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TAX INCENTIVES EFFECTIVENESS FOR THE INNOVATION ACTIVITY OF INDUSTRIAL ENTERPRIZES IN UKRAINE

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ABSTRACT. The paper is devoted to the investigation of the effects of tax advantages on R&D. An analysis of earlier studies reveals that most authors argue that national programs of R&D budget funding and tax benefits have stimulating impacts. None of these studies have empirical support that shows the direct relationship between taxation incentives and the impacts of innovation programs. We tried to verify this relationship statistically, but obtained no meaningful results. The research was complicated by the absence of any statistics concerning the value of tax advantages for R&D in Ukraine. Using approach of Grytsenko (2008) to mathematical modeling of a company's tax burden in Ukraine we determine the effect of profit exemption and some economic transactions exemptions from taxation. In most cases exemption from taxation leads to a smaller tax burden decrease than the tax rate. The effect depends on whether industrial production is material- or labour-intensive.

JEL Classification: G390, H250, O310

Keywords: tax benefit, tax exemption, tax burden, R&D, innovation, Ukraine.

Introduction

Modernization processes are closely connected with the introduction of innovations. The experience of foreign countries shows that government support in a form of targeted funding, tax incentives, preferential government loans and guarantees and innovative infrastructure creation plays a great role in modernization processes.

In practice the tax mechanism of R&D stimulation becomes more and more popular in our days and is recognized as one of the most effective tools affecting the innovation activity in OECD countries (European Commission, 2006; Yeroshkin, 2011). Thus, since the mid-1990s the number of OECD countries, which are actively using fiscal policy tools to accelerate the innovation process, has increased several times. In 2011 27 of 34 country-members of OECD implemented tax preferences for R&D. Expanding the implementation of tax methods in R&D support is stipulated primarily by their accessibility and non-discrimination. Moreover, in the globalizing world innovation-oriented tax policy becomes an important factor of attracting foreign direct investments into high-tech industries of national economies (Yeroshkin, 2011).

However, this tool is not yet wide spread in CIS countries. In spite of the fact that the Tax Code of Ukraine, implemented in 2010, contains tax benefits focused on the support of industrial production or implementation of innovations, the variety of preferential categories is small and does not cover all the priority areas of innovation activities in Ukraine.

In particular, the Annual Proclamation of the President of Ukraine to Verkhovna Rada of Ukraine (2011) stipulates tax incentives only for investment attraction. The document states that for the purpose of economic modernization and creation of the effective system of investment incentives, it is necessary:

1) to introduce the amendments to the Tax Code of Ukraine with provisions about tax investment incentives, which must be differentiated depending on the type and amount of investments, size of enterprises, region of investing, investment goals, innovative level of production and number of new jobs;

2) to implement assessment tools of long-term efficiency of received tax benefits usage; to provide their targeted application and responsibility of recipients for benefits conditions breach and timeframes.

In spite of their declaration in Annual Proclamation of the President of Ukraine to Verkhovna Rada of Ukraine in 2011, these goals have not been achieved yet. Hence it is necessary to find out why such a popular measure is hardly used in Ukraine, and what effects tax benefits have on stimulating innovation activity and its results in industrial enterprises.

The research goal of the paper is an attempt to reveal the effects of tax benefits, which have been implemented for stimulating the innovation activity of industrial enterprises, and to give recommendations to enhance the effectiveness of tax incentives.

1. Literature review

The efficacy of tax incentives was given consideration in many analytical studies devoted to OECD countries. In the notes of Directorate for Science, Technology and Industry in OECD countries under the name "Maximizing the Benefits of R&D Tax Incentives for Innovation" it is stated that tax benefits are considered to be a neutral tool of government R&D stimulation policy in comparison with direct funding, because they are market-based. On the other hand, tax benefits may create an unlevel playing field for multinational and national companies (OECD, 2013).

Multinational companies in OECD countries can use their benefits at different stages of the value chain in several countries simultaneously. In such conditions national enterprises, which do not have an opportunity to conduct cross-border tax planning, are in a worse position in comparison to transnational corporations. Thus, the study proposes to provide additional benefits that may stimulate, at first, 'stand-alone' firms; to combine indirect incentives (tax preferences) to direct funding to accelerate innovation activity. The effectiveness of tax benefits depends upon the broader regulatory environment and its stability over time (OECD, 2013).

In a report of the European Commission (2006), "Promoting innovation by tax incentives: A review of strategies and their importance to biotech growth", the estimation of tax incentives for biotechnology development as one of the priority areas in R&D in Canada, France, Norway and United Kingdom is made. It also indicates that it is impossible to estimate the full effect of the implementation of various types of stimulating fiscal policy. However, as unambiguous improvements the report considers the increasing investments in R&D and job creation.

Vukmirović (2011) argues that results of implementing tax benefits to a corporate tax are closely connected with the accounting policy that is introduced in the company and is required by law. Corchuelo and Martínez-Ros (2009) uses econometric methods for analysis

of fiscal policy impact on R&D. The conclusion is that large companies receive more benefits from tax preferences because they can guarantee the viability of the projects and actively take part in innovation activity. Moreover, companies that use government funding also use tax incentives. Stimulating fiscal policy on average promotes R&D technological effort, but the increase is significant only for large firms.

In research based on OECD countries Thompson (2013) builds the model of tax incentive effectiveness according to types of industries. Thompson indicates that in spite of wide-spread use of tax incentives for R&D, their impacts remain ambiguous. Stimulating policy is not homogenous in reference to different industries – some of them get much more preferences than others. Econometric modeling shows that the most reliable results can be received not from cross-country or firm-level approaches, but cross-industrial analysis. The result of the research is that on average a one dollar tax incentive increases firm's expenditures on R&D by 0.24 dollars. Other results are presented according to the statistical study of Hall (2001) in the USA, which reveals that 1% of tax credit provides an increase in R&D expenditures by 1.2%.

Parsons (2011) focuses on the implementation of tax preferences for small and medium enterprises (SMEs) in Canada and determined that that they should encourage the development of innovations that are competitive at the international level. Disparities in conducting R&D at large enterprises and SMEs are closely linked with the uneven approach to the tax policy for such companies. The research on tax benefit efficacy shows that tax benefits are not sufficient for intensive R&D. In order to provide industrial enterprises with the impetus for intensive innovation activity, the full innovation value chain should be run and a demand for innovations would play a crucial role in it. However, the analysis shows that Canadian companies do not feel the same pressure connected with implementation of innovative projects as foreign companies do. In the process of choosing a business strategy they prefer a gradual development rather than an innovative one.

There are some studies concerning tax benefits and preferences and their impact on investments and innovations, as well as international experience of tax incentive implementation for economic development in Ukraine. In particular, a thorough work of Vasylevska (2013) concerning the structure of tax preferences in Ukraine in the period of 1998-2010 reveals that tax preferences in Ukraine were not effective because their permanent increase began to significantly divert funds from the consolidated budget but there were not any valuable effects on innovative development. Similar conclusions are also made in Kasperovych (2012) which indicates that Ukrainian tax preference policy leads only to deterioration of results of budget revenues. Another result is that none of the industries that benefited from preferential support 10-12 years ago has made any significant technical or economical breakthrough in either qualitative or quantitative parameters.

Kizim and Kasyanova (2012) examines the tax preferences that are stimulating innovation activity in Ukraine mostly by using T. Saati's analysis of hierarchy method and determines that: 1) R&D organizations are sensitive to the deferment of profit tax payment and to exemption from import VAT, and to preferences for the unified obligatory state social insurance (in short – unified social dues); 2) motivational impact on the innovative enterprises is reflected by incremental tax credit, tax rebate and accelerated depreciation; 3) the volume-based tax credit and rebate are the priority types of tax incentives for industrial companies.

Due to the lack of reliable statistical data about the tax benefits provided for R&D in Ukraine, especially from 2011, it is complicated to conduct econometric research of their impacts on innovative activity indicators of industrial enterprises. In this case some theoretical mathematical models of tax effects on economical entities play an important role. One of the approaches belongs to a prominent Ukrainian scientist A.A. Grytsenko. He reveals the dependence of a company's tax burden on a structure of production costs and the

multiplication effects of tax reduction (Grytsenko, 2008). Using such an approach in our further research we will try to demonstrate these effects on specific tax preferences in Ukraine.

Thus, any unambiguous and reliable results concerning tax influence on innovative development of an enterprise or a country have not been obtained. Most researchers estimate the effect of increasing R&D expenditures while the effects should be tested on quantity and quality of innovations developed and implemented in a production, on the increase in business activity of innovative goods production what can be measured by index of competitiveness (innovation factor) and the level of foreign direct investments per capita *et cetera*.

2. An evaluation of the effects of tax incentives on innovation activity

2.1. The state of R&D in Ukraine

In a globalization process innovation-oriented tax policy of a state becomes an important factor of the attraction of foreign direct investments into high-tech industries of a national economy (Yeroshkin, 2011). For Ukraine this matter is extremely serious today. Compared with OECD countries the index of competitiveness of Ukraine (innovation factor) is ahead of only the Slovak Republic with a score 3.03 against 3.02.

The analysis of R&D investment trends, volumes of production of innovation goods and other indicators of innovative activity demonstrate mainly the deterioration of its results in Ukraine (see *Table 1*).

Table 1. R&D Statistics of Ukraine

Year	Enterprises' own funding in total R&D expenditures, %	Government share in total R&D expenditures, %	Innovative products introduction, units	Proportion of innovative products sales in industry sales, %	Share of R&D work in GDP, %
2000	79.63	0.44	-	-	1.16
2001	83.90	2.83	-	6.8	1.11
2002	71.07	1.51	-	7.0	1.11
2003	70.21	3.04	7416	5.6	1.24
2004	77.21	1.40	3978	5.8	1.19
2005	87.72	0.49	3152	6.5	1.09
2006	84.60	1.86	2408	6.7	0.98
2007	73.72	1.33	2526	6.7	0.93
2008	60.56	2.81	2446	5.9	0.90
2009	65.02	1.60	2685	4.8	0.95
2010	59.35	1.08	2408	3.8	0.90
2011	52.92	1.04	3238	3.8	0.79
2012	63.90	1.95	3403	3.3	0.80

Source: State Statistics Services of Ukraine (www.ukrstat.gov.ua), author's calculations.

The study of Kovalenko and Melnik (2009) indicates five features that are necessary for each program of fiscal incentives:

– large amounts of funding to have an impact on investment decisions;
– predictability to enable the implementation of long-term investment planning;
– clarity to ensure companies' understanding of programs;
– low administrative burden to encourage small firms to claim resources;

– a clear target profile to concentrate funds where they will have the greatest effect.

The analysis of the Ukrainian system of tax incentives for innovations shows that it poorly meets the indicated principles. The dynamic of changes in tax preferences for industrial enterprises are given below (see *Table 2*).

Table 2. Number of tax incentives from the main taxes quarterly

Tax	2011				2012				2013			
	I	II	III	IV	I	II	III	IV	I	II	III	IV
Tax on company profit:	72	71	84	86	87	85	86	85	90	95	95	95
- including those related to innovation activity	12	15	17	19	19	19	19	19	21	23	23	23
Value-added tax:	151	99	105	109	106	110	110	122	125	125	125	125
- including those related to innovation activity	18	14	14	14	11	11	11	12	13	13	13	13
Excise tax:	27	35	35	37	37	37	38	38	40	45	45	46
- including those related to innovation activity	5	7	7	7	7	7	7	7	7	7	7	7

Source: Ministry of Revenue and Duties of Ukraine, author's calculations.

Quarterly dynamic of innovation activity oriented tax incentives is given for three key taxes – tax on profit, value-added tax (VAT) and excise tax. It indicates the increase in the total number of tax on profit incentives, first reduction and then the increase in preferences of VAT, and the almost permanent number of excise tax preferences.

It should be noted that preferences we considered (as those that are related to innovation activity) include reduced tax rates or exemption from taxation as a result of energy-effective measures, alternative energy and fuel use, conducting R&D in aviation and space industry etc, as well as intergovernmental agreements on technical cooperation.

It can be logically assumed that implementation of tax incentives should be based on the priority areas of innovative development in Ukraine. In particular, in 2013 the second phase of the Program of investment and innovation activity development in Ukraine (2011) began. This program generally provides:

- investments;
- reduction of energy consumption by 20 percent;
- a system of financial support for investment and innovation activity especially by cheaper loans;
- creation of conducive environment for public-private partnership;
- introduction of new generation technologies in industrial production;
- competitive selection of the most efficient investment and innovation projects that can be realized in basic industries.

The tools to achieve these goals consist of the use of state guarantees, direct budget funding, repayment of interest rates on loans, partial reimbursement of production costs, loans at the expense of the state budget, subsidies from the state budget to the local budget, loans and grants from international financial institutions, tax, customs and currency preferences.

According to the Law of Ukraine "On the priority areas of innovative activity in Ukraine" (2011) the basic industries which the stimulating measures are focused on are: energy sector; atomic and rocket-space engineering; aircraft and shipbuilding; agricultural engineering; production, processing and storage of agricultural products; pharmaceuticals; healthcare; and robotics. Also, according to the Program of investment and innovation activity

development in Ukraine (2011) these types of economic activity should be supplemented by oil, gas and coal mining; construction and reconstruction of roads and other objects of transport infrastructure; heat, water and sewerage; and housing construction.

Comparing tax incentives in the Tax Code of Ukraine with the priority areas of development it is obvious that the structure of tax benefits is closely connected with the priority areas, but tools used for it are not always effective.

Tax incentives can be divided into two categories: 1) those which cause budget losses; 2) those which do not cause budget losses. The greatest number of benefits by quantity and which cause the significant amount of budget losses is provided from the value-added tax – 91.3% in 2010, the next largest benefits are from tax on profit – 5.8% in 2010, and the rest are benefits from other state taxes and dues (Vasylevska, 2012). The losses of budget revenues due to tax benefits in 2011 were $12.9 billion or 25.9 percent of Consolidated budget, where $7.5 billion (1.6 times more than in the previous year) was from the State Tax Service data and $5.4 billion (2 times more than in the previous year) was from the State Customs Service data.

The rapid dynamics of budget loss was caused by expansion of the benefit taxation base according to tax and customs legislation, and also by inadequate supervision of relevant government authorities of the accounting and the legality of tax benefits. The number of beneficiaries has increased by 2.4 thousand in the first half of 2012 from the first half of 2011. According to the information about budget losses caused by tax benefits (2012) tax preferences from VAT are 54.7% of total budget losses, from tax on profit – 39.1%.

The largest losses are declared by taxpayers who have a negative meaning of profit and participate in international cooperation, benefited from government support of energy industry, aircraft industry, etc.

2.2. Research methodology

In the research we would like to find out if budget losses due to tax benefits for innovative firms make sense. In other words, we plan to verify the hypothesis about the positive influence of tax incentives on innovative activity in Ukraine and other countries empirically and theoretically.

First, we estimate the correlation between a share of tax benefits in GDP for OECD countries (percentage) and some indicators of R&D activity, in particular, with the index of competitiveness (innovation factor); share of foreign direct investment in GDP; high-tech exports as a per cent of industrial exports; a share of enterprises that have implemented product/process innovations in the total number of innovative enterprises (percentage); and a share of enterprises that have implemented organizational/marketing innovations in the total number of innovative enterprises (percentage). These indicators were chosen as available and representative for each country. For Ukraine the estimation of these relationships can be hardly made because of unavailable statistical data on the amount of tax benefits since 2012, when the State Tax Service stopped publishing information about the amount of tax benefits on its official web-site.

The linear relationship between a share of tax benefits in GDP and some R&D indicators is represented by a correlation coefficient (1):

$$r_{xy} = \frac{\text{cov}(x, y)}{\sigma_x \sigma_y}, \qquad (1)$$

where cov (x, y) – covariance between x – a predictor (selected R&D indicator) and y – an explained variable (a share of tax benefits in GDP (percentage)); σ_x, σ_y – standard deviations

of *x* and *y* respectively.

Then we investigate the impact of the most popular tax benefit tools in Ukraine on the industrial companies' tax burden. Here we assume that the release of part or total profit becomes a source of investments that will be aimed at a firm's innovative production or R&D, which in the future will cause creation of innovative products. We use a mathematical model to describe the process of taxation in Ukraine including the three most significant taxes into the model – profit tax, value-added tax and payroll tax (in Ukraine – unified social dues). This approach for tax burden modeling was proposed in Grytsenko (2008), which examines the effects of different types of indirect taxes on tax burden. It helps to find out how the peculiarities of production process affect the changes in tax burden when we use exemption from taxes because of tax preferences. So, as a result we can not only make a conclusion about the possible amount of a company's investments in R&D, but we can define what type of production – material-intensive or labour-intensive will benefit more from using tax incentives.

2.3. Research results

When we estimate the share of R&D expenditures in GDP in Ukraine against other OECD countries, we can see clearly that Ukraine has one of the lowest levels of the indicator (*Table 3*). Direct government funding for R&D in 2012 was UAH 224.3 million and the level of nominal GDP was UAH 1408889 million according to State Statistics Service of Ukraine. Thus, its share in GDP was 0.02%.

Table 3. Indicators of direct funding, tax preferences for R&D and the index of economic competitiveness (innovation factor) in OECD countries and Ukraine

Country	Index of Competitiveness (innovation factor)	Direct government funding of R&D, % of GDP	Tax preferences for R&D, % of GDP
Slovakia	3,02	0,03	0,0002
Ukraine*	3,03	0,02	-
Russian Federation	3,13	0,39	0,020
Poland	3,24	0,03	0,000
Mexico	3,35	0,01	0,000
Brazil	3,42	0,10	0,050
Turkey	3,47	0,03	0,040
Hungary	3,51	0,11	0,080
Chile	3,60	0,02	0,003
Slovenia	3,63	0,28	0,060
Italy	3,69	0,04	0,003
Czech Republic	3,70	0,14	0,050
Spain	3,75	0,12	0,030
Estonia	3,89	0,10	0,000
China	3,89	0,05	0,050
Portugal	3,93	0,03	0,090
New Zealand	4,34	0,07	0,000
Australia	4,45	0,02	0,100
Canada	4,47	0,04	0,210
Ireland	4,58	0,05	0,140
France	4,68	0,12	0,260
Luxembourg	4,70	0,04	0,000
Korea	4,78	0,19	0,200

Austria	4,82	0,10	0,100
Belgium	4,87	0,09	0,180
United Kingdom	4,90	0,09	0,080
Norway	4,90	0,08	0,050
Denmark	4,99	0,05	0,050
Netherlands	5,16	0,04	0,150
USA	5,37	0,26	0,060
Sweden	5,43	0,12	0,000
Japan	5,49	0,03	0,070
Germany	5,50	0,09	0,000
Switzerland	5,70	0,03	0,000
Finland	5,79	0,08	0,000

* - data for Ukraine are for 2012; the level of tax preferences in Ukraine is not available

Sources: Organization of Economic Co-operation and Development (OECD) (2013); World Economic Forum (2013).

Using (1) we conducted data correlation analysis (excluding Ukraine) which shows that there is no any significant relationship between the index of competitiveness (innovation factor) and the share of direct state funding of R&D in GDP (r = -0.08), as well as the share of tax preferences (r = 0.21) for such goals. It means that government financial incentive for innovation is not a determining factor in this process regardless of what tools of the policy are used – tax preferences or direct funding. That is why it is not easy to estimate the effectiveness of tax benefits using quantitative indicators.

To be more convincing we tried to find some correlation between the share of tax preferences for R&D in GDP, %, and such factors as:

- foreign direct investments, share in GDP, %: r = -0.03;
- high-tech exports, % to industrial exports: r = 0.53;
- a share of enterprises that have implemented product/process innovations in the total number of innovative enterprises, %: r = -0.02;
- a share of enterprises that have implemented organizational/marketing innovations in the total number of innovative enterprises, %: r = 0.04.

These indicators were considered as measures of innovative activity results partially obtained due to tax benefits. We also see no significant results besides the share of high-tech exports in industrial exports. It can be explained by raising tax benefits for exporters of innovative products. In other cases we may confirm that R&D expenditures do not necessarily mean the production of a final product – innovation in the amount comparable to the expenses.

Obviously, the effects of different forms of financial support – direct funding or tax benefits – are only indirectly connected with the innovative process, and they are just the means of stimulation, but not production. Therefore, we propose to investigate these effects using a theoretical model of tax incentive impact on the stimulation of R&D at industrial enterprises.

There are several most used tools of fiscal incentives, which include the volume-based tax credit, tax rebates on social dues, on corporate taxes, tax holidays, raising coefficients on R&D costs, and accelerated depreciation. Theoretically, the government should provide tax benefits on the condition that a company has expenditures on R&D that is expected to become profitable in the future and to have significant positive externalities (Tanayama & Ylä-Anttila, 2009).

The advantage of tax benefits compared to direct government funding of innovation projects is that they are considered to be a transparent and predictable tool of government innovation policy. At the same time it depends on how correctly R&D costs were computed.

In addition, tax benefits are focused on increasing the quantity of innovations rather than quality compared to direct funding.

Let us consider what types of tax incentives are used in the innovation policy of the countries with the highest index of competitiveness (innovation factor).

In France there are such tax benefits that are widely used as reduction of payroll taxes and compensation of tax credit. The sum of benefits is up to 33.5% from R&D expenditures for young companies, up to 17.5% for companies above the age of 5 years, and up to 14% for companies above the age of 10 years. The main program is "*Research tax credit*". According to it the tax credit is 10% of R&D expenditures and 40% of their growth compared to their average for the last two years. The maximum tax credit is equal to 10 million euro per year.

Canada applies a tax credit of 20% of R&D expenditures. Moreover, the rapid write-off of capital investments related to R&D is permitted. Investments in equipment and technology necessary for R&D and innovations may be written-off at once (Kovalenko & Mel'nyk, 2009). Canada is considered to be a country where R&D is largely supported. In particular, tax credit on R&D covers 20 to 35% of all expenditures on such activity (Parsons, 2011).

The system of tax incentives in Great Britain provides for increasing costs that reduce the taxable profit by 150% from R&D expenditures for small and medium business, by 125% from R&D expenditures for large companies. According to a research survey conducted in 2005 on 1000 firms, tax preferences have a significant influence on entrepreneurship in the innovation area. A third of respondents indicated that tax incentives have brought an opportunity to carry out long-term projects. The survey showed a strong support of the existing system of tax incentives and revealed no significant reason to change it (European Commission, 2006).

In the United States tax benefits are the strongest incentives for innovative activity. In particular, a significant effect of fiscal tools can be explained by the following features of the federal corporate tax:

1. The expenditures on R&D.
2. The research and experimental tax credit.
3. The accelerated depreciation and tax credits for investment in capital equipment.
4. The tax treatment of acquisitions, especially as it relates to purchase accounting, in-process R&D, and the treatment of good will.

These advantages can be used by all economic entities regardless of the kind of industry. Among the most effective tax mechanisms of innovative activity motivation of US enterprises according to Hall (2001) there is a reduction of profit tax rates, that helps entrepreneurs and venture investors to partially compensate for the risk they bear.

Tax exemption and tax rate reductions are the most popular fiscal tools in Ukraine. Let us consider the types of tax benefits from profit tax and VAT in terms of innovative activity priority areas.

In the energy sector the main types of tax benefits are: 1) exemption from profit taxation within the costs of investment projects; 2) exemption from taxation of part of the profit; 3) exemption from taxation of profit gained from activities related to energy efficiency; 4) exemption from VAT on transactions of technical provision for alternative energy sources production.

In the field of nuclear and space-rocket engineering the exemption from VAT is used for R&D and research into engineering.

Aviation and shipbuilding industries have such tax privileges through exemption from tax on profit obtained from their main production and R&D, as well as exemption from VAT on R&D and research into engineering.

In production processing and storage of agricultural goods the profit tax is reduced by

the amount of land tax, and the value-added tax that has to be paid totally remains at the disposal of agricultural companies and is used to support domestic production.

Transactions in healthcare, pharmaceutical production and scientific activity are exempt from value-added tax.

In the area of software production the main benefits are the profit tax rate reduction up to 5% and exemption from VAT.

Using the approach from Grytsenko (2008), let us consider the model of the tax burden formation in the enterprises which are involved in innovative activity, and define the effects of exemption from taxation and tax rates reduction. Thus, we may estimate the effects of fiscal benefits theoretically.

Let us assume that an enterprise produces goods at the price (P) that consists of such elements as material costs including purchase of energy (M), labour costs (L), depreciation (D) and potential profit (Pr):

$$\mathrm{P} = \mathrm{M} + \mathrm{L} + \mathrm{D} + \mathrm{Pr}, \qquad (2)$$

Taxation of product units of a company will be based on the following tax rates:
t_L –base rate of social unified dues, accrued payroll;
t_{Pr} – base rate of profit tax;
t_{VAT} – base rate of VAT.

The total sum of taxes (T) to be paid by the company from one product unit is equal to:

$$\mathrm{T} = t_L \cdot L + t_{VAT} \cdot (L + D + \mathrm{Pr}) + t_{\mathrm{Pr}} \cdot (\mathrm{Pr} - t_L \cdot L - t_{VAT} \cdot (L + D + \mathrm{Pr})), \qquad (3)$$

We suppose that the value-added consists of the sum of labour costs, depreciation and profit. And taxable profit is equal to the difference between potential profit and taxes to be paid by the enterprise.

We estimate the tax burden related to the profit of a company, transforming (3):

$$TB = \frac{\mathrm{T}}{\mathrm{Pr}} \cdot 100\%, \qquad (4)$$

where:

$$TB = t_L \cdot \frac{L}{\mathrm{Pr}} + t_{VAT} \cdot \left(\frac{L}{\mathrm{Pr}} + \frac{D}{\mathrm{Pr}} + 1\right) + t_{\mathrm{Pr}} \cdot \left(1 - t_L \cdot \frac{L}{\mathrm{Pr}} - t_{VAT} \cdot \left(\frac{L}{\mathrm{Pr}} + \frac{D}{\mathrm{Pr}} + 1\right)\right), \qquad (5)$$

Compiling similar members of equation (5), we get:

$$TB = \frac{L}{\mathrm{Pr}} \cdot (1 - t_{\mathrm{Pr}}) \cdot (t_L + t_{VAT}) + \frac{D}{\mathrm{Pr}} \cdot (1 - t_{\mathrm{Pr}}) \cdot t_{VAT} + t_{VAT} \cdot (1 - t_{\mathrm{Pr}}) + t_{\mathrm{Pr}}, \qquad (6)$$

Thus we can see that the tax burden depends on wages/profit and depreciation/profit ratios. It follows that the more production is material-intensive, the lower the tax burden is.

However, let us turn to the effects caused by tax incentives. Earlier we found out that there are two most widespread types of tax preferences related to innovative activity in Ukraine, which are tax exemption and tax rates reduction. In addition, it should be noted that with the exception of the shipbuilding industry there are not any benefits from unified social dues connected with innovation activity for any industry. And most benefits from the unified

social dues are focused on social security. So we consider only benefits from profit tax and value-added tax.

Let us determine the tax burden (*TB*') in the case of total exemption from profit tax (assume $t_{pr} = 0$, because it doesn't create any burden on profit):

$$TB' = \frac{L}{\Pr} \cdot (t_L + t_{VAT}) + \frac{D}{\Pr} \cdot t_{VAT} + t_{VAT} \qquad (7)$$

In this case it is clear that the tax burden is mostly dependent on the level of value-added taxation, and on the degree of material- and labour-intensity of production. The reduction of tax burden (ΔTB) will be the following:

$$\Delta TB = TB - TB', \qquad (8)$$

where:

$$\Delta TB = -t_{\Pr} \cdot \left[(\frac{L}{\Pr} \cdot (t_L + t_{VAT}) + \frac{D}{\Pr} \cdot t_{VAT} + t_{VAT}) - 1 \right] = -t_{\Pr} \cdot (TB' - 1) \qquad (9)$$

From the equation (9) we see that in the case of exemption from profit taxation the tax burden will decrease not by total rate of tax but only by a part of it. This is a part of profit the enterprise can use for increasing their investments in R&D.

Let us consider what happens to the tax burden in the case of total exemption from VAT, transforming (6):

$$TB' = t_L \cdot \frac{L}{\Pr} \cdot (1 - t_{\Pr}) + t_{\Pr}, \qquad (10)$$

The change in the tax burden is:

$$\Delta TB = t_{VAT} \cdot (1 - t_{\Pr}) \cdot \left[\frac{L + D + \Pr}{\Pr} \right], \qquad (11)$$

If simultaneously the enterprise has exemption from profit tax, then from (7) we get that the tax burden *TB*' is: $TB' = \frac{L}{\Pr} \cdot t_L$, and it depends on labour-intensity and on social unified dues rate.

If the state provides exemption only for a part of profit or transactions (for VAT), the tax burden will reduce to a lesser extent. This greatly reduces the profit released for re-investments in innovative projects or R&D.

Conclusions

We may summarize that tax incentives are being used in most developed countries as an effective tool of innovation policy along with the state funding. There are many forms of implemented tax preferences in the world that can stipulate increase in R&D expenditures. However, it is impossible to evaluate directly the impacts of their implementation because of the complexity of the transformation mechanism of tax benefits into innovation products.

The attempts to estimate statistically the impact of tax benefits on selected indicators

of innovation activity were not yet successful. On the other hand, this impact can be theoretically estimated by using a mathematical model of tax burden of industrial enterprises. The analysis shows that exemption from taxation and cutting of tax rates help to reduce the tax burden and tax payments to the extent that depends on the degree of material- or labour-intensity of production.

Despite the prevailing negative trends in innovative activity and R&D in Ukraine we may also observe positive changes. The share of enterprises engaged in innovations compared with 2005 has increased by 6.2 percent (from 11.2 to 17.4). This dynamic represents the growing stimulus for R&D and innovations. Presumably, an important role in this process belongs to tax benefits. Because of the implementation of tax incentives R&D expenditures in Ukraine have increased 4.5 times within 12 years to $149.5 million.

Tax incentives certainly have a positive impact which is stipulated by the exemption part of profit that can be reinvested into production of innovative products, or used to compensate partly or fully for R&D expenditures.

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