Measurement of personal income tax progressivity in the post-socialist countries of Europe compared to other OECD countries

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Abstract

The aim of the article is to measure and analyse changes in the steepness of PIT tax progressivity in OECD countries in 2004-2017, using an alternative method of measuring the type of tax progression. The Steepness Progression Index was developed based on the OECD's indicators of average and marginal taxation in two selected income groups (67% and 167% of average remuneration). The index was used to determine the type of tax progressivity: progressive, regressive and proportional. The result of the empirical study showed that seven OECD groups could be identified among OECD countries with similar levels of progression steepness. Post-socialist countries (except Slovenia) formed one group of countries characterized by the occurrence of regressive progression in the PIT tax and a minimal difference between the average and marginal taxation at both levels of income. Progressive tax progression occurs in most OECD countries. However, in the years 2004 - 2017, the steepness of progression fluctuated. Significant changes in the steepness of progression occurred in most countries in the post-global financial crisis period (2008-2012).

Keywords: personal income tax progressivity, measurement of tax progression

Introduction

Tax progression, which is usually used in personal income tax, is the equalizing market income distribution instrument. However, over the past decade, there has been a tendency to reduce taxation as well as to reduce the differentiation in the schedule of tax burdens. In a situation where the tax burden on high-income people is reduced more than proportionally compared to low-income people, the progressive taxation weakens (e.g. by a reduction of nominal tax rates or increasing the number of tax preferences, whose design contributes to higher benefits for

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persons achieving high income). Consequently, tax progression is losing significance as a redistribution tool.

Tax progression denotes that the tax liability increases more than proportionally relative to the taxable income rise. However, based on the tax liability in particular income group charts, it is evident that the distribution of tax liabilities is a non-decreasing monotonic function, in which the tax liabilities' increment is differential in a particular income group. Therefore, three types of progression can be distinguished: progressive, proportional and regressive. Progressive progression is characterized by the fact that the tax liability increment is higher than the income increment. In a proportional progression, at each income level, the tax liability increment is equal. In turn, in regressive progression, a higher tax liability increment applies to the lower-income taxpayers and decreases with the transition to the next levels of income. With reference to these types of tax progression, this article discusses the following research problems: the type of progression that dominates in OECD countries, direction of changes in the steepness of tax progression in most OECD countries in 2004-2017, whether it is possible to examine groups of countries with a similar characteristic basis of steepness of the PIT tax progression level and the progression levels at individual income levels.

Three research hypotheses have been assumed. At first, we assume that progressive progression in personal income tax has been occurring in most OECD countries. In the second hypothesis, we assume that most of the countries made changes in the steepness of progression in the PIT tax during the global financial crisis period. In the third hypothesis, we assume that it is possible to examine groups of countries with a similar characteristic basis of steepness of the PIT tax progression level and progression levels at individual income levels. The research was conducted on a group of 34 OECD countries in the period of 2004-2017. The research period was divided into three subperiods: 2004-2007 (prosperity), 2008-2012 (crisis and post-crisis period) and 2013-2017 (recovery period). The hypotheses were verified based on a comparative analysis of the Steepness Progression Index level, which was constructed for the purposes of this research. Indexes, which show progressivity, proportionality and regressivity of the tax system, based on tax burden distribution, have been widely discussed in the subject literature. However, few publications discuss the problem of diversifying forms of progressive or regressive taxation progression.

This article attempts to add on to the existing research in the fields determining the types of tax progression in PIT based on the tax burden distribution at individual levels of income. The classification of countries, based on the level of the Steepness Progression Index and its sub-indexes, was made by using the cluster analysis carried out using the Ward method.

1. Elements of the PIT tax structure determining the strength of tax progression

Nowadays, tax progression has become an important tool for increasing the level of general well-being, in line with welfare theories based on the role of income inequality. The purpose of tax progression is the 'redistribution of income in the vertical plane, in favour of taxpayers with lower income' (Litwińczuk, 2001, p. 20). Tax burden differentiation by income ranges contributes to reducing differences in the income market distribution. The further elimination of income disparities occurs by transferring the taxable part of the income of richer taxpayers to the lowest-income households in the form of social benefits or public services. Tax progression, which causes a higher tax burden on high-income people, carries out both the principle of justice and the principle of payment capacity. As a result, it impacts the level of well-being, under the maxim in principle in Rowl's theory of justice[1].

Tax progression is a liability rise along with an increase in income; however, the tax rate growth rate is higher than the tax base growth rate (Sosnowski, 2015, p. 188). Consequently, the marginal tax rate is higher than the average rate. The effect of the PIT tax structure on changes in the income distribution depends on the degree of progression, i.e. the ratio of the growth rate of tax liabilities to the percentage increase of income. The degree of progression is affected by the following elements: the range of average tax rates, the range of tax brackets, the number of tax brackets.

Usually, tax progression is identified by the range nominal tax rate, i.e. the ratio of the highest PIT rate to the lowest PIT rate, or the distance between these rates expressed as percentage points. The level of the minimum nominal PIT rate determines by what part of the income will the lower payment possibilities taxpayer's income be reduced (not including tax preference). And the maximum nominal PIT rate determines by what part of the income will be reduced beyond a certain threshold (usually a multiple of the average income in the economy). In simplified terms, the minimum and maximum PIT rate show the differentiation of the intended share of low and high income taxpayers in financing public the public sector. The lower PIT rate range, the lower the burden differentiation between the income groups. However, the nominal tax rate range does not show the actual degree of progression because most countries apply many tax preferences in PIT tax. The true tax burden differentiation depends on the average rate of the PIT range. The higher the average tax rate range, the higher the progression degree. Then, people from different income groups or in different situations of expenditure (e.g. large families) incur tax burden in compliance with the payment possibilities and the

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[1] According to this theory, the level of general well-being is determined by the well-being of the most disadvantaged social groups. Therefore, as a result of reduced taxation, the rising disposable incomes of wealthy people would not improve their well-being. So, using Rowl's theory, it must be assumed that an improvement in terms of welfare should occur if the poorest people's income is burdened to a minimal extent, and will, in addition, be supported by transfers from the taxation of the richest people in society.

principle of fairness of taxation. If the rate range is low, the low-income person incurs a relatively higher tax burden compared to wealthy people, due to the higher marginal utility of income.

The increase of the progression degree is affected by the decrease average of the minimum rate (with the maximum rate unchanged or increased), increase of the average maximum tax rate (with the minimum rate unchanged or decreased), decrease of the average minimum rate more that the average maximum tax rate or an increase of the average maximum tax rate exceeding the average minimum tax rate. An increase/ decrease of the average tax rate occurs as a result of the changed nominal tax rate or usage of tax preference in a selected income group[2]. However, it should be noted that some tax preferences contribute to a decreased progression degree (Young, 2003, p. 148). These include tax deduction and tax credit, in which the tax base or input tax are reduced in connection with making a specific expenditure, e.g. private healthcare cost, mortgage interest. If the amount of tax deduction or tax credit depends on the spending volume, then higher-income taxpayers gain higher benefits. Consequently, tax preferences may lead to a decrease in the strength of tax progression (Humbelin and Farys, 2017, p. 25; Matsaganis and Flevotomou, 2007, pp.6-7). According to Gomułowicz and Małecki, these types of tax instruments mean that a progressive tax scale could have the characteristics of regressive and proportional taxation, inside each degree tax scale (Gomułowicz and

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[2] Examples of tax preference items include: tax-exempt income, tax deduction, privileged tax rates, tax credit. Tax-free allowance is a popular type of tax preference. Its purpose is to exclude income necessary to meet basic living needs from the tax base (or reduction tax due by this amount). (Krajewska, 2012, p. 91) A tax-free allowance implements the principles of cheapness tax too because it reduces the cost of collecting tax revenue, which would be disproportionately high to the volume revenue, and prevents the second refund of collected tax in the form of low income benefits (Sosnowski, 2015, p. 191). Tax-free allowance can take the form of either reducing the tax base or tax due amount, or the zero rate tax bracket. If the preference amount were determined on the basis of the income level (the lowest income, the highest benefits), then the degree of progressivity would increase. The use of the zero rate tax bracket contributes to the widest participation of taxpayers in benefits, in terms of the highest income too. Tax deduction is aimed at reducing taxable income by the amount of e.g. expenses that taxpayers incur during the year (for specific purposes indicated by the legislator). In turn, tax credit reduces the tax due. Tax deduction or tax credit differs from tax-free allowance in the fact that their use is restricted by compliance with specific conditions: obtaining income from specific activities (e.g. employment relationship), incurring actual expenses for the purposes indicated by the legislator (e.g. commuting, contributions to a private retirement account), demonstrating a specific life situation (e.g. disability). Taxpayers are able to reduce the taxable income or tax due by the amount of (or part thereof) expenses, such as: life insurance contributions, pension contributions, and charitable donations (Burns and Krever, *in*: Thuronyi, 1998, p. 537). The effect of tax relief is an increase in the disposable income of individuals, while reducing public revenues, and therefore the nature of the relief is comparable to social transfers.

Małecki, 2010, pp. 72-74). To increase progressivity, the amount of tax deduction/tax credit should be made conditional on the income level: the higher the income level, the lower the value benefits. Such preferences cause strong progressivity even in a flat tax.

The tax bracket range and their number have an impact on strength progressivity too. The tax bracket range is calculated as the ratio of taxable income subject to the maximum tax rate, to taxable income subject to the minimum tax rate. The increase of the tax bracket range causes a decrease of the progressivity degree because the percentage of taxpayers paying the highest taxes shall be reduced. If the width of the tax bracket with the minimum rate is significantly higher than with a maximum rate, then the highest tax burden shall be borne by a small proportion of taxpayers. In addition, taxpayers in the worst income conditions are taxed in the same way as persons with a relatively higher ability to pay. However, too low a tax bracket range results in a low progressive also because the tax is progressive only at income levels corresponding to tax thresholds while, in other cases, it is proportional. The higher the number of tax brackets and proportionality of their width to the distribution of income (percentage of persons in a certain income group), the higher the degree of income equalization.

2. Measurement of tax progression

The income tax system may be proportional, regressive or progressive. In proportional tax, the tax burden increases in proportion to the income increase. If the taxation system is regressive, then the average rate falls with the rising income. In the case of progressive tax, the tax burden increases more than proportionally to the rise of income. Both progressive and regressive taxation can have the characteristics of proportionality (if the rate of progression / regression is proportional in all income scales), regressiveness (if the rate of progression / regression decreases in each subsequent income range) and progressiveness (the rate of increase / decrease in the tax rate is higher than income growth rate). Gomułowicz and Małecki identified three types of tax progression on that basis: linear, accelerated and delayed progression. In linear progression, the average tax rate increase is constant in relation to the increasing tax base. In accelerated progression, the average tax burden increases at higher rate than tax base, while in the case of delayed progression, the average tax rate increment decreases in relation to the tax base rising (Gomułowicz, Małecki, 2010, pp. 70-71). According to Wolański, this type of progression shows its steepness, which increases more when the tax rate increases faster in relation to the tax base rising (Wolański, 2016, p. 24).

The increase in the state's redistributive activity has initiated a scientific debate over how to measure the progressiveness of selected taxes and the whole tax system. The pioneers in measuring tax progressivity were Musgrave and Thin, who considered the degree of progressiveness of the tax system from the perspective of

the ratio of the level of income inequality before and after taxation (Musgrave and Thin, 1948, pp. 498-514). Then, D.B. Suit, N.C. Kakwani, D.F. Stroup and W. Raynold and P. Smolensky developed this approach by drawing up progressive indices based on the concept of Lorenz's income distribution, concentration of Gini inequality and the difference before and after the Gini index (Arcarons and Calonge, 2015, pp. 207-223). Therefore, these indices measure progressiveness by the degree of change in the distribution of income in society as a result of taxation, i.e. the extent of the effect of using this tool. On the other hand, a study on the measurement of tax progressivity from the perspective of tax structure was initiated by R.E. Slitor (Slitor, 1948, pp. 309-313). His Progression Index is based on an estimate of the ratio of the difference between marginal and average taxation to the level of income to which these rates relate.

The Index takes into account the impact of tax preferences on the actual tax burden distribution in society. This inspired subsequent researchers to abandon the perception of tax progression through the perspective of nominal tax rates' range. Tax progression indicators constructed in the subsequent years are based on the average and marginal tax rate and their changes in relation to the change in income. They are addressed in Table 1.

Table 1. Indicators of tax progression

Coefficient	Formula	Variables	Characteristic
Progression Index (Slitor)	$\dfrac{Dt(x)}{dx} = \dfrac{m(x) - t(x)}{x}$	$t(x)$ – average tax rate at a certain level of income; x – income level, $m(x)$ marginal tax rate at a certain income level;	It measures the ratio of the marginal and average tax rate difference at a certain level of income to this level of income.
Progression Index (M. Kakinaka, R.M. Pereira)	$t = \dfrac{\sigma T, t}{\sigma Y, t}$	$\sigma T, t, t$ is the proportional standard deviation of the tax revenue in period t, $\sigma Y, t$ is the proportional standard deviation of the income in period t. The proportional standard deviation is defined by the standard deviation	Index is based on the relative volatility of aggregate tax revenues to aggregate incomes. The system is the more progressive the higher the ratio of tax income deviation to income deviation. If tax revenues increase proportionally to income, then the system is proportional.

		divided by the mean".	
Average rate progression (Pigou)	$AP = \frac{\Delta a(y)}{\Delta y}$ $AP = \frac{m(y)-a(y)}{y-\Delta y}$	y- income Δy – change of income a(y) – average rate $\Delta a(y)$- change of average rate	It measures the rate of change in the average tax rate to the income change. If AP=0 tax is proportionality, AP<0 regressive a AP>0 progressive.
Marginal rate progression (Pigou)	$MP = \frac{\Delta m(y)}{\Delta y}$	$\Delta m(y)$-change of the marginal tax rate, Δy-change of income	It measures the rate of change marginal tax rate to the change of income. MP=0 if tax is proportionality, MP>0 is if progressive, and MP<0 regressive.
Liability progression (Musgrave and Thin)	$LP = \left(\frac{\Delta t(y)}{\Delta t}\right) * \left(\frac{y}{t(y)}\right)$ lub $LP = \frac{m(y)}{a(y)}$ If the change of income is high: $LP = \left[\frac{\Delta t(y)}{t(y)-\Delta t(y)}\right] * \left[\frac{y-\Delta y}{\Delta y}\right]$ or $LP = \Delta m/a$	$\Delta t(y)$-changes tax liabilities, Δt-change of income, m(y) – marginal tax rate, a(y) – average tax rate, Δm- the change of marginal tax rate,	It measures the ratio of the percent change in tax liabilities to the percent change in income. If LP=1 tax is proportionality, LP>1 progressive, a LP<1 regressive.
Residual income progression (Musgrave and Thin)	High income changes: $RP = \left\{\frac{[\Delta(y-t(y))]}{[(y-\Delta y)-(t-\Delta t)]}\right\} * \left[\frac{y-\Delta y}{\Delta y}\right]$ Low income changes: $RP = [\Delta\left(y - \frac{t(y)}{\Delta y}\right) * [y/(y - t(y)]$ or: $RP = \frac{1-m(y)}{1-a(y)}$	$\Delta t(y)$-change in tax liabilites Δy-change in income y- income t(y)- tax liabilities	It measures the ratio of the percent change in post-tax income to the percent change in income before tax. If RP=1 tax is proportionality, RP>1 regressive, RP<1 progressive.
Tax progression (F. Govori)	$TP = \left(\frac{\Delta t(y)}{t(y)}\right) - \left(\frac{\Delta y}{y}\right)$	$\Delta t(y)$-change in tax liabilites Δy-change in income y- income t(y)- tax liabilities	"The coefficient measures the difference between the rate of tax liability change and the rate of income change at a given level" If TP=0 tax is proportionality (m=a), TP<0 regressive, TP>0 to progressive. If the

	coefficient is the same at all income levels, the tax progression is proportional, if rising - progressivity, and if falling – regressivity.

Source: author's representation based on Govori (2015); Kakwani (1977); Kakinaka and Pereira (2006)

The aim of this study is to measure the proportionality, regressivity and progressivity of tax progression, that is, the steepness of progression of PIT. This study was inspired by the work of F. Govori, who created the TP tax progression indicator and showed that tax progression takes three forms, differing in the relationship between the increase in tax liability and the level of income. The ratios addressed in the table show whether people with higher incomes incur higher tax burdens compared to people with lower incomes. Their advantage is the inclusion of reliefs reducing nominal taxation. Using the indicators listed in the table above, it is possible to find the proportionality, regressiveness or progressiveness of taxation. However, in order to find out what type of progression works in a given country, the value of the above indicators should be calculated for each income level. For the aim of this study, the Steepness Progression Index has been developed in order to improve this process. It is based on the Residual income progression RP index used in the study of tax progressivity scale on panel data by Arnold (2008) and Attinasi, Checherita-Westpal and Rieth (2016):

Residual Income Progression = 1 – (100 – marginal tax rate)/(100 – average tax rate).

where the marginal and average rates concerned the average remuneration of a full-time productive worker who is not married and who is childless.
For the purposes of this analysis, this formula has been transformed as follows:

Progression Steepness Index = [1-(1 – (100 – MTR 167%)/(100 – ATR167%))]/[1-(1-(100-MTR67%)/(100-ATR67%)].

Where: MTR 67% means a marginal income tax rate of 67% of the average remuneration, ATR 67% - average income tax rate of 67% of the average remuneration, MTR 167% - marginal income tax rate of 167% of the average remuneration, MTR 167% - average income tax rate of 167% of the average remuneration. The average remuneration refers to a full-time production worker who is not married and who is childless. OECD indicators were used to measure the steepness of progression because of easy access and the possibility of obtaining comparable results. However, OECD statistics only show the spread of the tax burden on wages in the range of 67% - 167% of the average wage. To show the

difference in the distribution of tax burdens in society, the available marginal indicators were therefore chosen to measure the degree of steepness of progression. The average income tax rate of 67% of the average salary represents the tax burden on low pay, while the average income rate of 167% of the average salary represents the high-income load. In some of the countries surveyed, the income lower than 67% of the average remuneration is subject to tax exemption (within the free amount, tax range with zero rate). The progression steepness indicator has been constructed to show the degree of increase or decrease in progressivity as income increases because, in different income ranges, its intensity may be variable (the difference between marginal and average taxation may increase or decrease). Chart 1 illustrates three types of tax progression. The line chart shows the distribution of marginal taxation in four income groups (67%, 100%, 133%, 167% of the average remuneration, according to the OECD methodology), depending on the type of tax progression. As you will notice, in the chart in each variation, progression is a non-decreasing function; however, it takes on a linear function only for proportional progression. In regressive progression, the highest increase in marginal taxation occurs at the lowest level of income and decreases as it increases.

Figure 1. Types of tax progression - proportional, regressive, progressive, and the value of the progression index and marginal tax rate at certain income levels (67%, 100%, 133%, 167%)
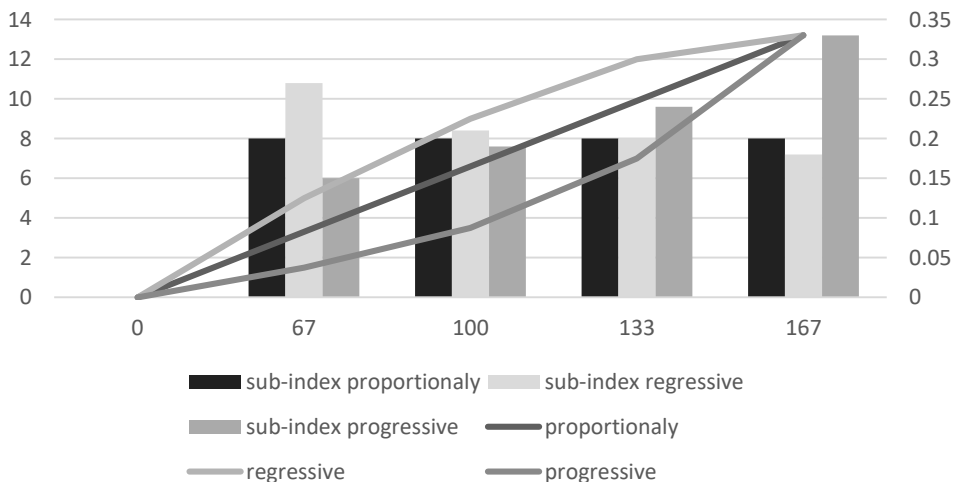
Source: author's representation

The opposite situation is the case of progressive progression - the highest increase in marginal taxation applies to the highest level of income. The higher the degree of progressivity / regressivity progression, the higher the distance between

the progressivity / regressivity progression line and the proportional progression line. The analysis of the tax progressivity index level (sub-index Progressivity Steepness Index) calculated for each income level also confirms the above relationships. The index takes the same value at every income level in the case of proportional progression. In regressive progression, the value of the index decreases as the level of income increases, while in the case of progressive progression, the opposite relation occurs.

The higher the strength of progression, the higher the values of the Steepness Progression Index. An Index level below one means that the Progression Sub-Index calculated for an income of 167% of the average salary is lower than the Progression Sub-Index for an income of 67% of the average salary. Thus, the rising tax incurred on an additional income unit is higher in the case of low-income taxpayers than for high-income taxpayers. Then, we are dealing with regressive progression. If the Steepness Progression Index is 1, then there is proportional progression, and in the case of unity exceeding - progressive progression. In the study of tax progression in a group of countries, the main restriction is obtaining comparable data on the amount of tax liabilities in certain tax ranges for a specified period (several years). This problem was solved by relying the construction of the Steepness Progression Index on indicators from the OECD database.

3. Research results

A comparative analysis of the Steepness Progression Index (SPI) level in 2004-2017 showed that, in most countries, there was progressive progression in the PIT tax in that period. The research period was divided into three subperiods: 2004-2007 (prosperity), 2008-2012 (crisis and post-crisis period) and 2013-2017 (recovery period). In 2004-2007, 22 countries showed progressive progression (65% of the study group), in 2008-2012 – 20 (59% of the study group), and in 2013-2017 – eighteen (53%). This means that more and more countries are giving up the progressive progression in the PIT tax. In the prosperity period, the UK, Sweden, Slovenia, the Netherlands, Japan, Denmark were characterized by the highest progressivity progression (PSI above level 1,1). In 2008-2012, Portugal and New Zealand also belonged to this group. In 2013-2017, the highest Progression Steepness Index level was obtained by the following countries: Sweden, the Netherlands, Slovenia, Japan, Israel, United Kingdom, Denmark, Germany, Canada. In 2004-2007, only nine countries showed PSI below 1. There were five European post-socialist economies as well as Belgium, Finland, Italy and Island. In the next period, Australia, the Czech Republic, Luxemburg and Mexico joined this group. In 2013-2017, Portugal and France were also characterized by regressive progression. There was a change from progressive to regressive progression in five countries: Australia, the Czech Republic, France, Portugal, Turkey (15% of the study group, and 28% of countries, which decrease PSI). In Luxemburg and Poland,

proportionality progression changed to regressive progression. The study showed that fifty percent of the examined group showed a lower level of the Index in the third examined period to 2004-2007.

Both the group of countries characterized by progressive progression as well as that characterized by regressive progression are diversified in terms of the degree of progression at individual income levels (sub-index 167 and 67). In order to identify the groups of countries with a similar Steepness Progression Index and a degree of progression at individual income levels (167% and 67% of the average salary), a classification was conducted by using the Ward cluster analysis. It involves combining clusters that ensure the minimum sum of squares of the distance from the focus of the newly created cluster. This method is considered very effective (Stec, Janas and Kuliński, 2005, pp. 136–137). When forming clusters, the Euclidean distance was used as a measure of the distance between objects. The data was standardized[3] to eliminate the effect of differences between dimensions on the distance. The analysis uses variables that are median Steepness Progressivity Index, sub-index SPI 167% average salary, sub-index SPI 67% average salary from 2012-2017. The research results were presented by using a dendrogram (Fig. 1). Seven groups of countries were distinguished:

- Mexico, Turkey, Switzerland, USA – The Steepness Progression Index indicates the occurrence of proportional or low progressivity progression, the difference between marginal and average taxation at both levels of income is small. These countries are characterized by a high range of rates. While the maximum PIT rate is relatively low compared to European countries, the minimum PIT rates are set at a significantly lower level than in European countries (2.77 in Switzerland or 1.95 in Mexico). These countries are also characterized by the use of a tax scale with numerous tax ranges (7-11, except Turkey 4).
- Japan, New Zealand, Canada, Korea, Israel, Slovenia – The Steepness Progression Index indicates the occurrence of progressivity progression, the difference between marginal and average taxation at high levels of income is high, and at a low level of income, it is low. The countries of this model obtained the highest progression steepness through the use of numerous tax ranges on a tax scale (4-7), a high range of tax rates while maintaining a relatively low level of fiscalism. The minimum tax rates do not exceed 15% and the maximum - 50%.
- Denmark, United Kingdom, Germany, Ireland, Norway, Spain - The Steepness Progression Index indicates the occurrence of high progressive progression, the difference between marginal and average taxation at both levels of income is high (with the exception of Denmark and the United Kingdom, where sub-index 67 is relatively low). In the countries of this model, the range of nominal rates are at a moderate level (around 20 p.p.). The maximum tax rates are around 45%

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[3] And as a result, the variable obtained an average of 0 and a standard deviation of 1.

and the minimum 20% (in Denmark, Norway and Spain, the combined local and state tax rates are taken into account). What distinguishes the countries of this model is the relatively high range of personal allowance and tax credit (except for Germany).

- the Netherlands, Sweden - The Steepness Progression Index indicates the occurrence of high progressive progression, the difference between marginal and average taxation at high levels of income is very high and, at a low level of income, it is low. Both countries are characterized by a moderate number of thresholds (4, in Sweden a central tax of three levels is paid only after exceeding the set threshold, taking into account the local tax; it can be stated that there are 4 ranges). In the Netherlands, unlike Sweden, there is a broad range of nominal tax rates. Both countries show a similar level of maximum tax rate (above 50%). The feature that distinguishes these countries from the group is the high increase in the tax rate in higher income ranges.

- Estonia, Latvia, Poland, The Czech Republic, Slovakia, Lithuania4 - The Steepness Progression Index indicates the occurrence of regressive progression, marginal and average taxation at high levels of income is almost equal and the difference between them at a low level of income is low. This model brings together European post-socialist countries in which a flat or quasi-progressive tax operates. The use of tax preferences in flat tax causes a differentiation in the distribution of tax burdens in individual income groups. In Poland and Slovakia, the tax scale applies in PIT tax, however, with only two tax ranges. In Poland, the tax threshold, which is exceeded upon transition to a higher rate, is set at around 180% of the average salary, while in Slovakia – at around 290% of the average salary. This design of the tax scale means that a high percentage of taxpayers charge tax at one nominal rate, and only tax preferences influence the differentiation of the average tax rate. The level of the flat tax rate or the lowest rate of the scale used is at the level of 15-20%, i.e. it is close to the average study group.

- Finland, Italy, Australia, Belgium, Portugal, France, - The Steepness Progression Index indicates the occurrence of regressive progression, the difference between marginal and average taxation at both levels of income is high but, at the low-income level, it is lower (above 0,2 p.p.) than at the high-income level. The countries of this model are characterized by a high level of nominal maximum PIT rates (40-50%) and by a relatively high number of tax ranges (5). The range of progression (around 20-25 p.p.) and the scope of tax preferences are at a moderate level compared to other models.

- Greece, Island, Luxemburg, Austria - The Steepness Progression Index indicates the occurrence of low regressively or proportional progression, the difference

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[4] In most of these countries, there is a proportional tax, however, the use of tax preference in it makes it take the form of a progressive tax.

between marginal and average taxation at both levels of income is high (below 0,2 p.p.). The countries of this model are characterized by relatively high maximum and minimum PIT rates (in Luxembourg, the minimum rate was 8% in 2017 and it stood at 22-25% in other countries). The number of tax brackets varies (in Luxembourg 23, Austria 7, in Greece 4 and only 2 in Iceland). Furthermore, the scope of preferences (personal allowance or tax credit) varies in this group.

The choice of the number of classes into which the examined set of objects should be divided was made by using the Hubert and Levine index. The criterion for choosing the number of classes is the lowest level of the index. The study included from 3 to 10 classes. The index value was the lowest in the case of 7 classes. Levene's test was used to assess the equality of variance for a variable calculated for seven groups. The resulting p – value of Levene's test is above the 0.05 significance level, which made it possible to assume the homogeneity of variance. Compliance with the condition of homogeneity of variance allowed for ANOVA analysis of variance. The significant result of the F test (analysis of variance) confirmed that the groups differ in their steepness of progression[5].

This study confirmed the hypothesis that, based on the Progression Steepness Index and its sub-indexes, some groups of countries with similar levels can be distinguished. The results of the clustering exercise show that post-communist countries form a separate, unique group compared to other OECD countries. Both the tax system, as a whole, and the system of individual taxes are the result of the influence of political, economic and social factors or historical traditions. It is also an expression of the adopted socio-economic doctrine. It is also determined by the degree of acceptance of a given tax in society, the ease of its collection, the number of subjects that can be covered by it, or its potential scope. Most of the OECD countries analysed are members of the European Union. In the EU, personal income tax is not harmonized, so Member State authorities can shape its system in line with the assumed objectives of fiscal and social policy, and as part of tax competition. European Union countries are diverse in terms of economic and social development, of adopted institutional solutions and cultural models and attitudes in society. However, due to geopolitical conditions, geographical proximity, economic and social connections, and, above all, due to their sharing a similar historical fate, the EU countries form similar institutional solutions groups, also in terms of the tax

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[5] Analysis of variance meeting restrictive criteria, such as homogeneity of variance, normality of distribution. Given that an inconsistent result was obtained as to the normal distribution of the Progression Steepness Index variable in the distribution normality tests, the non-parametric Kruskal-Wallis test was also used. Also, the result of the Kruskal-Wallis test allowed the rejection of the null hypothesis on the equality of cumulative distribution function in the compared groups. There are statistically significant differences between the compared groups.

system. In post-communist countries, the PIT tax system was created during the transformation of the economy.

Figure 2. **Classification of countries based on the Steepness Progressivity Index and its sub-indexes**
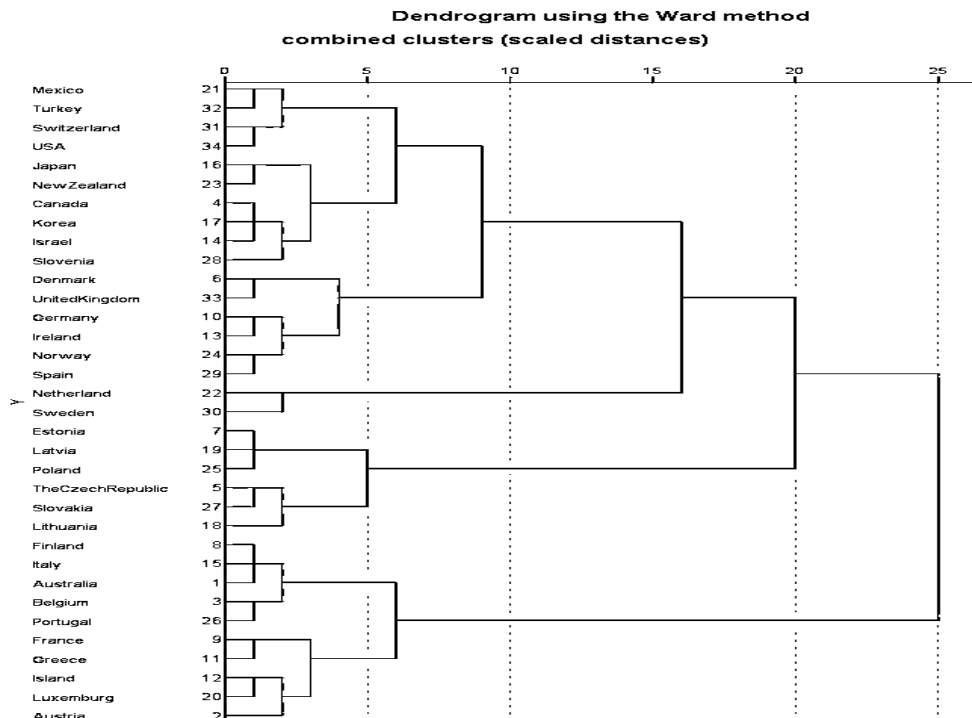
Source: author's representation based on IBM SPSS

In response to the economic situation, these countries had to create a unique PIT tax system. The recommendations of international institutions (such as the International Bank for Reconstruction and Development), emphasizing the importance of observing liberal principles in the economy in order to accelerate economic growth and, as a consequence, improve welfare, were taken into account. A flat tax with relatively low rates has become a tool to stimulate economic growth, ensure the inflow of foreign direct investment as a result of guaranteeing low labour costs, stimulating entrepreneurship, etc. In these countries, the redistributive function of PIT tax is of marginal importance, which confirms the identification of regressive progression in PIT in these countries. Such a tax structure is a response to the problems faced by post-communist countries: a high level of informal economy, inefficient tax administration, the lack of appropriate tools for monitoring and analysing data, and the existence of politically influential groups of people with the highest income, preventing the construction of a tax system that would harm their

interests. The introduction of high-steep progressive taxation could increase the shadow economy, increase the costs of tax administration and withdraw the support of the ruling authority from interest groups. However, it should be noted that a high steep progression does not have to be associated with a high level of fiscalism. Following model II countries (Asian countries, Canada, New Zealand), it is possible to achieve a high steep progression by using low minimum PIT rates and a gradual increase in rate increase with the transition to subsequent tax ranges. This type of construction could contribute to increasing the redistributive role of the PIT tax in post-communist countries, without suppressing economic growth with excessive fiscalism.

The next research step was to verify the hypothesis that during the crisis and post-crisis periods, most of the countries made changes in the steepness of progression in the PIT tax. The below analysis confirms the hypothesis that most of the surveyed countries changed the steepness of progressiveness during the crisis and post-crisis periods (77% of the study group). Of these, 45% increased the steepness of progression. They did so by:

1. decreasing the degree of progression of low income levels (sub-index 67%) as well as increasing it in relation to high income (sub-index 167%) - 23% of countries;
2. increasing the degree of progression of high income levels (sub-index 167%) with no changes in terms of low income - 31% of countries;
3. decreasing the degree of progression of low income levels (sub-index 67%) more than in the case of high income (sub-index 167%) - 31% of countries;
4. increasing the degree of progression of high income levels (sub-index 167%) more than in the case of low income (sub-index 67%) - 23% of countries.

In turn, countries that reduced the steepness of progression did so through an increase of the degree of progression of low income and a decrease in terms of high income (54% countries), or due to an increase of the progression degree of low income with no changes in terms of high income (46%).

Table 2. Steepness Progression Index in 2004-2007, 2008 – 2011, 2012-2017, and its sub-indexes for 67% and 167% average remuneration

	PSI 2004-2007	PSI 2008-2012	PSI 2013-2017	SPSI167 2004-2007	SPSI167 2008-2012	SPSI167 2013-2017	SPSI67 2004-2007	SPS67 2008-2012	SPS67 2013-2017
Australia	1.07	0.92	0.90	0.21	0.16	0.13	0.16	0.23	0.21
Austria	1.00	1.00	1.02	0.20	0.20	0.19	0.19	0.19	0.18
Belgium	0.92	0.92	0.91	0.17	0.17	0.18	0.24	0.24	0.25
Canada	1.07	1.09	1.11	0.14	0.16	0.17	0.08	0.08	0.08
The Czech Republic	1.08	0.92	0.92	0.14	0.06	0.05	0.07	0.14	0.13
Denmark	1.20	1.19	1.19	0.24	0.24	0.24	0.09	0.10	0.09
Estonia	0.95	0.96	0.97	0.04	0.03	0.02	0.08	0.06	0.05

Finland	0.96	0.91	0.91	0.16	0.15	0.16	0.20	0.23	0.23
France	1.06	1.07	0.99	0.13	0.12	0.12	0.07	0.08	0.12
Germany	1.07	1.09	1.11	0.23	0.23	0.23	0.18	0.15	0.14
Greece	1.03	1.03	1.01	0.19	0.18	0.16	0.17	0.15	0.15
Iceland	0.91	0.94	0.99	0.07	0.13	0.16	0.16	0.19	0.17
Ireland	1.12	1.10	1.10	0.23	0.23	0.23	0.14	0.15	0.16
Israel	1.05	1.08	1.11	0.20	0.17	0.19	0.17	0.10	0.10
Italy	0.99	1.00	0.96	0.15	0.16	0.16	0.16	0.16	0.20
Japan	1.13	1.15	1.15	0.13	0.15	0.15	0.02	0.03	0.02
Korea	1.08	1.06	1.09	0.10	0.08	0.15	0.03	0.03	0.08
Lithuania	0.92	0.93	0.89	0.05	0.01	0.00	0.13	0.08	0.11
Latvia	0.97	0.97	0.97	0.02	0.02	0.02	0.05	0.05	0.04
Luxemburg	1.00	0.99	0.95	0.16	0.16	0.16	0.16	0.17	0.19
Mexico	1.03	0.98	1.00	0.12	0.10	0.09	0.10	0.11	0.09
Netherland	1.43	1.34	1.53	0.34	0.30	0.38	0.05	0.06	0.09
New Zealand	1.18	1.12	1.09	0.17	0.16	0.13	0.03	0.05	0.05
Norway	1.04	1.05	1.05	0.15	0.17	0.17	0.12	0.12	0.12
Poland	1.00	1.00	0.98	0.04	0.03	0.01	0.04	0.03	0.03
Portugal	1.07	1.15	0.97	0.19	0.21	0.21	0.14	0.09	0.23
Slovakia	0.93	0.93	0.94	0.06	0.06	0.05	0.12	0.12	0.11
Slovenia	1.11	1.15	1.15	0.14	0.18	0.18	0.04	0.06	0.06
Spain	1.00	1.10	1.10	0.17	0.22	0.21	0.17	0.14	0.13
Sweden	1.38	1.45	1.53	0.33	0.36	0.39	0.08	0.08	0.07
Switzerland	1.06	1.05	1.05	0.12	0.12	0.13	0.07	0.08	0.08
Turkey	1.01	1.00	0.99	0.05	0.10	0.08	0.04	0.10	0.09
United Kingdom	1.17	1.20	1.17	0.21	0.23	0.23	0.08	0.07	0.10
USA	1.04	1.04	1.04	0.11	0.11	0.11	0.08	0.08	0.08

Source: author's representation

In the following period, of those countries that increased the progressivity during the crisis periods, six lowered it again (40%), three remained at the same level (20%), and six continued to increase (40%). In turn, of the countries that decreased progressivity during the crisis, four continued their decrease (36%), five left it at the same level (45%), and three raised it (27%). So, 33% of the countries that introduced changes in progressivity degree in the crisis and post-crisis periods this tool as a crisis-only tool (these include: France, Italy, Korea, Lithuania, Mexico, the Netherlands, Portugal, United Kingdom), 37% continued policy reducing or increasing (Australia, Austria, Canada, Germany, Island, Ireland, Israel, Luxemburg, New Zealand, Sweden, Turkey) and 30% did not make any further changes (The Czech Republic, Denmark, Finland, Japan, Norway, Slovenia, Spain, Switzerland).

Conclusions

Popular measures of tax progressivity focus on demonstrating whether taxation is progressive (people with higher incomes are burdened with a higher tax

burden in relation to salary than people with lower incomes), regressive (higher tax burden in relation to incomes is borne by people with lower incomes) or proportional (in relation to income, taxpayers at different levels of income bear the same tax burden). However, as Govori noted, in progressive taxation, the tax burden on income does not only take a linear function, but a monotonous non-decreasing function in which, at different levels of income, the rate of increase in tax liabilities can be different. Regressive progression is characterized by a higher increase in the tax burden at lower income levels than higher levels; proportional progression has the same increase at each income level; and progressive progress is characterized by a higher tax increase at higher income levels than at lower levels.

This article attempts to demonstrate that in most of the countries there is a progressive progression. The changes in the steepness of progression during and after financial crisis were also analyzed. It was also examined whether groups of countries with similar characteristics could be distinguished on the basis of the steepness of the PIT tax progression level and the progression levels at individual income levels. The research hypothesis that, in most of the studied OECD countries, there is progressive progression in PIT, has been positively verified. In each of the identified research sub-periods, more than 50% of countries had PSIs above 1. The hypothesis that, the surveyed countries changed the steepness of progressiveness during the crisis and post-crisis periods, was also positively verified. During the crisis, 77% of the countries surveyed changed the steepness of progression, of which 55% lowered it. In the next period, four of these countries further lowered the Steepness of Progression Index. Of the countries that achieved an increase in the Index during the crisis, six (40%) lowered it in the years of 2012 - 2017. In addition, two countries that did not make any changes during the crisis achieved a decrease in the Index in the next period. Most of the countries that made changes in the steepness of the PIT tax progression did not continue the policy of increasing / decreasing it. One-third of them introduced changes only during the crisis, and one-third left the Index at the same level in the period of 2012-2017.

The lowering of the Index level was mainly due to the increase in the degree of progressiveness towards low income and lowering it / leaving it unchanged for higher income. In turn, in the case of countries where there was an increase in the steepness of progression in PIT, the increase in the Index was influenced by a higher increase in the degree of progression against an income of 167% of the average remuneration than an income of 67% of the average remuneration, or a stronger decrease in the degree of progression on a lower income level than a higher income level as well as lowering / leaving the progression level unchanged compared to low income while increasing the progression rate for higher income. Based on the level of Progression Steepness Index in the period 2012-2017 and its sub-indexes, some groups of countries with a similar level of progression steepness and degree of progression at individual income levels were identified. Seven groups of countries were created, of which post-socialist countries (except Slovenia) constituted one

group. It is characterized by the occurrence of regressive progression in the PIT tax and a low difference between the average and marginal taxation at both levels of income (67 and 167% of the average salary).

The results of this study are, therefore, important from the perspective of decision-makers. They show that an essential tax characteristic is not only the degree of progression but also its steepness. To ensure the effective execution of the tax redistributive function with a relatively low level of fiscalism, it would be necessary to have an increase in the tax rate increment with an increase in income. In countries with a lower level of welfare, compliance with this rule does not have to involve high tax rates.

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