger \, p > \max\left(\frac{f}{q_1(v,f)(1+x)}; \ \frac{\text{€} - \sim}{1-\left(q_1(v,f)-q_2(\sim,f)\right)(1+x)}\right); \tag{7}$$

$$E_{11} : \quad \frac{f}{q_2(\sim,f)(1+x)} < \ddagger \, p < \frac{\text{€} - \sim}{1-\left(q_1(v,f)-q_2(\sim,f)\right)(1+x)}. \tag{8}$$

In Sokolovsky (2014) it is proved that the sequence of the occurrence of Nash equilibriums at increase of p is: E_{01}, E_{00} E_{11}, E_{10} [14; 15].

The analysis (5)-(9) by virtue of varying the size of incentives according to the efficiency of investors makes possible the optimization of contractors' behavior in order to reduce corruption. There is a number of different tax incentives, which in turn complicates both their analysis and efficiency and/or expediency of their use. Thus, the development of more consolidated classification of tax incentives, clustered by certain category, notably, by area of application, could be considered as an actual task.

It makes sense to recall the classification of tax incentives.

UNCTAD, the World Bank and economists proposed different classifications of tax incentives which can be summarized as following:
- reduced corporate income tax rates;
- loss carry forwards;
- accelerated depreciation;
- tax holidays;
- investment allowances and credits, grated in addition to the depreciation allowances as a percentage of appropriate investment expenditures;
- favorable deduction rules, super deductions;
- reinvestment incentives;
- investment tax credits (flat investment tax credit and incremental investment tax credit);
- reduced withholding taxes;
- personal income tax, payroll tax and social security reductions;
- sales tax exemptions;
- reduced tariffs (import duties), notably on imported capital equipment and component parts or increased tariffs on finished goods, produced by investor, in order to protect the internal market from imported competitive goods;
- property tax reductions;
- preferential treatment of long-term capital gains;
- deductions for qualifying expenses;

    – duty-free zones, allowing both tariff and VAT exemptions, and special economic zones, where investors enjoy special tax incentives, which are not applied on the rest of the recipient country;

    – tax reductions/credits for foreign hard currency earnings, which are widespread in the developing countries in order to receive currency earnings [4; 8; 10].

The mentioned classifications, made by the World Bank and the UNCTAD, allowed us to aggregate these tax incentives at eight main categories, according to the area of their application, notably, tax incentives applied to the income/profit, to sales, to the added value (independent categories); applied to the capital investment, to the work force and to other types of expenditures (category related to the expenditures); and also tax incentives applied to both imports and exports (category related to the foreign trade). Table 2. describes different types of tax incentives according to each area of application.

In order to analyze practical application of tax incentives in different countries we made a sample of 32 countries [13]. Analysis revealed that there were used 47 tax incentives of 12 different types. At this, there are 2 types of incentives – tax credits and super tax deductions, which are used more than half the time. I.e., one can observe that many countries replaced tax holidays with accelerated depreciation or tax credits. Besides we should note that the most widespread types of incentives (and a number of others as well) are profit/income-based.

Table 2

Main categories of tax incentives

Area of application	Types of tax incentives
Income/profit	Reduced corporate income tax rates; tax holidays; loss carry forward; tax credit; tax deduction
Sales	Reduced corporate income tax rates depending on the turnover
Added value	Reduced corporate income tax rates for local production; tax credits taking into account the net added value
Capital investment	Accelerated depreciation; investment allowances and credits; reinvestment incentives
Work force	Personal income tax, payroll tax and social security reductions
Other expenditures	Reduced corporate income tax rates with expenditures on training, marketing and promotion on external markets
Imports	Reduced or zero tariff rates
Exports	) Tax incentives related to the production: zero export tax rates; reduced corporate income tax rates depending whether the activity is related to the currency exchange or export supplies; b) Tax incentives related to the operational expenditures: export tax refund; tax deduction for expenditures abroad; tax allowances for capital goods, purchased for export industries

Source: [13].

Under this logic we can suppose that prevalence of mentioned incentives can be explained by better efficiency (vs. other investors) and their bigger benefits with regard to profitable investment. At the same time Ukraine as well as Moldova use reduced tax rates and tax holidays [7] which are much less widespread in the developed countries: they are applied primarily in transition post-soviet countries and in China.

Thus, an analysis of applying the tax incentives in countries worldwide showed that developed countries prefer to use both over tax deductions and tax credits, while the transitional economies tend to use both reduce tax rates and tax holidays. This is conditioned by, foremost, the simplicity of applying the latters.

Results and discussion

It is difficult to assess numerically the cost of allocation of resources, induced by distortions in economics emerged as a consequence of implementation of inefficient tax incentive regime for the investment, since it refers to the indirect cost. Thus it is more reasonable to model the situation allowing both to find out the fundamental factors and to estimate the evolution of interaction. The implementation

of inefficient tax incentives could be caused by government failures, while the distortions could appear in the form of market inconsistency, notably, of absence of production of required goods, caused, in turn, by an adverse selection problem, by presence of free-riders or another reasons of market failure.

The prevention of market failures could be regarded as the reason for introduction of tax incentive regime for certain industries or regions. But, it is evident, that tax incentives reduce the efficiency of the whole investment in the economy, since the efficient investment is accompanied by investment which is efficient only in the framework of the tax incentive regime. In such situation the economically inefficient states arise.

The reduction of tax rate with simultaneous enlarge of the tax base could not lead to the increase of tax revenue. In this case, if the government decides to enlarge more the tax base by way of granting tax incentives, this will induce further decrease of tax revenue. This, in turn, could lead to the abolition of tax incentive regime and consequently to the increase of tax rates, which will induce the negative response from the part of investors, caused both by unstable government policy and their own losses.

But at the same time the economic situation in certain industry, enjoying the tax incentives, could not be regarded as efficient by the following reasons. First, an additional investment in industry is effected by attracting of relatively inefficient investors, which could not face the higher taxes; this leads to the reduction of average productivity in industry. Second, the less efficient investment shift from other industries, which, on the one side increase the productivity in industries without tax incentives, and on the other side lead to the outflow of investment from these industries causing the risks of shortage. As a result, the investors-satisfizers could decide both do not take risks and do not expand production. And also it should be taken into account that the lower profitability of new investors could be caused by lower quality of their products, accordingly, so it causes problems for consumers – so the situation of market inconsistency arises.

On the other side, it is evident that uncontrolled increase of tax burden is not a reliable option, since it could lead, particularly, to the shifting of investors to the shadow sector. So the requirement for the tax optimization arises. At this, in Sokolovsky (2014) it is shown that the curve, representing the relationship between rates of taxation and the resulting levels of government revenue (the Laffer curve) could have more than one local maximum, which allows to vary the tax rates in order to promote development of certain industries [14; 15].

Consequently, the tax incentive regime cannot be considered as a normal state of economic system, but only as an exception. As mentioned above, tax incentives are by no means always efficient. Therefore, it's important to design measures in order to protect in some way the economy from failures caused by problems with implementation of tax incentives. For that choosing the tax incentives policy government should balance between costs and benefits of their providing. In such case it's feasible to consider the following factors:

– increase of income because of possible increase of investment;
– public goods: increase of number of jobs as a consequence of increase of investment, positive externalities;
– loss of income from investment, which could be realized without tax exemptions;
– indirect costs such as economic distortions, administrative cost, tax base erosion.
– In order to raise efficiency of tax incentive regime it's feasible to enforce the policy, related to reducing cost in the following directions:
– to make decision about type of tax incentive regime: broadly-based or targeted;
– to limit the duration of tax incentive regimes aimed to reduce possible cost of inefficient or not sufficiently planned programs by clearly fixing in the law the special status concerning the termination of tax incentives («sunset» provision);
– to define requirements to potential recipients of tax incentives in order to discover relations between receipt of exemptions and conditions of production;
– to obligate all recipients of benefits to provide information for appropriate investment agencies, and also to make authorities responsible for control and development of tax rules, related to tax incentives;
– to demand from policymakers, charged with providing of tax exemptions, to evaluate costs and benefits of certain tax incentive regime with determination of time-schedule and officials, responsible for evaluation.

Conclusions

In this paper we developed a classification of tax incentives both by area of their application and by tax incentive regimes. Those classifications allowed us to single out and to systematize possible local problems, which may be caused by introduction of tax incentives and also to systematize their mechanisms and consequences of their implementation. We considered also causes and consequences of failures pending implementation of tax incentives.

Methodological background of our research is the systemic approach allowing us to classify and identify links between elements of tax incentive systems. We considered different types of economic and mathematical models aimed to define the behavior of economic agents under various tax incentive regimes. Established regularities, despite of their non-numerical character, can help to decision-makers, since revealed inefficient states and norms define specific risks which should be taken into account in providing of tax incentives.

Consequently, the further research could be conducted to develop the prevention mechanism of inefficient states and norms of agents' behavior, to investigate the specific features of such mechanism in practice, and also to test the proposed models on real statistical data with further econometric analysis.

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