

TESTING THE PREDICATIVE ABILITY OF THE TAX PROGRESSIVENESS INDICES

Václav Friedrich, Kateřina Maková, Jan Široký

Introduction and Aim of the Paper

The even tax rate of personal income tax has been a part of the tax system in the Czech Republic since 1/1/2008. The Czech Republic has joined the group of countries that use the even tax rate. In 31/12/2008 this group included 7 countries in the framework of the European Union (Bulgaria, Czech Republic, Estonia, Latvia, Lithuania, Romania and the Slovak Republic), conversely there are 17 tax brackets in Luxembourg. The term "even tax" is misleading according to the authors. Upon deductibles, allowances or the existence of tax credits, "even tax" will always be progressive tax and theoretically the value of the effective tax will achieve the "even tax" value in infinitude.

This rate is – viewing the existence of deductibles, allowances or tax credits – a progressive tax as well, though [2]. The tax progressiveness can be measured according to several indices, whereas the indices of progressiveness of the average rate, progressiveness of the tax obligation and progressiveness of earning after taxation are used the most frequently [9], in Czech literature [5] or [11, p.128].

The aim of the paper is to test the predicative ability of these indices or how sensitively they will react to the changes of the effective tax rate. This analysis will be done with the help of the application of tax progressiveness indices on the tax system of the Czech Republic. A dynamic model of personal income tax (*PIT*) was presented in [13], but it does not deal with tax progressiveness. In the analysis some statistical tools are used, especially correlation.

The authors have chosen as an example of using the method described by analysis of the

personal income tax paid by an employee in Czech Republic in the period of 1993–2008. A relatively long analysed period (the lower bound is qualified by the implementation of the present tax system) gives the possibility to generalize some results for possible upcoming research in this field. It is possible to analyse other types of employee e.g. employee with children or disabled in future continuation of the research. In detail – see [12, p. 654].

1. The Effective Tax Rate and the Tax Progressiveness Definition

The effective taxation (effective tax rate; *ETR*) is characterized by the average tax rate that is defined as the percentage ratio of tax obligation to gross pay.

The *ETR* can be defined in different ways depending on the definition of the tax obligation (which deliveries are implicated in the tax obligation). The ETR_T index was monitored in the Czech Republic with regard to the purpose of the paper. The ETR_T was defined as the personal income tax (*T*) to the gross income (*Y*) from which the tax is calculated:

$$ETR_T = \frac{T}{Y} \times 100 [\%] \quad (1)$$

Moreover the ETR_{T+SI} index was monitored, which adds the social insurance payments paid by an employee (*SI*) to the tax obligation and expresses the employee's total tax burden by tax deliveries more objectively:

$$ETR_{T+SI} = \frac{T + SI}{Y} \times 100 [\%] \quad (2)$$

The progressiveness of personal income tax is calculated by means of the gross income values and the tax obligation corresponding to the gross income as well. Even if the progressiveness of the personal income tax determination comes out of the same values as the effective tax rate (eventually tax burden), there is no distinct link between the tax progressiveness and the effective tax rate. If the effective tax rate at two gross incomes is higher in one country than in another country, this does not have to mean that the tax progressiveness has to be higher in this country too [10, p. 153] or [3, p. 386]. While the effective tax rate (eventually tax burden) is a static value, the tax progressiveness is examined at a specific income interval (or in time [6] did concrete calculations of the tax progressiveness in the Czech Republic in 1993–2006), and that’s why this is the flow value [7, p. 201].

According to the tax progression, the tax can be proportional, progressive and regressive. The tax is progressive if the average tax rate grows together with growth of the gross income (the tax grows more quickly than the income).

Measuring the tax progressiveness and its changes is important for the comprehensive determination of the impacts of the tax legislation amendments or for the determination of which income interval has the highest progressiveness (in which group of taxpayers the tax is growing the most). While the degree of tax burden only tells “...*what part of their income the taxpayers pay in the form of tax, the degree of progressiveness characterizes the degree of difference of the tax burden of individual taxpayers according to their income*” [5, p. 455].

There are usually three ways of measuring the tax progressiveness in literature (e.g. [9, p. 333] or [5, p. 456]. The term “local progressiveness” is used sometimes: progressiveness of the average rate (PAR), progressiveness of the tax obligation (PTO) and progressiveness of earning after taxation (PEAT).

Progressiveness of the average rate measures the ratio of the average rate change and the income change:

$$PAR_j = \frac{\frac{\Delta T}{Y}}{\Delta Y} = \frac{\frac{T_j}{Y_j} - \frac{T_{j-1}}{Y_{j-1}}}{Y_j - Y_{j-1}} \quad (3)$$

Indices j and $j-1$ relate to marginal points of the j -th income interval, in which the progressiveness is measured.

The PAR index illustrates the inclination of the curve that models the dependence of the effective tax rate *ETR* on the income Y . If the tax is proportional ($ETR = \text{constant}$), its value is zero. Mathematically, the index shows the derivation of the examined values ($\partial ETR / \partial Y$).

The progressiveness of the tax obligation represents the elasticity of the tax obligation with regards to the income before taxation:

$$PTO_j = \frac{\% \Delta T}{\% \Delta Y} = \frac{\frac{T_j - T_{j-1}}{T_{j-1}}}{\frac{Y_j - Y_{j-1}}{Y_{j-1}}} \quad (4)$$

The calculated coefficient measures the ratio of the relative change of the tax obligation T towards the relative change of the income Y – it would be expressed by the direction of the dependence curve of the tax T to the income Y in the logarithmic graph. If the tax is proportional, the value of this index is one. The index shows the tax elasticity $E_{T/Y}$ mathematically.

The PEAT index of the progressiveness of earnings after taxation is the elasticity of the earnings after taxation with regards to the income before taxation:

$$PEAT_j = \frac{\% \Delta (Y - T)}{\% \Delta Y} = \frac{\frac{(Y_j - T_j) - (Y_{j-1} - T_{j-1})}{(Y_{j-1} - T_{j-1})}}{\frac{Y_j - Y_{j-1}}{Y_{j-1}}} \quad (5)$$

If the tax is proportional, the value of this index is one as well. However, this index is opposite towards the index (4) – see Table 1.

Tab. 1: Interpretation of Particular Tax Progressiveness Indices

Tax	Value		
	Progressiveness of the average rate	Progressiveness of the tax obligation	Progressiveness of earning after taxation
proportional tax	0	1	1
progressive tax	>0	>1	<1
regressive tax	<0	<1	>1

Source: [9] or [8]

It is evident that any of the indices can be used for the calculation of the tax progressiveness; nevertheless the degree of progression will differ at all indices depending on the construction of the index. A review of values that the individual indices can reach is given in Table 1.

As it cannot be assessed theoretically, which from the featured indices is more proper for investigation of the tax progressiveness, these indices were calculated in the Czech Republic in the period of 1993–2008.

Act No. 586/1992 Coll., on Income Tax, was amended 98 times during the period and these changes obviously have a reflection in the PIT change and in the change of the progressiveness.

2. Methodology Adopted

If such methodology is chosen [8], the standard procedure is that indices 0 and 1 are matched with marginal values of the income interval, and cannot be changed for the time of the

examination. Such an approach, however, represents a fixation of the values whose real valuation is decreasing with time. If a fixed interval were taken into account, the result would be a comparison of the tax progressiveness along the interval, and a determination of how the changes in the construction of the tax (deductibles, tax brackets and tax rates within them, tax credits) affected the degree of the progressiveness within the interval defined by means of fixed nominal margins.

The average employee gross wage was increased more than 4 times in the Czech Republic in the examined period and that's why the authors have chosen, for the calculations "movable" end points of the examined intervals with the help of average wage multiples. This solution partly eliminates the impact of the change of the price level that has a reflection in an increase of the average wage too. Table 2 shows the values of the average wage in the Czech Republic, their totals and the year-on-year growth.

Tab. 2: Development of the Average Wage in the Czech Republic in 1993–2008

year	1993	1994	1995	1996	1997	1998	1999	2000
average wage (in CZK)	5,817	6,894	8,172	9,676	10,691	11,693	12,666	13,490
year 1993 = 100	100.00	118.51	140.48	166.34	183.79	210.01	217.74	231.91
previous year = 100	100.00	118.51	118.54	118.40	110.49	109.37	108.32	106.51
year	2001	2002	2003	2004	2005	2006	2007	2008
average wage (in CZK)	14,642	15,707	16,917	18,250	19,406	20,211	21,119	23,542
year 1993 = 100	251.71	270.02	290.82	313.74	333.61	347.45	363.01	404.71
previous year = 100	108.54	107.27	107.70	107.88	106.33	104.15	104.49	111.47

Source: www.czso.cz [Czech Statistic Office] + own calculations

Now the margin values of the intervals are matched to the average wage adjusted by coefficients equal to the particular multiple of the average wage at the *PAR*, *PTO* and *PEAT* calculations. Viewing the level of the intervals, the average wage represents an independent variable. The main advantage of this modified approach is the relatively constant number of the taxpayers within the individual intervals analysed, taking into account the fact that the income "scissors" have been opening wide (In the Czech Republic 68 % of the employees were earning below-average wages.), applying this method of determining the interval margin values, you may find out how the tax progressiveness is changing in the case of a taxpayer that stays within the same income interval for the whole period examined.

For the purposes of the analysis, an employee was chosen as a representative of the majority of the "active" taxpayers who claims only the non-taxable part of a tax base (in 1993–2005) or the tax credit (in 2006–2008).

3. Results

The calculations of the effective tax rate and the tax progressiveness of the personal income tax in the Czech Republic cover the period from 1993–2007, income categories 0.50; 0.67; 1.00; 1.33; 1.50; 1.67 and 2.00 multiple of the average wage; the lower average wage is not as predicative for the taxpayer's income (social security benefit influence), higher incomes refer to the minimum of the employee.

In the Czech Republic three methods have been used in taking into account the inflation since the tax system reform in 1993. This includes: increasing tax reliefs, the adjustment of the tax rates and the adjustment of the tax brackets. The exemption limit was considered as the basic allowance, whose worth was raised every year during the period from 1993–1999 (and in 2001 as well). In 2006 the allowances were substituted with tax credits.

In the 1993–2000 period the number of tax brackets was lowered gradually from the previous six (1993–1995) to five (1996–1999) and four (until 2007), in the year 1993 (47 %), 1994 (44 %), 1995 (43 %), 1996 (40 %) and 2000 (32 %) the highest marginal tax rate was lowered as well. On the other hand the lowest marginal tax rate (15 %) was not changed until

2006, in the next two years it was 12 %. The tax bracket with the lowest tax rate was increased in 1996, 1998, 1999, 2001 and 2006. The biggest change in calculation of the tax happened in 2008 when the even tax rate was established in the amount of 15 %, however this is calculated from the "super gross wage", i.e. social insurance payments are also included in the tax base (paid by an employer for an employee). Tax credits also increased considerably in 2008.

The values of the effective tax rate, using only the tax (ETR_T) and the deliveries of social insurance (ETR_{T+S}) and the tax progressiveness indices calculated from them are shown in Tables 3, 4 and 5. These tables are in the appendix.

4. Strength of the Individual Indicators of Tax Progressiveness

In the analysis, using mathematical and statistical tools, especially correlation, three important indicators of tax progressiveness were compared: *PAR* – Progressiveness of the Average Rate; *PTO* – Progressiveness of the Tax Obligations; *PEAT* – Progressiveness of the Income After Tax.

The indicators have been calculated both for the income tax itself, and for all charges (i.e. taxes + insurance).

Some information about the similarity of these characteristics can be offered using the "contour maps" coloured tables with the values of all the indicators broken down by income intervals (rows) and year (column). The Excel Spreadsheet offers this option in its last version MS Excel 2007 (this tool can be found as Conditional Formatting – Color Ranges at Styles toolbar). The minimum values for each indicator are assigned dark green ("plain"), maximum values to dark red ("top of the mountain"). Other values are interpolated into a range from green through yellow-brown, brown to red.

In black and white printings the advantages of color maps are not so clear, as it is shown in Table 6 (colour maps of *ETR* and *PAR* Tables to compare).

(The full colour version of Excel 2007 spreadsheet with all the tables from this article can be found on web – see http://moodle.vsb.cz/moodle/file.php/1/analysis2_final.xlsx.)

Tab. 6: Graphic Design of “Contour Map” Views of Table Values to be Compared (ETR and PAR – calculated without charges)

year / level	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0.5	0.177	0.184	0.189	0.188	0.189	0.188	0.187	0.192	0.191	0.196	0.204	0.204	0.207	0.171	0.173	0.152
0.67	0.199	0.204	0.208	0.205	0.206	0.205	0.205	0.208	0.208	0.211	0.214	0.217	0.220	0.195	0.199	0.196
1	0.221	0.223	0.226	0.222	0.223	0.222	0.222	0.225	0.226	0.231	0.236	0.240	0.244	0.227	0.230	0.240
1.33	0.232	0.239	0.246	0.239	0.242	0.241	0.240	0.244	0.244	0.248	0.252	0.255	0.260	0.255	0.258	0.261
1.5	0.240	0.247	0.253	0.246	0.248	0.248	0.247	0.250	0.250	0.254	0.259	0.265	0.270	0.265	0.268	0.269
1.67	0.247	0.253	0.258	0.251	0.253	0.253	0.252	0.255	0.256	0.261	0.267	0.273	0.277	0.277	0.282	0.275
2	0.257	0.262	0.273	0.266	0.267	0.266	0.265	0.270	0.270	0.272	0.280	0.287	0.294	0.298	0.302	0.284

year / range	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0.5-0.67	0.132	0.117	0.109	0.102	0.101	0.103	0.103	0.096	0.097	0.090	0.084	0.078	0.073	0.141	0.151	0.262
0.67-1.0	0.065	0.059	0.057	0.051	0.050	0.051	0.052	0.053	0.054	0.059	0.065	0.070	0.074	0.097	0.095	0.131
1.0-1.33	0.034	0.049	0.060	0.050	0.058	0.058	0.056	0.056	0.056	0.052	0.049	0.045	0.049	0.085	0.085	0.066
1.33-1.5	0.049	0.044	0.041	0.041	0.039	0.039	0.039	0.038	0.038	0.034	0.042	0.058	0.056	0.059	0.059	0.044
1.5-1.67	0.041	0.035	0.031	0.032	0.031	0.031	0.032	0.030	0.030	0.045	0.051	0.047	0.044	0.071	0.082	0.035
1.67-2.0	0.030	0.028	0.044	0.046	0.040	0.040	0.037	0.043	0.044	0.042	0.038	0.042	0.051	0.064	0.061	0.026

Source: own calculations (in MS Excel)

At first glance no visual similarity is clear between the efficient tax rate (*ETR*) and the various indicators of progressiveness (*PAR*, *PTO*, and *PEAT*). On the contrary, the similarity between the *PAR* and *PTO* indicators is obvious, both for the distribution of the tax itself, and all charges. Therefore, it seems that these two factors have similar explanatory power (they can be interchangeable).

The similarity between the first two indicators (*PAR*, *PTO*) and the third (*PEAT*) is significantly weaker, especially in the distribution of the tax itself. If we examine the distribution of both taxes and insurance, a certain similarity between the *PTO* and *PEAT* indicators is shown, however, it is weaker than between the *PAR* and *PTO*.

More precise expression of the similarity between the indicators can be allowed using correlation analysis. The correlation can be understood as the degree of linear interdependence between two indicators. The higher the degree of correlation, the stronger the link between the values of both indicators can be understood. The high correlation cannot be explained as the causal relationship, it means that the similarity between the two indicators can

be expressed as the approximate arithmetic relationship between their values.

The default statistic for measuring the correlation is the correlation coefficient with values from the interval of -1 to +1 (for more details see [4]). Correlation coefficients were calculated between the individual tax burden and progressiveness indicators, as well as between the indicators themselves. The calculation was performed both in individual income groups as well as for the entire table.

Correlation coefficients were calculated between the individual tax burden and progressiveness indicators, as well as between the indicators themselves. The calculation was performed both in individual income groups as well as for the entire table (total).

When examining the correlation of individual income groups all three indicators in both types of tax burdens (i.e. only tax and taxes + insurance) are shown for similar behaviour. While the low and high incomes show a higher correlation, this means better explanatory power, on the other hand the lowest explanatory power was shown in income groups around the average wage (the group with the lowest correlation is 0.67 to 1.00 times the average wage) – see Table 7.

Tab. 7:

Correlation between the Effective Tax Rate and Various Indicators of the Progressiveness Tax Burden – for the Individual Income Groups and the Total

range	only tax			tax + insurance		
	ETR-PAR	ETR-PTO	ETR-PEAT	ETR-PAR	ETR-PTO	ETR-PEAT
0.5-0.67	-0.819	-0.747	0.817	-0.887	-0.873	0.888
0.67-1.0	0.115	-0.142	-0.142	0.066	-0.025	-0.093
1.0-1.33	0.373	0.052	-0.407	0.297	0.177	-0.333
1.33-1.5	0.486	-0.069	-0.538	0.597	0.438	-0.638
1.5-1.67	0.634	0.430	-0.654	0.691	0.632	-0.709
1.67-2.0	0.650	0.307	-0.683	0.622	0.488	-0.660
total	-0.030	-0.028	-0.237	-0.046	-0.040	-0.228

Source: own calculations (in MS Excel)

When we examined the similarity of the tables as a whole, the highest correlation between the percentage of tax burden and the progressiveness indicator was shown using *PAR*, the lowest (weak dependence, virtually independent) using *PEAT*. In all cases the negative correlation is calculated. The values of the correlation for both types of tax burdens are practically identical, we can therefore say that particular explanatory power indicators do not differ if we follow only its own tax is a tax or insurance.

(The significance of correlations mentioned above is not calculated using the statistical t-tests because it is meaningful only for sample analysis.)

Although all three indicators of the progressiveness tax burden are relative, i.e. they eliminate the development of average wages over time, an analysis correlation with eliminating the time influence was made (using the trace analysis and partial correlations). Although the values of the correlation coefficients changed slightly, these changes are minimal and the findings mentioned in the previous paragraph shall remain valid. The effect of development time on the explanatory power of the indicators is minimal. We confirm the initial assumption that the relative tax burden progressiveness indicators are independent of time. Given the minimal relevance of this correction the concrete results are not indicated in this paper.

In the next phase of the correlation analysis the progressiveness indicators were compared among themselves, again separately for each type of tax burden. The results monitored in both tax burdens (without and with insurance)

are practically identical. In various income groups the correlation coefficients show a nearly perfect linear relationship (the value is close to +1 or -1), where the *PAR – PEAT* shows 100% correlation even in all groups, which points to a mathematical relationship in the calculations of both indicators. It also (as a result of the nature of these indicators) shows that *PEAT* has the opposite development tendency from the other two factors – correlations between *PEAT* and the remaining indicators are negative, while the correlation between the *PAR* and the *PTO* is positive.

If we examine the correlation of the entire table, i.e. over all the income bands, the similarity between indicators will no longer be as strong. The greatest similarity is shown between the *PAR* and *PTO*, there the dependence may be assessed as very strong. It can be stated that both indicators have very similar explanatory power and are largely fungible. The similarity between the *PAR* and *PEAT*, or the *PTO* and *PEAT*, is significantly lower, here we have to evaluate the dependence as of the average strength. Only a *PTO – PEAT* pair in the case of taxes including insurance has again shown a strong similarity. It seems that with the growing share of the tax burden the behaviour of *PEAT* is more similar to *PTO*, even if their dynamics are opposite – see Table 8.

All of these exact findings still confirm the assessment based on the analogy with coloured line maps in the tables as mentioned at the beginning of this text.

Finally, the interdependence of the same indicators for both types of reference tax

Tab. 8: Correlations between Various Indicators of Progressiveness Tax Burdens – for the Individual Income Groups and the Total

range	only tax			tax + insurance		
	ETR-PAR	ETR-PTO	ETR-PEAT	ETR-PAR	ETR-PTO	ETR-PEAT
0.5-0.67	0.986	-1.000	-0.985	0.999	-1.000	-0.999
0.67-1.0	0.967	-1.000	-0.959	0.996	-1.000	-0.993
1.0-1.33	0.944	-0.999	-0.931	0.992	-0.999	-0.987
1.33-1.5	0.835	-0.998	-0.800	0.982	-0.999	-0.971
1.5-1.67	0.969	-1.000	-0.962	0.997	-1.000	-0.994
1.67-2.0	0.920	-0.999	-0.900	0.986	-0.999	-0.976
total	0.902	-0.999	-0.900	0.883	-0.487	-0.801

Source: own calculations (in MS Excel)

burdens was examined. In this case an extremely high dependence was detected in both *ETR* and all three progressiveness indicators (i.e. *PAR*, *PTO*, and *PEAT*). All the correlation coefficients of the *PAR* and *PEAT* indicators were virtually equal to 1 that indicates almost a direct linear functional relationship between the indicators, while the amount of the tax burden is almost invariant to the behaviour of these indicators (the only exception is the category 1.67–2.00). The origin *ETR* and *PTO* index also indicate high relationship, but not directly functional, meaning that they depend somewhat on the amount of the tax burden – see Table 9.

The almost 100% level of correlation between the two indicators of the *PAR* is so interesting that we have returned to the original tables 4A and 5A expressing the distribution of this indicator over time and between different

income groups. One surprise finding is that even the value of the *PAR* indicators alone is, with only one exception virtually identical, which means that this indicator does not affect whether it is calculated from the tax only or from taxes with insurance. Low sensitivity to the understanding of the tax burden is also shown in the indicator of progressiveness of income after tax – *PEAT*. There are, however differences between the values of the order of hundredths of points (units in per cent). The biggest differences (the order of tens or hundreds of percentage points) are reported in the progressiveness of the *PTO* tax obligation indicator. This indicator reacts most of all to a change of the perception of the tax burden (the "net" tax or any charges). The greatest changes in the *PTA* values are in the lowest income categories.

Tab. 9: Correlation between Corresponding Indicators for Both Types of Tax Burdens (Tax Only, or Taxes + Insurance) – for the Individual Income Groups and the Total

range	tax – tax + insurance			
	ETR	PAR	PTO	PEAT
0.5-0.67	0.955	1.000	0.991	1.000
0.67-1.0	0.917	1.000	0.984	1.000
1.0-1.33	0.951	1.000	0.975	1.000
1.33-1.5	0.963	1.000	0.919	1.000
1.5-1.67	0.969	1.000	0.985	1.000
1.67-2.0	0.975	0.966	0.933	0.969
total	0.993	0.999	0.909	0.995

Source: own calculations (in MS Excel)

Discussion and Conclusion

An employee was chosen for analysis in this paper, this employee claims only the basic allowances (from 1993–2005), or the tax credit (from 2006–2008) and he does not claim any other tax reliefs or credits. This means that this analysis refers e.g. to a single, childless taxpayer or the second from the spouse who does not claim any tax reliefs for children.

An increasing effective tax rate trend was stable in the 1993–2005 period with the exception of the years 1998 and 1999 (all taxpayers) and 2001 (the two lowest income groups of taxpayers). This was caused by the increase of the average wage and by the fact that the tax system in the Czech Republic was only slightly flexible. In 1998 and 1999 the change of this trend was caused mainly by the enlargement of the tax brackets with the lowest tax rate (15 %). In 2006 tax credits were introduced instead of allowances and this led to the decrease of ETR_T for all taxpayers with the exception of taxpayers earning 2 times the average wage. In 2008 the establishment of a flat tax rate caused a decrease of ETR_T for most taxpayers with the exception of taxpayers earning the average wage or 1.33 and 1.5 multiples of the average wage.

The analyses were done in the Czech Republic in 1993–2008. It would be interesting to verify whether similar conclusions have been reached in other countries, especially in countries with different philosophy of calculating tax from wages. This would show in what measure the conclusions reached are independent of the taxation method and in what measure they represent the specifics of the Czech tax model.

It is necessary to remember that the methods used (correlation) belong among statistical methods, i.e. they examine the similarity of the behaviour of individual indices regardless of their real mathematical relationship. Analysis of the mathematical relationship would predicate the affinity of the mentioned indices interestedly, e.g. by a formula deduction that would make it possible to transform one index into another. Nevertheless such a relationship can be quite complicated and would not provide an easy survey, the function of up to 4 incoming parameters complicates transparent analysis. The use of statistical methods simplifies this

problem considerably even if the correlation analysis does not explain the real bindings among indices (it considers these relationships only as “the black box”).

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Ing. Václav Friedrich, Ph.D., ING-PAED-IGIP

VSB – Technical University of Ostrava
Faculty of Economics
Department of Mathematical Methods in
Economics
vaclav.friedrich@vsb.cz

Ing. Kateřina Maková, Ph.D.

VSB – Technical University of Ostrava
Faculty of Economics
Department of Public Economics
katerina.makova@seznam.cz

prof. Ing. Jan Široký, CSc.

VSB – Technical University of Ostrava
Faculty of Economics
Department of Public Economics
jan.siroky@vsb.cz

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Abstract

TESTING THE PREDICATIVE ABILITY OF THE TAX PROGRESSIVENESS INDICES (USING THE EXAMPLE OF AN EMPLOYEE IN THE CZECH REPUBLIC IN 1993–2008)**Václav Friedrich, Kateřina Maková, Jan Široký**

The personal income tax is not harmonised in the European Union that's why there are different systems of the personal income tax which reflects in different nominal tax rates, different allowances, deductions and tax credits. The comparisons based on nominal tax rates predicate the real rate of taxation insufficiently because of these differences. More objective way how to measure the tax circumstances of the taxpayers in individual countries are relative indicators such as the tax incidence of the taxpayer with an average wage, the calculation of an effective tax rate or measuring the tax progressiveness. The index of the tax progressiveness which is based on the effective tax rate predicates the effective tax burden and the relationship between the change of the income and the tax burden.

The personal income tax paid by the employee in the period of 1993–2008 in the Czech Republic was chosen for analysis. The paper deals with the application of tax progressiveness indices on the tax system of the Czech Republic. Calculations are performed of the effective tax rate, the progressiveness of the average rate, the progressiveness of the tax obligation and the progressiveness of earning after taxation for an employee who claims only the basic allowances (from 1993–2005), or the tax credit (from 2006–2008) and does not claim any other tax reliefs or credits. It is tested how sensitively the particular indices of the tax progressiveness react to the changes of the effective tax rate.

Key Words: *effective tax rate, even tax rate, personal income tax, tax obligation, tax progressiveness.*

JEL Classification: *H 21, H 22, H 24.*

Appendix

Tab. 3A: Development of the Effective Tax Rate in the Czech Republic from 1993–2008 (tax only)

year / interval	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0.5	4.17	5.15	5.66	6.28	6.38	6.26	6.22	6.65	6.62	7.07	7.49	7.90	8.22	4.56	4.81	2.66
0.67	6.41	7.14	7.51	8.02	8.10	8.01	7.97	8.28	8.27	8.60	8.92	9.23	9.46	6.96	7.38	7.13
1	8.57	9.08	9.38	9.70	9.75	9.70	9.67	10.03	10.06	10.56	11.05	11.53	11.89	10.16	10.51	11.46
1.33	9.68	10.69	11.36	11.36	11.65	11.61	11.52	11.88	11.90	12.29	12.66	13.01	13.51	12.95	13.33	13.64
1.5	10.52	11.44	12.05	12.05	12.32	12.28	12.19	12.52	12.54	12.87	13.37	13.99	14.46	13.96	14.33	14.39
1.67	11.22	12.04	12.58	12.60	12.84	12.81	12.73	13.03	13.05	13.64	14.23	14.79	15.21	15.17	15.72	14.98
2	12.22	12.98	14.03	14.11	14.16	14.13	13.96	14.45	14.50	15.01	15.50	16.19	16.89	17.28	17.74	15.85

Source: own calculations (in MS Excel)

Tab. 3B: Development of the Effective Tax rate in the Czech Republic from 1993–2008 (tax and social insurance)

year / interval	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0.5	17.67	18.40	18.91	18.78	18.88	18.76	18.72	19.15	19.12	19.57	19.99	20.40	20.72	17.06	17.31	15.16
0.67	19.91	20.39	20.76	20.52	20.60	20.51	20.47	20.78	20.77	21.10	21.42	21.73	21.96	19.46	19.88	19.63
1	22.07	22.33	22.63	22.20	22.25	22.20	22.17	22.53	22.56	23.06	23.55	24.03	24.39	22.66	23.01	23.96
1.33	23.18	23.94	24.61	23.86	24.15	24.11	24.02	24.38	24.40	24.79	25.16	25.51	26.01	25.45	25.83	26.14
1.5	24.02	24.69	25.30	24.55	24.82	24.78	24.69	25.02	25.04	25.37	25.87	26.49	26.96	26.46	26.83	26.89
1.67	24.72	25.29	25.83	25.10	25.34	25.31	25.23	25.53	25.55	26.14	26.73	27.29	27.71	27.67	28.22	27.48
2	25.72	26.23	27.28	26.61	26.66	26.63	26.46	26.95	27.00	27.15	28.00	28.69	29.39	29.78	30.24	28.35

Source: own calculations (in MS Excel)

Tab. 4A: Progressiveness of Average Rate Development PAR (tax only) – Czech Republic 1993–2008

year / range	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0.5-0.67	0.132	0.117	0.109	0.102	0.101	0.103	0.103	0.096	0.097	0.090	0.084	0.078	0.073	0.141	0.151	0.262
0.67-1.0	0.065	0.059	0.057	0.051	0.050	0.051	0.052	0.053	0.054	0.059	0.065	0.070	0.074	0.097	0.095	0.131
1.0-1.33	0.034	0.049	0.060	0.050	0.058	0.058	0.056	0.056	0.056	0.052	0.049	0.045	0.049	0.085	0.085	0.066
1.33-1.5	0.049	0.044	0.041	0.041	0.039	0.039	0.039	0.038	0.038	0.034	0.042	0.058	0.056	0.059	0.059	0.044
1.5-1.67	0.041	0.035	0.031	0.032	0.031	0.031	0.032	0.030	0.030	0.045	0.051	0.047	0.044	0.071	0.082	0.035
1.67-2.0	0.030	0.028	0.044	0.046	0.040	0.040	0.037	0.043	0.044	0.042	0.038	0.042	0.051	0.064	0.061	0.026

Source: own calculations (in MS Excel)

Tab. 4B: Progressiveness of Tax Obligations PTO (tax only) – Czech Republic 1993–2008

year / range	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0.5-0.67	3.117	2.523	2.288	2.092	2.063	2.102	2.109	1.966	1.982	1.853	1.752	1.664	1.595	3.074	3.106	7.600
0.67-1.0	2.021	1.823	1.755	1.635	1.617	1.639	1.646	1.640	1.656	1.691	1.724	1.755	1.778	2.393	2.285	2.842
1.0-1.33	1.522	1.715	1.851	1.690	1.785	1.794	1.771	1.743	1.737	1.660	1.587	1.517	1.549	2.107	2.081	1.767
1.33-1.5	1.766	1.619	1.536	1.536	1.507	1.509	1.513	1.475	1.475	1.416	1.495	1.665	1.620	1.688	1.662	1.485
1.5-1.67	1.654	1.515	1.432	1.448	1.415	1.424	1.435	1.400	1.400	1.588	1.632	1.562	1.510	1.851	1.953	1.407
1.67-2.0	1.540	1.473	1.699	1.726	1.623	1.625	1.586	1.660	1.673	1.609	1.541	1.574	1.669	1.843	1.779	1.351

Source: own calculations (in MS Excel)

Tab. 4C: Progressiveness of Income After Tax, PEAT (tax only) – Czech Republic 1993–2008

year / range	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0.5-0.67	0.908	0.917	0.923	0.927	0.928	0.926	0.926	0.931	0.930	0.935	0.939	0.943	0.947	0.901	0.894	0.819
0.67-1.0	0.930	0.937	0.939	0.945	0.946	0.944	0.944	0.942	0.941	0.935	0.929	0.923	0.919	0.896	0.898	0.859
1.0-1.33	0.951	0.929	0.912	0.926	0.915	0.915	0.917	0.917	0.918	0.922	0.927	0.933	0.926	0.875	0.873	0.901
1.33-1.5	0.918	0.926	0.931	0.931	0.933	0.933	0.933	0.936	0.936	0.942	0.928	0.901	0.903	0.898	0.898	0.923
1.5-1.67	0.923	0.933	0.941	0.939	0.942	0.941	0.940	0.943	0.943	0.913	0.902	0.909	0.914	0.862	0.841	0.932
1.67-2.0	0.932	0.935	0.899	0.895	0.908	0.908	0.915	0.901	0.899	0.904	0.910	0.900	0.880	0.849	0.855	0.938

Source: own calculations (in MS Excel)

Tab. 5A: Progressiveness of Average Rate Development PAR (taxes + insurance) – Czech Republic 1993–2008

year / range	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0.5-0.67	0.132	0.117	0.109	0.102	0.101	0.103	0.103	0.096	0.097	0.090	0.084	0.078	0.073	0.141	0.151	0.262
0.67-1.0	0.065	0.059	0.057	0.051	0.050	0.051	0.052	0.053	0.054	0.059	0.065	0.070	0.074	0.097	0.095	0.131
1.0-1.33	0.034	0.049	0.060	0.050	0.058	0.058	0.056	0.056	0.056	0.052	0.049	0.045	0.049	0.085	0.085	0.066
1.33-1.5	0.049	0.044	0.041	0.041	0.039	0.039	0.039	0.038	0.038	0.034	0.042	0.058	0.056	0.059	0.059	0.044
1.5-1.67	0.041	0.035	0.031	0.032	0.031	0.031	0.032	0.030	0.030	0.045	0.051	0.047	0.044	0.071	0.082	0.035
1.67-2.0	0.030	0.028	0.044	0.046	0.040	0.040	0.037	0.043	0.044	0.031	0.038	0.042	0.051	0.064	0.061	0.026

Source: own calculations (in MS Excel)

Tab. 5B: Progressiveness of Tax Obligations PTO (taxes + insurance) – Czech Republic 1993–2008

year / range	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0.5-0.67	1.500	1.426	1.386	1.365	1.359	1.368	1.368	1.335	1.340	1.308	1.282	1.257	1.236	1.554	1.585	2.160
0.67-1.0	1.329	1.288	1.273	1.248	1.243	1.250	1.252	1.255	1.261	1.281	1.301	1.321	1.335	1.498	1.477	1.669
1.0-1.33	1.203	1.291	1.353	1.301	1.344	1.347	1.336	1.331	1.329	1.302	1.276	1.248	1.268	1.496	1.494	1.367
1.33-1.5	1.320	1.276	1.247	1.255	1.245	1.245	1.246	1.232	1.231	1.206	1.249	1.339	1.322	1.350	1.342	1.253
1.5-1.67	1.286	1.239	1.206	1.220	1.206	1.210	1.215	1.200	1.200	1.298	1.327	1.297	1.273	1.449	1.509	1.218
1.67-2.0	1.245	1.225	1.340	1.365	1.316	1.316	1.295	1.337	1.344	1.234	1.288	1.311	1.367	1.462	1.434	1.192

Source: own calculations (in MS Excel)

Tab. 5C: Progressiveness of Income After Tax PEAT (taxes + insurance) – Czech Republic 1993–2008

year / range	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0.5-0.67	0.893	0.904	0.910	0.916	0.916	0.915	0.915	0.921	0.920	0.925	0.930	0.934	0.938	0.886	0.878	0.793
0.67-1.0	0.918	0.926	0.928	0.936	0.937	0.936	0.935	0.933	0.932	0.925	0.918	0.911	0.906	0.880	0.882	0.837
1.0-1.33	0.943	0.916	0.897	0.914	0.902	0.901	0.904	0.904	0.904	0.909	0.915	0.921	0.914	0.855	0.852	0.884
1.33-1.5	0.904	0.913	0.919	0.920	0.922	0.922	0.922	0.925	0.925	0.932	0.916	0.884	0.887	0.880	0.881	0.910
1.5-1.67	0.909	0.922	0.930	0.928	0.932	0.931	0.930	0.933	0.933	0.899	0.886	0.893	0.899	0.838	0.813	0.920
1.67-2.0	0.919	0.924	0.882	0.878	0.893	0.893	0.900	0.884	0.882	0.917	0.895	0.883	0.859	0.823	0.829	0.927

Source: own calculations (in MS Excel)