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UNIVERSAL APPROACH TO BUILDING THE PROGRESSIVE SCALE FOR INCOME TAXATION

The article presents the developed algorithm for building the progressive taxation scale along with the methods for formation of linear growing and non-linear progressive scales in taxation. Basing on the carried out calculations the author proves the applicability of the suggested methods.
Keywords: *progressive scale; income taxation; private income tax; taxation policy; social orientation.*

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УНІВЕРСАЛЬНИЙ ПІДХІД ДО ФОРМУВАННЯ ПРОГРЕСИВНОЇ ШКАЛИ ОПОДАТКУВАННЯ ПРИБУТКУ

У статті розроблено алгоритм побудови прогресивної податкової шкали. Запропоновано методи формування лінійно зростаючої та нелінійної прогресивних шкал оподаткування. На основі проведених розрахунків доведено придатність запропонованих методів для застосування.
Ключові слова: *прогресивна шкала; оподаткування прибутку; податок на прибуток фізичних осіб; податкова політика; соціальна спрямованість.*
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УНИВЕРСАЛЬНЫЙ ПОДХОД К ФОРМИРОВАНИЮ ПРОГРЕССИВНОЙ ШКАЛЫ ПОДОХОДНОГО НАЛОГООБЛОЖЕНИЯ

В статье разработан алгоритм построения прогрессивной налоговой шкалы. Предложены методы формирования линейно возрастающей и нелинейной прогрессивных шкал налогообложения. На основе произведенных расчетов доказана применимость предлагаемых методов.
Ключевые слова: *прогрессивная шкала; подоходное налогообложение; налог на доходы физических лиц; налоговая политика; социальная направленность.*

Introduction. In today's global practice the most widely spread form of social orientation realization in taxation policy is the use of progressive taxation which is in full compliance with the principles of social justice. Progressive taxation of income is available in the majority of developed countries, including G-20, OECD countries and also BRICS.

Russia's transition to market and the changing mechanism of national incomes distribution lead to many new social problems, among which the most serious one is the income gap between social groups. In 2001 Russian Federation put aside the idea of progressive tax scale for private individuals and introduced a single tax rate – 13%. The key argument grounding the introduction of flat scale in taxation was that this would have helped moving large volumes of income from the shadow sector of the economy. However, in real practice this reform proved its value only partially and did not manage to reduce the income gaps which are only increasing since 2000 and till now. In 2014, according to federal statistics, income of the poorest social group were smaller than those of the richest social groups by 16 times (Federal Statistics Service, www.gks.ru).

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If to compare the current state with the beginning of the so-called "Perestroika" period, the gap between 10% of most rich and 10% of most poor used to be "only" 5–7 times. Thus, we can surely state that today the key goal for our state in the field of taxation should become the development of socially oriented taxation policy in full compliance with the rules of truly democratic society development.

Recent research and publications analysis. Currently the issue of Russian Federation's transition to the progressive taxation scale is widely discussed in various circles and levels of public authorities, including economic regulation bodies and legislation ones. Among Russian economists who are strongly for the introduction of the progressive taxation scale, we need to mention M. Antonova (2009), R. Grinberg (2010), I. Karavaeva (2010), M. Sokolov (2009), N. Tyutyurkov (2008) etc.

Obviously, redistribution of incomes by means of progressive scale introduction means that a range of optimization methods would be used, both qualitative and quantitative ones. Several authentic variants of progressive scales have already been suggested by Russian economists and political leaders, including: A. Bagaryakov (2010), A. Bobrova (2007), O. Dmitrieva (2013), A. Gorelko (2014), I. Nikolaev (2013), O. Nilov (2014), L. Pavlova and V. Pankratov (2010), Y. Vasiliev (2008), S. Zaitseva and I. Lyutova (2007).

Studying all the suggested variants in more detail, we need to note that there are significant differences between them. Table 1 presents the key parameters of the progressive taxation scales, as suggested by various economists and politicians of Russian Federation.

Table 1. **Comparing the key parameters of the suggested scales for progressive taxation,** *compiled by the author*

		(Gorelko, 2012)	(Shevyakov, 2011)	(Nilov, 2014)	(Dmitrieva, 2013)	(Bagaryakov, 2010)	(Nikolaev, 2013)	(Nigmatullin et al., 2014)
m	–	4	5	4	4	5	2	4
n_1	%	13	0	13	13	5	13	0
n_m	%	25	50	28	50	45	20	50
R_1	mln RUB	0.36	0.05	5	3	0.6	–	0.18
R_m	mln RUB	1.2	30	500	30	12	6	12
n_m / n_1	–	1.92	∞	2.15	3.85	9	1.5	∞

Legend: m – the number of taxpayers' groups; n_1 and n_m – minimal and maximum rates of taxation, accordingly; R_1 and R_m – annual income which is taxable for the first and m-th groups of taxpayers.

Table 1 clearly shows that the suggested number and parameters differ significantly, even though in some cases they come from the same institution (Gorelka – Shevyakov) or the same political fraction (Dmitrieva – Nilov). At the same time all these authors state that their developments are based on the latest achievements of economic science and on the actual statistical data on population income distribution in Russian Federation.

Some authors also mention the necessity to consider the scale examples from other countries. Considering this international experience, we can note the variety of taxation scales (Table 2).

Table 2. **Income tax rates in various countries,** *%, compiled by the author on the data from* (worldwide-tax.com; www.tradingeconomics.com)

2014	Austria	UK	Germany	Denmark	Spain	Canada	Norway	Poland	USA	Finland	France	Sweden	Japan
n_1	21	0	14	38	24.8	15	28	18	0	6.5	5.5	0	5
n_m	50	45	47.5	55.6	52	29	39	32	39.6	51.5	50.3	57	50

The presented examples of taxation scale clearly show that there is no optimal solution in the formation of progressive taxation scale. Economists' attempts of practical recommendations on constructing "fair" or "optimal" scale from the economic viewpoint in real practice lead to vast variety of propositions which mostly have ideological background and essentially most of them are redistributive in nature.

It is questionable whether taxation systems from different countries can be actually built on the common principles of income taxation scales. In this regard (Laffer, 1979) stated that the optimal taxation rate can be calculated only for a particular economic situation. However, numerous follow-up studies in this regard and practical approbation of the Laffer theory as such in the USA did not prove this idea to be absolutely right. Nowadays many economists consider this Laffer's statement "a phantom in the theory of taxation and the dead end of the economic thought development" (Balatskiy, 1997).

Research objective. This article presents an attempt to consider the development of a universal method of constructing the income taxation scale for different levels of economic development from the viewpoint of social justice, basing on the general principle of taxpayers distribution by level income according to Lorenz curve.

Constructing the function of Lorenz distribution and determining on its basis the Gini coefficient and Hover index is a widely used method to measure the inequality in taxpayers' income distribution.

The above allows us formulate ***the objective of this study*** which is the development of a universal approach to the formation of progressive income taxation scale within the framework of socially oriented taxation policy carried out by public authorities.

Key research results.

1. Developing the algorithm for the taxation scale formation. In economic literature various terminology is used to describe the types of taxation scales. Within this study we use the following notions: flat scale – standing for the single tax rate for all taxpayers; progressice scale – when the tax rate rises along with taxpayer's income growth.

Let us consider the suggested principle of taxation scales construction, the theoretical basis for which is the quantitative measure of taxpayers' inequality in their incomes, calculated by means of the Lorenz function.

Let us place the N quantity of taxpayers in line by the growth of their taxable money income and then split them into groups $i = 1, 2, ..., m$. Each group might have

a different amount of taxpayers N_i. Let us introduce the following notations: S_i – the taxable base of the i-th group; n_i – the tax rate of the i-th group.

Then the country's total taxable base would be:

$$S_0 = \sum_{i=1}^{m} S_i. \quad (1)$$

And the total tax on personal income would be:

$$C_0 = \sum_{i=1}^{m} n_i \times S_i. \quad (2)$$

Let's introduce the generalized coefficient of tax load n0 as a relation:

$$n_0 = \frac{C_0}{S_0}. \quad (3)$$

The coefficient n0 according to (3) is the generalized averaged tax rate on personal income which can supply to the state budget the total inflow equal to the actual tax rate.

Let's present (3) in the expanded form:

$$n_0 S_0 = n_1 S_1 + \ldots + n_i S_i + \ldots + n_m S_m. \quad (4)$$

Let's distribute the taxpayers by groups in such a way that in each i-th group there is such a number of taxpayers N_i, at which the total tax inflow from each group is the same: $S_1 = \ldots S_i \ldots = S_m$, $S_i = S_0 / m$.

Then the equation (4) takes the form:

$$n_0 S_0 = S_i (n_1 + \ldots + n_i + \ldots + n_m)$$

or

$$n_0 m = \sum_{i=1}^{m} n_i. \quad (5)$$

Here we should note that the tax relation (5) in which the sum of rates of any taxation scale should be equal to the product n_0 x m, essentially is the universal precondition for constructing any type of taxation scale according to the suggested here principle of grouping taxpayers using the Lorenz distribution function, thus it can be called the Lorenz tax relation.

The number of taxpayers in each group N_i is determined according to the Lorenz distribution function in points $S_i = S_0 / m$.

Figure 1 shows the example of Lorenz curve for Russian Federation calculated by the taxpayers' quintiles for 2014.

Using this curve we can determine the % share of taxpayers for each group: N_1 = 47.3%; N_2 = 21.8%; N_3 = 14.2%; N_4 = 8.4%; N_5 = 8.3%.

The volumes of taxable income for each group are presented according to the data of the Federal Service for State Statistics of Russian Federation.

Let us consider the use of tax relation (5) in the construction of various variants of taxation scales.

2. Building a linear growing progressive scale of taxation. Variants of progressive linear scale for taxation are the means of realizing one of the simpliest principles of

being fair – tax should be paid proportionally to income. In this case the tax rate increase for ni follows the law of arithmetical progression:

$$n_i = n_1 + \Delta \times (i-1), \quad \Delta = n_{i+1} - n_i = const. \tag{6}$$

Thus, the increase of tax rate from group to group of taxpayers is constant.

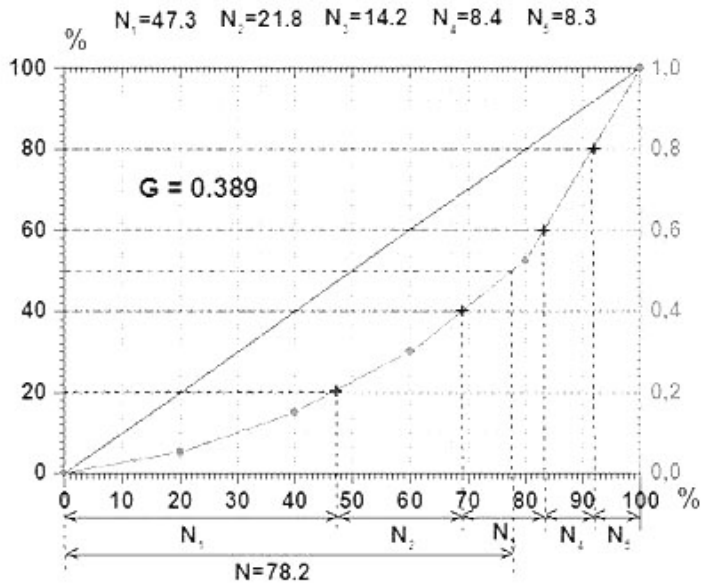


Figure 1. **Lorenz curve for Russian Federation taxpayers' groups,** 2014, *constructed by the author on the* Federal statistics data

The tax relation (5) has to be fulfilled for any type of taxation scale, thus, plugging (6) into (5) we get:

$$n_1 + (n_1 + \Delta) + (n_1 + 2\Delta) + \ldots + [n_1 + (m-1)\Delta] = n_0 m. \tag{7}$$

Let us now group the summands (7) in other order:

$$mn_1 + \Delta[1 + 2 + \ldots + (m-1)] = n_0 m. \tag{8}$$

Considering that the sum of natural numbers $\sum_1^{m-1} i = \frac{(m-1)m}{2}$, from (8) we get the tax rate growth:

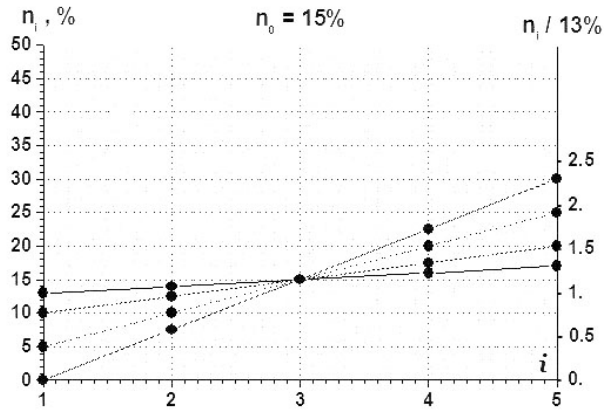
$$\Delta = \frac{2(n_0 - n_1)}{m-1}. \tag{9}$$

Then, according to (6) and (9), the rate for *i*-th group of taxpayers would be determined by the formula:

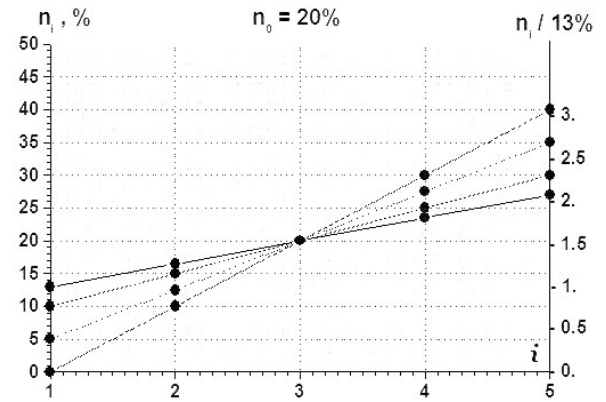
$$n_i = n_1 + \frac{2(n_0 - n_1)(i-1)}{m-1}. \tag{10}$$

Therefore, the type of taxation scale depends mostly on two parameters: the size of generalized tax rate n_0 (3) and the rate n_1 for low-income group of taxpayers.

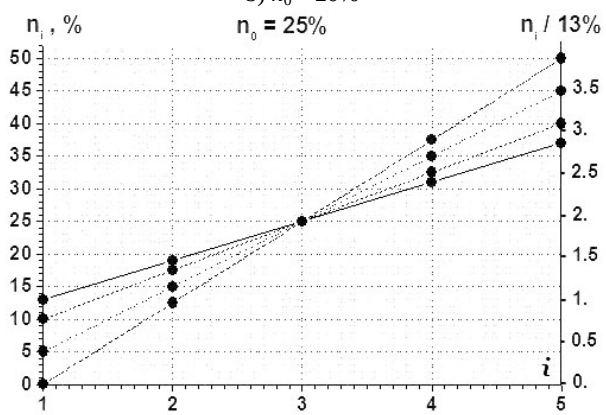
The graphical representations of (10) for various choices of n_0 and n_1 are presented in Figure 2.



a) $n_0 = 15\%$



b) $n_0 = 20\%$



c) $n_0 = 25\%$

Figure 2. **Building the linear progressive scale at n_0,** *author's development*

On the horizontal axis we can see 5 groups of taxpayers ($m = 5$) according to their share contribution to the total income, determined by the Lorenz curve (see

Figure 1). And on the vertical axis on the left are the percentage values of taxation rates n_i for all groups of taxpayers, and on the right is the relation n_i / 13%.

Figure 2 presents the variants of linear progressive scales of the expected coefficients of tax load n_0 = 15%, 20%, 25% at different rates for the first group of taxpayers n_1 = 0%, 5%, 10%, 13%.

And Figure 3 presents the variants of linear taxation scales saving the tax rate of n_1 = 13% with the simultaneous increase of the total tax load C_0 by 20%, 30%, 40% (α = 1,2; 1,3; 1,4) as compared to its value under flat taxation. The figure clearly shows what should be the value of nondimensional tax coefficient $n_0 = n_1$.

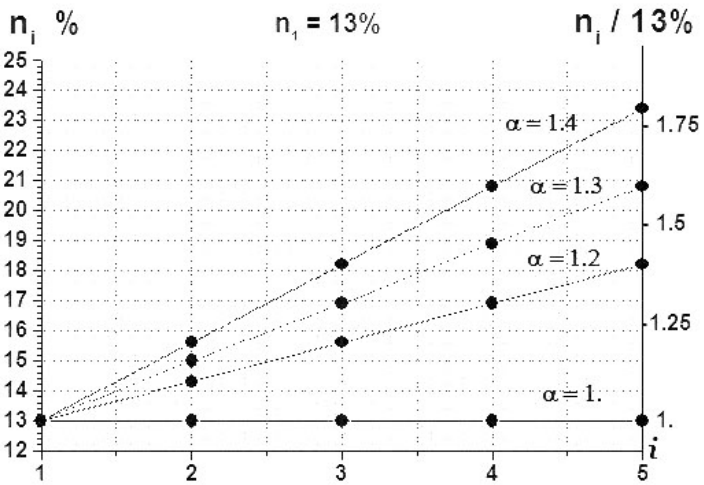


Figure 3. **Building the linear progressive scale at n_1 = 13%,** *author's development*

We should note here the feature of linear taxation scales, constructed by the suggested here way: the "knot" for various variants of scales will always be in the middle of the scale and will be equal to n_0 (Figure 2).

For the purposes of definiteness, let's assume m is any odd number. Then in the middle of the taxation scale is the group of taxpayers with the number of $i_{cp} = \frac{(m+1)}{2}$.

Using (10) we can calculate the tax rate for this group:

$$n_{i_{cp}} = n_1 + \frac{2(n_0 - n_1)\left(\frac{m+1}{2} - 1\right)}{m-1} = n_0 \qquad (11)$$

In case the total number of taxpayers' groups is even, the "know" would be situated in the middle of the scale, between neighbouring groups, for example: if m = 10, then between i = 5 and i = 6 with $n_0 = (n_5 + n_6) / 2$.

The middle of this scale actually divides all taxpayers into two groups: N_1 with the tax rates of $n_i < n_0$, and N_2 with the tax rates being $n_i > n_0$. Thus, for example,

according to Lorenz distribution for Russian Federation, as of 2014: the year N_1 = 78.1% and N_2 = 21.9%, N_1 / N_2 = 3.57 (see Figure 1).

3. Construction of non-linear progressive scale for taxation. In economic literature there exist two key approaches to constructing the progressive scale for taxation purposes:

- Tax rate is to be growing with incomes increase (as it is in most of developed countries).
- Tax rate growth is to be slowing down with income increase.

Differences in these approaches are based on the discussion concerning the interrelation between employers' activeness, the size of his/her salary and the tax burden on it.

Let us consider the construction of non-linear progressive scales for taxation, when the tax rate growth speed is increasing or decreasing with the size of the very tax rate.

Here it is worthy reminding that for linear progressive scale the rate is determined according to the law of arithmetic progression (6).

For a non-linear progressive scale the tax rate growth Δ is not a constant value and can change along with n_i. This change can be programmed in advance according to a certain rule set, for example, in accordance with growing or decreasing progression, exponent or logarithmical function, polinominal or other.

Let us consider a simple case of non-linear progressive scale in which the tax rate increase Δ is taking place according to the arithmetical progression law:

$$n_i = n_1 + \Delta_i \times (i-1), \quad \text{where} \quad \Delta_i = \Delta + \delta(i-1), \quad \delta = const. \tag{12}$$

Then the formula for the taxation rates increase would be:

$$n_i = n_1 + \Delta \times (i-1) + \delta(i-1)^2 \tag{13}$$

or

$$n_i = n_1 + \Delta\left[(i-1) + \frac{\delta}{\Delta}(i-1)^2\right] = n_1 + \Delta(i-1)[1 + k(i-1)] \tag{14}$$

and here $k = \delta / \Delta$.

The values k and δ may be both below and above zero: at $k > 0$ the growth of tax rate will be quicker, and at $k < 0$ it will be more slow as compared to its linear growth.

Formed according (14), the non-linear progressive scale has to satisfy the relation (5). Putting (14) into (5), we get:

$$mn_1 + \Delta\sum_1^m (i-1) + \Delta k\sum_1^m (i-1)^2 = n_0 m. \tag{15}$$

Taking into account that the sum of positive whole numbers is $\sum_1^m (i-1) = \frac{(m-1)m}{2}$,

and the sum of their squares is $\sum_1^m (i-1)^2 = \frac{(m-1)\times m(2m-1)}{6}$, we get

$$n_1 + \frac{m-1}{2}\Delta + \frac{(m-1)\cdot m(2m-1)}{6} \times \Delta k = n_0. \tag{16}$$

Then, the growth of tax rate is taking place according to:

$$\Delta = \frac{6(n_0 - n_1)}{(m-1)[3+(2m-1)k]}, \quad (17)$$

and the very value of tax rate would be:

$$n_i = n_1 + \frac{6(n_0 - n_1)(i-1)[1+k(i-1)]}{(m-1)[3+(2m-1)k]}. \quad (18)$$

Noteworthy here, that at $k = 0$ the formulas (17) and (18) are the same to (9) and (10).

Formulas for setting rates within the non-linear taxation scale for any groups of taxpayers have been actually presented by O. Kalinina (2011; 2014).

Figures 4 and 5 graphically present various variants of taxation scales, set according to the formula (18), and these variants correlate to various growth rate of the non-linear progressive taxation scale (k = 0.2; –1.2) at various coefficients n_0 = 15%; 20%; 25%.

All notions and interpretations is similar to those in Figures 2 set for the case of linear progressive scale.

Figure 6 presents the variants of non-linear progressive scales while saving the tax rate for the low-income group n_1 = 13% under simultaneous increase of the total taxation load C_0 by 20%; 30% and 40% (α = 1.2; 1.3; 1.4) as compared to the load under the flat taxation scale.

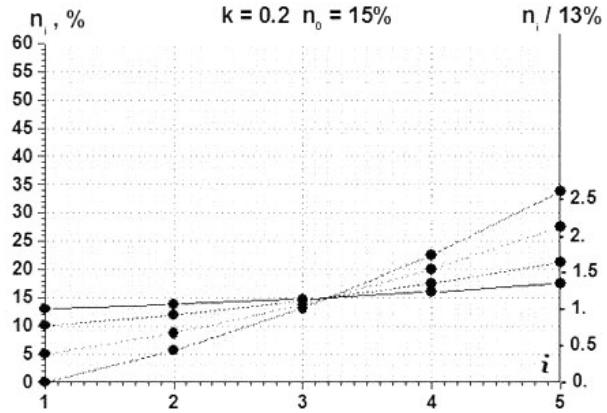
The graphs demonstrate what should be the size of adjustable tax coefficient $n_0 = n_3$. Graphs on Figures 6 are similar to those on Figures 2 for linear progressive scale.

Using the formula (18) we can analyze other possible variants of non-linear progressive scales. In particular, for the case of grouping all taxpayers into 10 groups (m = 10), the tax rate can be easily determined using the graphs on Figure 2–6 by the intersection points of coordinate lines. The number of steps can be actually decrease up to 2, and in this case from (5) we get $n_1 + n_2 = 2n_0$.

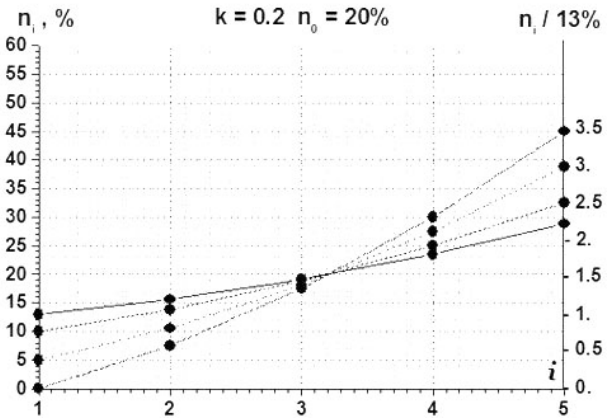
I. Nikolaev (2013) writes (this author is the Director of the Institute of Strategic Analysis) that for Russian Federation at the very first stage of transition from flat taxation scale to the progressive one "the best variant would be the introduction of two-rates scale with 13% and 20%". We have to note here that this suggestion fully complies with the suggested here taxation relation (5) at n_0 = 16.5%, thus, this variant is quite feasible. And with its potential application, the total C_0 would increase by 1.27 times as compared to the existing flat scale with n_0 = 13%.

Conclusions. In the final part we would like to outline once again the major advantages of the suggested and described here variant of progressive taxation scale.

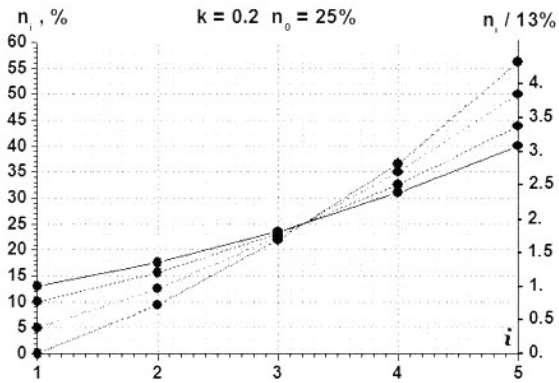
1. The theoretical basis for constructing a taxation scale is the Lorenz function, thus, the suggested here method can be considered both economically feasible and socially fair. The groups of taxpayers are formed not by their volumes or by range of income, but by the group contribution to the total inflow of personal income tax to the state budget. Ranging of taxpayers and their movement from one group to another is done naturally, straight after the change of income under tax level.



a) $k = 0.2$ and $n_0 = 15\%$



b) $k = 0.2$ and $n_0 = 20\%$



c) $k = 0.2$ and $n_0 = 25\%$

Figure 4. **Non-linear progressive scale at k and n_0,** *author's*

2. The suggested method can be treated as the universal principle for construction of taxation scales for various countries regardless the level of their economic development since it is based on the widely known criterion of quantitative distribu-

tion of taxpayers by their income according to the Lorenz curve. This makes the taxation scales be relatively comparable with each other. For example, the relation N_1 / N_2 can be treated as an international indicator for various taxation scales, same as the decile coefficient.

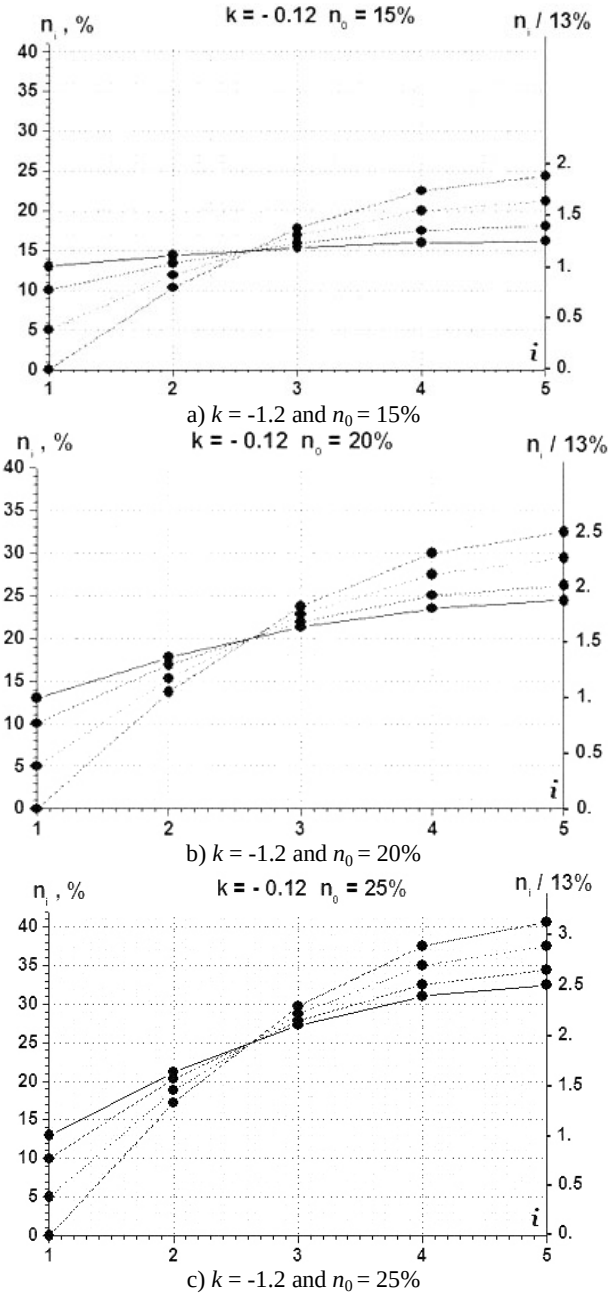
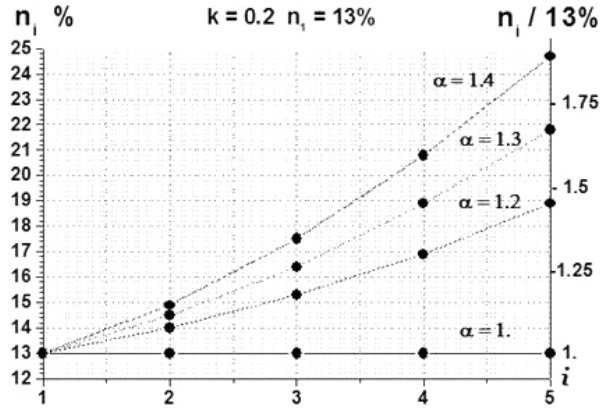
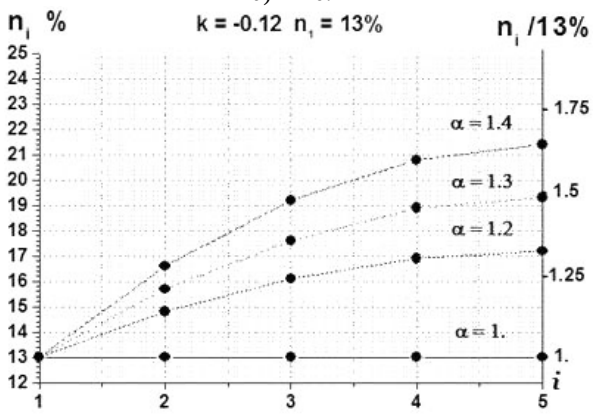


Figure 5. **Non-linear progressive scale at k and n_0,** *author's*



a) $k = 0.2$



b) k = -1.2

Figure 6. **Non-linear progressive scale at increasing total tax load with k,** *author's*

3. The formed progressive taxation scale is a self-organized system, within which the annual change in the level of country's economic development is automatically transformed into the changed number of taxpayers in each group m, and all values of the tax rates ni remain unchanged. Noteworthy here, that currently setting the tax rates is a public legal act: for example, in France the private income taxation scale is reconsidered and set as new by the parliament nearly annually. In our suggested here method under changing socioeconomic situation it would be enough just to select the value of the tax load n_0, according to this new variant of scale, see formula (18).

4. Presence in all variants of progressive scales of the single knot, which is in the middle of the scale, has an important social role. It is widely know that the middle class of taxpayers form the basis for any economy which can be called stable. This is why the strategy choice while converting to progressive scale should be additionally based on the tax rate which is appropriate for this middle group of taxpayers, that is the generalized coefficient of tax load n_0.

5. The suggested here method does not create more load on taxation authorities since such a ranging of taxpayers is an annual procedure for state statistics bodies,

and these data is gathered anyway, for example, for calculations of the Gini coefficient.

6. The suggested method of taxation scale formation is preferable for use within Russian Federation in its transition from flat scale to the progressive one. Let us very briefly consider the "hard" scenario variant of transition to progressive scale which presupposes that the rate for the first group of taxpayers is 13% and increasing for the rest of groups aims at the increase of the total tax inflow C_0 into the budget, for example, by 30% ($\alpha = 1.3$). As we can see in Figure 6, and also using the Lorenz curve from Figure 1 after the implementation of such a reform, 47% of all taxpayers (that is the first group) would still use the previous tax rate, that is same 13%, which can be considered as a socially valuable variant.

Summarizing the above, we can state that the suggested method of constructing the progressive taxation scale has a number of advantages, the key of which are its economic feasibility, social orientation and the universal logic of scale construction which is fit for countries with very different levels of economic development.

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