Larysa A. Nekrasenko[1], Olha V. Prokopenko[2], Valentyna I. Aranchiy[3]

CARBON TAX AS AN INSTRUMENT OF ENVIRONMENTAL MANAGEMENT IN UKRAINE

The article offers to use differentiated tax rate on carbon in regions, along with the method of calculating the adjustment factor. It has been suggested to increase the carbon tax for businesses by reducing the income tax. Calculations indicate the possibility of increasing incomes of local and state budgets by increasing tax rates on carbon and using an adjustment factor. To compensate damages from carbon footprints, the creation of a mechanism for redistributing the budgets incomes has been proposed.

Keywords: *carbon tax; carbon footprint; carbon emissions; adjustment factor.*
JEL classification: E62, H21, H23.

Лариса А. Некрасенко, Ольга В. Прокопенко, Валентина І. Аранчій

ВУГЛЕЦЕВИЙ ПОДАТОК ЯК ІНСТРУМЕНТ ЕКОЛОГІЧНОГО МЕНЕДЖМЕНТУ В УКРАЇНІ

У статті пропонується використовувати диференційовану ставку податку на вуглець в регіонах, запропоновано метод розрахунку корегувального коефіцієнта. Крім того, запропоновано підвищення податку на викиди вуглецю для підприємств за рахунок зниження податку на прибуток. Результати розрахунків вказують на можливість підвищення доходів місцевих та державного бюджетів за рахунок підвищення ставки податку на вуглець і використання поправочного коефіцієнта. Запропоновано розробити механізм перерозподілу доходів бюджетів для відшкодування збитків від вуглецевого сліду.

Ключові слова: *вуглецевий податок; вуглецевий слід; викидів вуглецю; корегувальний коефіцієнт.*
Форм. 7. Табл. 3. Літ. 18.

Лариса А. Некрасенко, Ольга В. Прокопенко, Валентина И. Аранчий

УГЛЕРОДНЫЙ НАЛОГ КАК ИНСТРУМЕНТ ЭКОЛОГИЧЕСКОГО МЕНЕДЖМЕНТА В УКРАИНЕ

В статье предлагается использовать дифференцированную ставку налога на углерод в регионах, для чего предложен метод расчета поправочного коэффициента. Кроме того, предложено повышение налога на выбросы углерода для предприятий за счет снижения налога на прибыль. Представленные результаты указывают на возможность повышения доходов местных и государственного бюджетов за счет повышения ставки налога на углерод и использование поправочного коэффициента. Предлагается создать механизм перераспределения доходов бюджетов для возмещения ущерба от углеродного следа.

Ключевые слова: *углеродный налог; углеродный след; выбросы углерода; поправочный коэффициент.*

Problem statement. Power engineering is the most vulnerable subsector of Ukrainian economy. The Energy Strategy of Ukraine aims to increase the share of domestic fossil fuels in the energy balance of the country to 91.8% until 2030 (Energy Strategy of Ukraine till 2030). It is obvious that Ukraine intends to continue to use fossil fuels. Energy policy should be reviewed due to the dependence on fossil sources and high prices on fuel. Therefore, vital issue is the motivation of enterprises and households to find alternative energy sources. The motivation tools are tax benefits and tar-

[1] Poltava State Agrarian Academy, Ukraine.
[2] Sumy State University, Ukraine.
[3] Poltava State Agrarian Academy, Ukraine.

iffs. The increase of tax rate will stimulate enterprises and population to change the attitude to fossil energy sources as expensive instruments of receiving income.

That is, instruments, including the financial ones, should be used to achieve a balance between economics and ecology, and between emissions and absorption. That should make carbon-dependence economy unprofitable and unpopular. But the state should motivate businesses to start thinking about these issues. High price on fossil fuels, high tax rates on air pollutants could be these motivators. At the same time there should be tax privileges for the companies that implement innovative "clean" technologies. These measures should be based on the principles of fairness, objectivity and scientific approach.

Recent research and publications analysis. We are considering carbon tax as a possible solution to reduce carbon emissions. The main reason for implementing carbon tax is its potential to achieve environmental goals, in particular, reduction of carbon dioxide emissions, while simultaneously increasing economic efficiency (Baranzini, Goldemberg and Speck, 2000). In European countries the introduction of environmental taxes began in 1990. There are many reviews of environmental taxes and literature on their potential, that taxes operated more effectively and assisted more effective environmental policy (Hoerner and Bosquet, 2001; Sterner and Kohlin, 2003; Stern, 2007; Tindale, 2010). But the issue of the effective interest rate of carbon tax is still unresolved.

J. Stiglitz (1997: 369) highlighted 5 properties of a good tax system:

- Economic efficiency of a tax system should not be in conflict with efficient allocation of resources.
- Administrative simplicity: administrative system should be simple and relatively inexpensive in use.
- Flexibility: Tax system should be able to respond quickly to changes in economic conditions.
- Political responsibility: Tax system should be structured in a way to convince people they pay to the political system accurately reflecting their preferences.
- Validity of a tax system should be fair in its approaches to different individuals.

In Ukraine more attention has been paid to the projects attempting to quantify economic and social implications of various environmental tax reform. Their objective is to improve the decision-making of public administration, in particular, the Ministry of Ecology and Natural Resources of Ukraine. Starting from 1999, Ukrainian government has imposed the environmental tax, officially known as environmental pollution fee. Discussions on its introduction have been conducted in Ukraine over the past decade. Pre-conditions of its introduction in Ukrainian scientific literature were first revealed in the papers by O. Veklych and O. Maslyukivska (2008). In 2011 Ukraine introduced the environmental tax and the carbon tax in the tax code. But the tax rate of 0.25 UAH/t CO_2 is very low considering the fear to lose competitiveness of power-hungry domestic industry (Tax Code of Ukraine, 2011). At the same time the carbon tax rate of 40 USD per 1 ton of CO_2 is considered reasonable in industrially developed countries.

The choice of the tax base is a responsible task because insufficiently substantiated tax base may cause doubts about the fairness of a tax and its economic feasibili-

ty. Moreover, the decision as to what should be the tax base is uncertain, particularly when there is uncertainty about the properties and the environmental impact of industrial use of various natural resources and consumption of products with externality (Fullerton and Metcalf, 1997).

Another factor that must be considered is the complexity of measuring tax base, monitoring harmful emissions, complex measuring procedures. All this factors should be take into account.

During the formation of an economically and environmentally efficient and fair tax system adjustment factors can be used. Carbon footprint could be used as an adjustment factor and as a measure of environmental damages similar to ecological footprint. The ecological footprint is one of the most popular and well-known environmental indicators. It means a measure of human pressure on the environment in the form of territories and water areas needed for resource extraction and waste disposal. Calculations of this indicator show that our planet is experiencing pressure from the mankind. The ecological footprint (EF) concept was introduced in 1996 by M. Wackernagel and W. Rees (1996), University of British Columbia. Yearly EF is calculated by the international organization "Global Footprint Network", which presents its evaluation reports of this indicator (Ecological Footprint Atlas, 2010).

The overall ecological footprint of Ukraine has been calculated by A.V. Kubatko (2009). But she has not calculated the carbon footprint, she was taking GDP as productivity and yield.

In our previous publications (Nekrasenko, Prokopenko and Konchakovskiy, 2014) we have calculated the carbon footprint by the method of ecological footprint. But this method has a lot of uncertainty and is very time consuming. Therefore, it is not suitable for the adjustment coefficient estimation.

Therefore, we propose to consider the carbon footprint in terms of environmental damage as did O. Balatsky (1979). We propose to calculate the damage as the ratio of carbon emissions and uptake capacity of forest per year.

Thus, the problems of environmental management can be solved by balanced and scientifically-based approach to the development and implementation of environmental taxes to ensure energy and environmental security.

The main objective of the paper is to determine the scientifically based adjustment factor of carbon tax which would take into account economic and natural features of different regions in Ukraine. Moreover, we provide scientific justification of the need to increase tax collections and thus motivate the transition to renewable energy.

We offer to increase the carbon tax by reducing the income tax for enterprises. We also propose to use differential tax rate in regions. The difference will be in the degree of damage to the environment and the possibility of its compensation. These factors should be taken into account while calculating pollution damages. Therefore, to form an economically and environmentally efficient and fair taxation system the adjustment factor should be used while calculating the optimum tax rate for each company or for a region. We propose to use the carbon footprint as the adjustment factor and as a measure of environmental damages.

Methods. Carbon footprint is the indicator which could be used to determine environmental reserves in regions. It shows the volumes of pollution damage happening as a result of the fossil fuels use to meet the needs of energy-intensive Ukrainian industry.

Calculations of the carbon footprint will be carried out by the method similar to calculations of the ecological footprint. For these calculations we should take into account the carbon sequestration divided by forest area, annual emissions of carbon dioxide, equivalent factor of CO_2 uptake (Calculation methodology for the national footprint accounts, 2010).

Key research findings. We believe it is enough to know carbon dioxide emissions, forest area and volume absorption to calculate the environmental damages from carbon dioxide. Therefore, for carbon footprint calculation in Ukraine we will use the formula:

$$CF = \frac{Pcu}{Ycu}, \tag{1}$$

where CF – carbon footprint in Ukraine, mln ha; Pcu – CO_2 emissions in Ukraine or in a region, mln tones (National Cadastre of antropogenic emissions from sources and absorption of greenhouse gases absorbers in Ukraine in 1990–2012, 2012); Ycu – the potential of carbon sequestration by forests of Ukraine (calculated as the ratio of uptake Uu to the forest area of uptake emission Su), t/ha:

$$Ycu = \frac{Uu}{Su}, \tag{2}$$

where Uu – carbon uptake in Ukraine, mln tones (National Cadastre of antropogenic emissions from sources and absorption of greenhouse gases absorbers in Ukraine in 1990–2012, 2012); Su – forest area in Ukraine, mln ha (National Cadastre of anthropogenic emissions from sources and absorption of greenhouse gases absorbers in Ukraine in 1990–2012, 2012).

Carbon footprint is a negative indicator. Opposite to it there is a positive index – biological capacity, which determines the ability of the environment of a respective territory to "heal itself". We believe biocapacity of absorption (BC) is equal to the forest area S in Ukraine:

$$BC = S. \tag{3}$$

The difference between footprint and biocapacity shows the debt or sufficiency of uptake potential:

$$CD = BC - CF, \tag{4}$$

where CD – debt of uptake potential or net carbon damage, mln ha.

The next stage will be the calculation of the price of timber manufacture of 1 ha:

$$I = Pt / Sf, \tag{5}$$

where I – price of timber manufacture, 1 ha of forest, UAH/ha; Pt – sold products, mln UAH (Ukraine in figures in 2013, 2014); Sf – cuttings area, mln ha (National Cadastre of anthropogenic emissions from sources and absorption of greenhouse gases absorbers in Ukraine in 1990–2012, 2012).

Next goes the calculation of the carbon footprint cost or the debt of uptake potential, which is related to productivity of timber manufacture:

$$DF = I \times CF, \tag{6}$$

where DF – cost of carbon footprint, UAH; I – price of timber manufacture 1 ha of forest, UAH/ha; DF – cost of carbon footprint, mln ha.

Calculation of the tax on emissions will be based on actual emissions and the adjustment coefficients of carbon footprint by the formula:

$$Tc = Pc \times T + DF, \quad (7)$$

where Tc – adjusted carbon tax, UAH; Pc – volume of carbon dioxide emissions in tones (National Cadastre of antropogenic emissions from sources and absorption of greenhouse gases absorbers in Ukraine in 1990–2012, 2012); T – standard fee per ton of waste carbon dioxide in UAH per ton (UAH/t); DF – the adjustment factor (cost of carbon footprint).

Adjustment factor for enterprises will be equal to the share of its CO_2 emissions in the total emissions in a region.

We did the calculations of the carbon footprint of Ukraine (Table 1).

Table 1. **Calculation of the carbon footprint of Ukraine,** *authors'*

Parameters	Equation	2012
Su, forest area in Ukraine, mln ha[1)]		10.36
Pcu, Ukraine's emission of CO_2, mln tons[1)]		302.7
Uu, carbon sequestration Ukraine, mln tons[1)]		-27.00
Ycu, potential of carbon sequestration by forests in Ukraine, t/ha	*Yc = Uu / Su*	-2.61
CF, Ukraine's carbon footprint, mln ha	*CF = Pcu / Ycu*	-116.10
BC, absorption biological capacity, mln ha	*BC = S*	10.36
CD, debt absorption capacity, mln ha	*CD = BC – CF*	-105.74

[1)] National Cadastre of anthropogenic emissions from sources and absorption of greenhouse gases absorbers in Ukraine in 1990–2012, 2012.

For calculations we have used the annual CO_2 emissions, carbon uptake and forest squares, taken from national inventories of anthropogenic emissions in Ukraine in 2012 (National Cadastre of anthropogenic emissions from sources and absorption of greenhouse gases absorbers in Ukraine in 1990–2012, 2012). Ukrainian carbon footprint in 2012 was -116.1 mln ha. The absorption biological capacity of Ukraine in 2012 was 10.36 mln ha. The debt of absorption is -105.74 mln ha.

Next, we calculate the adjustment factor to the carbon tax (Table 2). Thus, the amount of tax should be increased by 1499.09 mln UAH.

Table 2. **Calculation of the adjustment factor to carbon tax,** *authors'*

Parameters	Equation	2000	2011	2012
Sf, cuttings area, mln ha[1)]		0.4551	0.421	0.417
CD, debt of absorption, mln ha	*CD = BC – CF*	-49.70	-466.06	-105.74
Pt, sold products, mln UAH[2)]		744.40	5674.80	5911.60
I, price timber from 1 ha of forest, UAH/ha	*I = Pt / Sf*	1635.68	13453.77	14176.50
DF, adjustment factor (the cost of carbon footprint), mln UAH	*DF = I* x *CD*	81.29	6270.26	1499.09

[1)] National Cadastre of anthropogenic emissions from sources and absorption of greenhouse gases absorbers in Ukraine in 1990–2012, 2012.
[2)] Ukraine in figures in 2013, 2014.

We calculate the state budget profits using the compensation method and the adjustment factor (Table 3). Ukrainian income tax was 55349.7 mln UAH in 2012 (Law of Ukraine "On the State budget of Ukraine on 2012", 2011).

Table 3. **State budget profits with the compensation method and using the adjustment factor,** *authors'*

Parameters	2012	Compensation method
Pc, Ukranian CO_2 emissions, mln tons	302.7	302.7
Ri, rates of tax on income in Ukraine, %	21.0	17.0
Tax on income in Ukraine, mln UAH[1)]	55349.7	44806.90
Enterprises profit, mln UAH	263570.00	263570.00
Difference between the actual values and the projected performance, mln UAH	-	10542.80
Rc, rates of carbon tax in Ukraine, UAH per ton of CO_2	0.24	35.07
T, carbon tax in Ukraine, mln UAH	72.65	10615.45
DF, adjustment factor (cost of carbon footprint), mln UAH	1499.09	1499.09
Tc, adjusted carbon tax in Ukraine, mln UAH	1571.74	12114.54

[1)] Law of Ukraine "On the State budget of Ukraine on 2012" (2011).

For example, we consider the cut of tax rate on income from 21.0% to 17.0%. The budget losses will amount to 10542.8 mln UAH. The difference in profits of budget we suggest to compensate by raising carbon tax rate. Calculations show that in this case the optimal rate would be 35.07 UAH per 1 ton of CO_2. Thus, revenues from the carbon tax would amount to 10615.45 mln UAH completely covering budget losses. But given the principles of fairness, we also consider the adjustment factor that reflects the ecological damage or carbon footprint. As a result, the adjusted carbon tax increases to 1499.09 bln UAH and will be 12114.54 mln UAH per year.

The environmental tax should be calculated by the fair principle "the polluter pays" determining the share of each region in the overall picture of pollution from fossil energy sources because each company has various opportunities for emission purification and absorption. Their tax should depend on the amount of emissions and potential to absorption. In the short term it makes sense to increase the tax in those areas that create the highest environmental damages and as result also increase budget revenues. In the long term, this should encourage businesses to refuse of carbon fuels. To reduce the cost of production carbon tax should be included in before income tax expenses.

Conclusions. Ukrainian legislation and tax policy need improvements. One of the directions of environmental policy development in Ukraine is to introduce an effective mechanism for collection and use of carbon tax. Tax management should include firstly differentiated carbon tax rate and benefits to encourage consumers to save energy generated from fossil fuels, and to use carbon-free clean technologies. Secondly, an effective mechanism should be created for the redistribution of taxes to compensate for damages caused by carbon pollution that would provide funding to enhance forestry development. Effective tax management can decrease greenhouse gases emissions into the atmosphere and could become an incentive for further forestry development.

References:

Податковий кодекс України від 02.12.2010 №2755-VI зі змінами та доповненнями // zakon.rada.gov.ua.

Про Державний бюджет України на 2012 рік: Закон України від 22.12.2011 №4282-VI // zakon.rada.gov.ua.

Енергетична стратегія України на період до 2030 року: Розпорядження Кабінету Міністрів України від 24.07.2013 №1071 // zakon.rada.gov.ua.

Балацкий О.Ф. Экономика чистого воздуха. – К.: Наукова думка, 1979. – 296 с.

Веклич О.О., Маслюківська О.П. Оцінювання фіскального потенціалу податку на двоокис вуглецю при змінній базі та ставці оподаткування // Фінанси України.– 2008.– №6. – С. 63–69.

Кубатко А.В. Науковий підхід до визначення екологічного сліду в якості показника сталого розвитку на рівні регіональних економік // Механізм регулювання економіки.– 2009.– №1. – С. 194–202.

Національний кадастр антропогенних викидів із джерел та абсорбції парникових газів поглиначами в Україні в 1990–2012 / Министерство экологии и природных ресурсов Украины, Государственное агентство экологических инвестиций Украины. – К., 2012 // www.neia.gov.ua.

Стиглиц Дж.Ю. Экономика государственного сектора / Пер. с англ. – М.: МГУ; ИНФРА-М, 1997. – 720 с.

Україна в цифрах у 2013 році. – К., 2014 // www.ukrstat.gov.ua.

Baranzini, A., Goldemberg, J., Speck, S. (2000). A future for Carbon Taxes. Ecological Economics, 32(3): 395–412.

Calculation methodology for the national footprint accounts, 2010 edition // www.footprintnetwork.org.

Fullerton, D., Metcalf, G.E. (1997). Environmental Taxes and the Double-Dividend Hypothesis: Did You Really Expect Something for Nothing? // www.nber.org.

Hoerner, J.A., Bosquet, B. (2001). Environmental tax reform: the European experience. Washington, DC: Center for a Sustainable Economy, 2001. 94 p.

Nekrasenko, L., Prokopenko, O., Konchakovskiy, Y. (2014). Carbon footprint of Ukraine, its dynamics and prediction. Sustainable Development, 19: 64–69.

Stern, N. (2007). The Economics of Climate Change: The Stern Review. Cambridge and New York: Cambridge University Press.

Sterner, T., Kohlin, G. (2003). Environmental Taxes in Europe. Public Finance and Management, 1: 26.

Tindale, S. (2010). Carbon and energy taxes in Europe // climateanswers.info.

Wackernagel, M., Rees, W. (1996). Our Ecological Footprint: Reducing Human Impact on the Earth, New Society Publishers, Gabriola Island // www.footprintnetwork.org.

Стаття надійшла до редакції 24.12.2014.