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## TAX INCENTIVE REGIMES: MODELS AND RESEARCH METHODS

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### ABSTRACT

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.

The present research aims to improve the efficiency of tax incentive regimes. For this we made a classification of tax incentives by their area of application and also 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 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 and also in order to study individual and mutual behavior of economic agents we used optimization methods and game theory tools.

Finally we defined factors of improvement of efficiency of tax incentive regimes, particularly mechanisms of their implementation and termination. In practice our findings can help to decrease the number of blunders in distribution of tax incentives across priority economic areas, such as innovation projects, green and resource saving technologies etc.

Key words: tax incentives, transition economies, economic behavior of investors, “principal-agent” model

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 J. Auerbach & J. Hines Jr.[1], A. Easson & E. Zolt [2], D.Holland & R. Vann [3], A. Klemm [4], V. Tanzi & H. Zee [5], D. te Velde [6] and also experts of EU [7], UNCTAD [8; 9] and OECD [10; 11].

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 present research aims to define causes, factors and measures in order to prevent and neutralize failures of introduction of tax incentives.

First it makes sense to recall the classification of tax incentives.

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UNCTAD, the World Bank and economists [2; 8; 9] 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, favorable deduction rules, super deductions; reinvestment incentives; investment tax credits; reduced withholding taxes; personal income tax, payroll tax and social security reductions; sales tax exemptions; reduced import taxes and customs duties; property tax reductions; preferential treatment of long-term capital gains; deductions for qualifying expenses; duty-free zones and special economic zones; tax reductions/credits for foreign hard currency earnings [5; 6]. In order to analyze practical application of tax incentives in different countries we made a sample of 32 countries [12]. 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.

Under that 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 [13] which are much less widespread in the developed countries: they are applied primarily in transition post-soviet countries and in China.

But not all types of tax incentives are effective. In order to define effectiveness it makes sense to use economic and mathematical modeling.

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:

2 targets of tax incentives:

increase of budget revenue (state is the recipient);

product market expansion (customers are recipients),

and also

2 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).

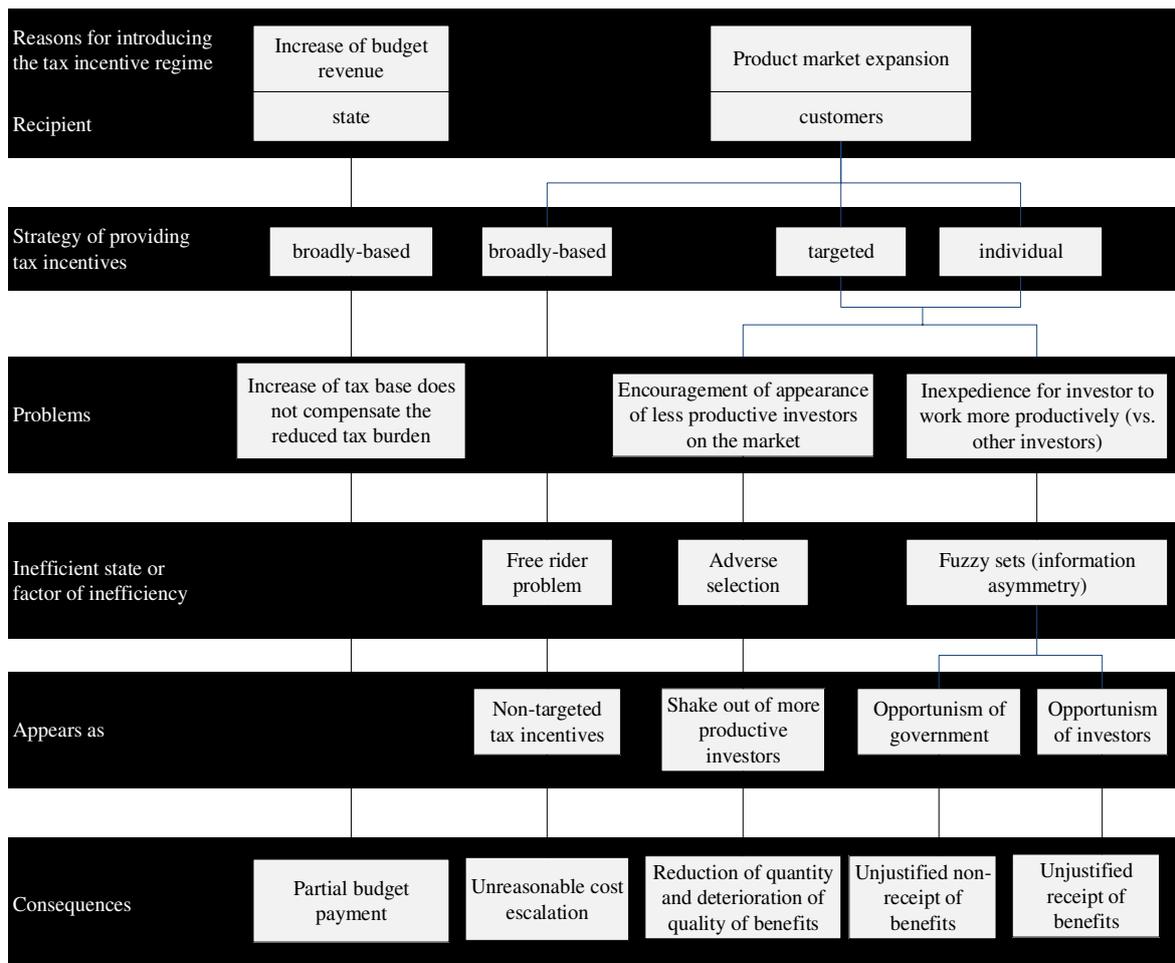


Fig.1. General pattern of providing tax incentives and its consequences

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

analysis of increase/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

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

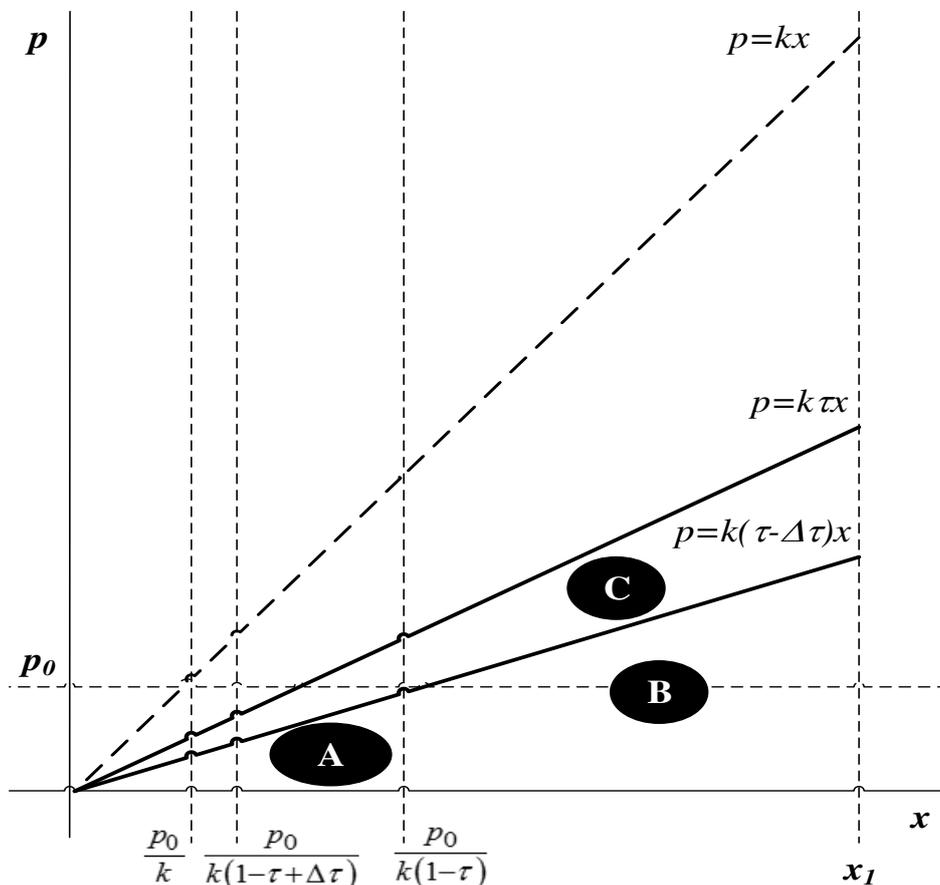


Fig. 2. Tax revenues in cases of standard and reduced tax rate

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:

$$P(\tau) = \tau \int_{p^{-1}\left(\frac{p_0}{1-\tau}\right)}^{x_1} p(x) dx; \quad (1)$$

tax revenues under tax incentive regime:

$$P(\tau - \Delta\tau) = (\tau - \Delta\tau) \int_{p^{-1}\left(\frac{p_0}{1-\tau+\Delta\tau}\right)}^{x_1} p(x) dx; \quad (2)$$

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).

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

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

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

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

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

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

where  $p_1 = kx_1$ .

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

$$\begin{aligned}
P(\tau) < P(\tau - \Delta\tau) &\Leftrightarrow \frac{\tau}{2k} \left( p_1^2 - p_0^2 \frac{1}{(1 - \tau)^2} \right) < \frac{\tau - \Delta\tau}{2k} \left( p_1^2 - p_0^2 \frac{1}{(1 - \tau + \Delta\tau)^2} \right); \\
\frac{1}{2k} \left( \tau \left( p_1^2 - p_0^2 \frac{1}{(1 - \tau)^2} \right) - (\tau - \Delta\tau) \left( p_1^2 - p_0^2 \frac{1}{(1 - \tau + \Delta\tau)^2} \right) \right) &< 0; \\
\tau \left( p_1^2 - p_0^2 \frac{1}{(1 - \tau)^2} \right) - \tau \left( p_1^2 - p_0^2 \frac{1}{(1 - \tau + \Delta\tau)^2} \right) + \Delta\tau \left( p_1^2 - p_0^2 \frac{1}{(1 - \tau + \Delta\tau)^2} \right) &< 0; \\
p_1^2 \Delta\tau - p_0^2 \left( \frac{\tau}{(1 - \tau)^2} - \frac{\tau - \Delta\tau}{(1 - \tau + \Delta\tau)^2} \right) &< 0; \\
p_1^2 \Delta\tau - p_0^2 \left( \frac{\tau}{(1 - \tau)^2} - \frac{(\tau - \Delta\tau)}{(1 - \tau + \Delta\tau)^2} \right) &< 0; \\
p_1^2 \Delta\tau < p_0^2 \left( \frac{\tau}{(1 - \tau)^2} - \frac{(\tau - \Delta\tau)}{(1 - \tau + \Delta\tau)^2} \right); & \\
\frac{p_1^2}{p_0^2} < \frac{1}{\Delta\tau} \left( \frac{\tau}{(1 - \tau)^2} - \frac{(\tau - \Delta\tau)}{(1 - \tau + \Delta\tau)^2} \right); & \\
\frac{p_1^2}{p_0^2} < \frac{1}{\Delta\tau} \left( \frac{\tau(1 - \tau + \Delta\tau)^2 - (1 - \tau)^2(\tau - \Delta\tau)}{(1 - \tau)^2(1 - \tau + \Delta\tau)^2} \right); & \\
\frac{p_1^2}{p_0^2} < \frac{\tau - 2\tau^2 + 2\tau\Delta\tau + \tau^3 - 2\tau^2\Delta\tau + \tau\Delta\tau^2 - \tau + 2\tau^2 - \tau^3 + \Delta\tau - 2\tau\Delta\tau + \tau^2\Delta\tau}{(1 - \tau)^2(1 - \tau + \Delta\tau)^2\Delta\tau}; & \\
\frac{p_1^2}{p_0^2} < \frac{-\tau^2\Delta\tau + \tau\Delta\tau^2 + \Delta\tau}{(1 - \tau)^2(1 - \tau + \Delta\tau)^2\Delta\tau}; & \\
P(\tau) < P(\tau - \Delta\tau) &\Leftrightarrow \frac{p_1^2}{p_0^2} < \frac{1 - \tau^2 + \tau\Delta\tau}{(1 - \tau)^2(1 - \tau + \Delta\tau)^2}; \tag{3}
\end{aligned}$$

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):

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

$$(G, H) = \left( \begin{array}{cc} \left\{ \begin{array}{c} 0; \\ p - \nu \end{array} \right\} & \left\{ \begin{array}{c} \tau p; \\ (1 - \tau)p - \mu \end{array} \right\} \\ \left\{ \begin{array}{c} q_1(\nu, \pi)(1 + \gamma)\tau p - \pi; \\ (1 - q_1(\nu, \pi)(1 + \gamma)\tau)p - \nu \end{array} \right\} & \left\{ \begin{array}{c} (1 + q_2(\mu, \pi)(1 + \gamma))\tau p - \pi; \\ (1 - (1 + q_2(\mu, \pi)(1 + \gamma))\tau)p - \mu \end{array} \right\} \end{array} \right) \quad (4)$$

where  $p$  is the agent productivity;

$\tau$  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;

$\pi, \nu, \mu$  are resources, spending on control of agent activity, on concealment of his evasion and on maintenance of transparency of agent own activity respectively;

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

Based on analysis of Nash equilibriums in pure strategies [14] model (4) makes possible to optimize the contractors' behavior and their income. Also 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 inefficient interaction.

## Conclusions

Tax incentive regime cannot be considered as a normal state of economic system, but only as exception. As mentioned above, tax incentives are by no means always efficient. Therefore it's important to define which types of incentives are rational to perform.

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.

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.

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 advance the providing of tax exemptions by clear defining of tasks of their introducing: either increase of budget revenue and/or product extension;

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.

In practice our findings can help to decrease the number of blunders in distribution of tax incentives across priority economic areas, such as innovation projects, green and resource saving technologies etc.

Future research can be directed to develop of prevention mechanism of inefficient states and norms of agents' behavior, to investigate the specific features of such mechanism in practice, to approve the proposed models on real statistical data with further econometric analysis.

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