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MEASURING INEQUALITY IN THE POLISH INCOME TAX SYSTEM

Abstract

In this paper the equity in income taxation is defined by means of three axioms, introduced by Kakwani and Lambert in 1998. Tax system is equitable if all axioms are satisfied. Violation of them – by a personal income tax system – produces negative influence on the redistributive effect of the tax. This negative influence provides the means to characterize the type of inequity present in a tax system. We analyze these effects, using decomposition of the redistributive effect. The analysis is made basing on data from the tax offices and household budget survey.

1. Introduction

Many authors attempt at assessment of tax system's justice and international or inter-temporal comparisons of existing tax systems. Observed, actual solutions in this field suggest that personal income tax is generally supposed to have redistributive character and to reduce inequalities in income distribution in the society.

The basic measure, allowing assessment of redistribution extent, is *RE* coefficient. This measure is based on Gini indexes before and after taxation (cf. [6]). Therefore, decomposition of Gini index into between-group, within-group and residual component gives the opportunity to distinguish vertical (*V*), horizontal (*H*) and reranking (*R*) effect of a tax system. Then, decomposition of redistribution coefficient could be written as:

$$RE = V - H - R. \quad (1)$$

Vertical effect (*V*) measures the redistribution that would have occurred if equals had been treated equally. Horizontal effect (*H*) is interpreted as the loss in the redistributive effect accounted for by the unequal treatment of equals. Reranking effect (*R*) is the loss in the redistributive effect caused by the difference in pre-tax and post-tax rankings of income units. All these effects are extensively discussed in [2].

In this way, the decomposition given by (1) could be applied in a tax equity assessment in the context of both vertical and horizontal tax equity (cf. [1], [3], [4],

[7]). Alluding to these concepts, Kakwani and Lambert have defined 3 postulates that should be respected by the personal income tax system (cf. [5]). Furthermore, they have proposed application of these postulates in tax systems' assessment. In this paper we follow this idea, and equity in income taxation is defined by means of their three axioms: the tax system would be equitable if all axioms are satisfied. Violation of axioms – by a personal income tax system – produces negative influence on the redistributive effect of the tax. This negative influence provides the means to characterize the type of inequity present in a tax system. All analyses are made basing on Polish data from the tax offices and household budget survey.

2. Rules introduced by Kakwani and Lambert

Kakwani and Lambert have defined three general rules that could be set as a basic requirement for the personal income tax system. Despite their arbitrary character, tax systems that violate them intentionally are very rare. Practical solutions in personal income tax systems are not, however, so clear. Tax deduction and exemptions – commonly used tax instruments – often cause violation of these rules.

Let x_1, x_2, \dots, x_n mean pre-tax income of n income units, who are paying t_1, t_2, \dots, t_n in tax. We can write X as a vector of x_1, x_2, \dots, x_n and T as a vector of t_1, t_2, \dots, t_n . In our analysis, household is set as an income unit, so

x_i will denote pre-tax income of household i , and

t_i tax payment of household i .

In this notation $x_i - t_i$ denotes post-tax income of household i .

The first rule – **Rule 1** – introduced by Kakwani and Lambert says that tax duty should increase monotonically with respect to taxpayers' ability to pay. This rule can be written as:

$$x_i \geq x_j \Rightarrow t_i \geq t_j.$$

Because the inequalities are weak, postulate of “equal treatment of equals” could be treated as a special case of this rule. It also enables government to exempt taxpayers with the lowest incomes from tax. This rule is named *minimal progression principle*.

According to **Rule 2**, the richer people must pay taxes at higher rates. Of course, a violation of minimal progression automatically entails a violation of this principle. The weak inequalities in rule 2 mean that proportional taxation is permitted.

This second rule – progression principle – is defined in the following way:

$$x_i \geq x_j \text{ and } t_i \geq t_j \Rightarrow \frac{t_i}{x_i} \geq \frac{t_j}{x_j}.$$

If tax system is ruled out by principles 1 and 2 taken together, then it means existence of regression in the tax system.

The last rule – **Rule 3** – says that a tax, satisfying the other two rules, should cause no reranking in taxpayers' post-tax income. This rule is named no-reranking criterion and can be written as:

$$x_i \geq x_j \text{ and } t_i \geq t_j \text{ and } \frac{t_i}{x_i} \geq \frac{t_j}{x_j} \Rightarrow x_i - t_i \geq x_j - t_j.$$

The Rule 3 can be seen as a vertical restriction, ruling out “too much” progression.

In order to detect violation of these rules – identified with tax inequity – we need to measure the extent of differences between the various rankings of income units. Because of its simplicity, the way of violation of Rule 3 will be described first.

The Rule 3 is violated if and only if the rankings of income units by X and $X-T$ differ. We can define test statistic S_3 as difference between the Gini coefficient for $X-T$ and the concentration index for post-tax income in the following way:

$$S_3 = G_{X-T} - C_{X-T, X},$$

where $C_{X-T, X}$ denotes concentration index for income after taxation. This measure is calculated in the same way as Gini index, but vector of incomes after taxation ($X-T$) is ordered by incomes before taxation (X). If both orderings are identical (taxation causes no reranking of income), Gini and concentration indexes calculated for the same vector of incomes take the same value.

Of course S_3 always takes non-negative values. We can write the way of verification as follows:

The Rule 3 is violated

⇕

$$S_3 > 0.$$

If S_3 is zero, the Rule 3 is uphold.

Applying a similar way of reasoning, we can define test statistics S_1 and S_2 for Rule 1 and Rule 2 respectively:

$$S_1 = \frac{\sum_{i=1}^n t_i}{\sum_{i=1}^n (x_i - t_i)} \cdot (G_T - C_{T, X})$$

and

$$S_2 = \frac{\sum_{i=1}^n t_i}{\sum_{i=1}^n (x_i - t_i)} \cdot \left(\left(G_{\frac{T}{X}} - C_{\frac{T}{X}, X} \right) - (G_T - C_{T, X}) \right).$$

Interpretation of S_1 and S_2 is analogous to S_3 :

The Rule 1 is violated



$$S_1 > 0$$

as well as

The Rule 2 is violated



$$S_2 > 0.$$

If S_1 or S_2 are zero the Rule 1 or Rule 2 are uphold respectively.

Violation of rules 1-3 has negative influence on redistributive effect of the income tax system. And measures S_1 , S_2 , S_3 can be interpreted as loss in redistribution, being a consequence of this violation.

Generally, RE is defined as the difference between Gini index for pre-tax income and Gini index for post-tax income. It measures reduction of inequality in income distribution, being a consequence of personal income tax:

$$RE = G_X - G_{X-T}.$$

Taking into account regressive character of consumption taxes (such as VAT), redistributive practices in income taxation could be justified by redressing the balance of the overall tax system. The basic assumption is that money should be redistributed to benefit the poorer members of society that are characterized by the higher consumption rate.

Using the decomposition of RE , we can measure losses in the redistribution due to the violation of rules 1, 2 and 3. In order to do that, we need to use the following decomposition of the redistributive effect:

$$RE = V - S_1 - S_2 - S_3,$$

where:

- S_1 – measures loss in redistributive effect, caused by a violation of Rule 1,
- S_2 – loss in redistributive effect, caused by a violation of Rule 2,
- S_3 – loss in redistributive effect, caused by a violation of Rule 3,
- V – value of redistributive effect that might be achieved if all rules are uphold.

3. Inequities in Polish income taxation 2001

The way of measuring inequity in income taxation, described in the previous section, was used to assess characteristics of Polish personal income tax system. Our analysis was based on data coming from the two separate sources. First dataset

contains 130 054 tax returns from two Lower-Silesian tax offices. The second one comes from household budget survey, carried out by the Polish Central Statistical Office. Both sets concern the year 2001.

Information on income and tax paid were taken directly from the first dataset. These data were supplemented by information on household characteristics, simulated on the basis of HBS data.

Nominal incomes in this joint dataset were transformed by the equivalence scale. This procedure allows accounting for different household composition of taxpayers. We used Cutler scale with $\alpha=0$ and $\beta=0$, defined as follows:

$$e(n_i^a, n_i^c) = (n_i^a + \alpha n_i^c)^\beta,$$

where:

$0 \leq \alpha \leq 1$, $0 \leq \beta \leq 1$ – parameters,

n_i^a – number of adults in i -th household (household of i -th taxpayer),

n_i^c – number of children in i -th household.

We decided to put $\alpha=0$ because Polish tax system in 2001 did not take children into account and we wanted to use the scale coherent with government scale for assessing equity in income taxation.

For these data, overall redistributive effect (*RE*) was equal to 2.7%. It means that the Polish personal income tax system causes transfer of 2.7% of overall income from the richer to the poorer taxpayer.

Losses in this redistributive effect, resulting from violation of rules 1, 2 and 3 are presented in Table 1.

Table 1. Losses in redistribution for the whole sample

Rule	Losses in RE, resulting from violation of consecutive rules $S_i \cdot 100\%$
Rule 1	0.346
Rule 2	1.026
Rule 3	0.031
Total	1.400

Source: own calculations.

The inequity, resulting from violation of Rule 1, reduces overall redistributive effect by 0.35 percentage points. Analogously, in case of Rule 2 and Rule 3 this reduction is equal to 1.03 and 0.03 percentage points, respectively. The violation of Rule 2 has the strongest influence on redistributive effect. This suggests existence of regression in the tax system (locally – in some subgroups). Loss of redistributive effect due to violation of Rule 3 is almost zero (0.03 percentage points). It means that

Polish tax system causes almost no reranking in taxpayers' income. The total inequity in the Polish tax system reduces the redistributive effect of taxation by 1.4 percentage points. These results suggest that the absence of all mentioned inequities could reduce the inequality of income by 4.1 percentage points (instead of 2.7 percentage points). And – what is worth mentioning – removal of these inequities could potentially improve the redistributive effect of taxation without increasing the marginal tax rates for higher income groups.

In the next step we have made an analysis aiming at verification, if decomposition results are the same for rich and poor taxpayers. In order to do this, we have distinguished two subgroups from the whole sample. To the group of poor taxpayers we have classified 25% of taxpayers with the lowest income. Income x_i of these taxpayers satisfies the condition:

$$x_{min} \leq x_i \leq Q_1(x_1, x_2, \dots, x_n),$$

where:

x_{min} – the minimal income before taxation in the analyzed sample,

$Q_1(x_1, x_2, \dots, x_n)$ – the first quartile for the incomes of all taxpayers.

Results obtained for such a group of poor taxpayers are presented in Table 2.

Table 2. Losses in redistribution for the group of poor taxpayers

Rule	Losses in RE, resulting from violation of consecutive rules $S_i \cdot 100\%$
Rule 1	0.484
Rule 2	0.224
Rule 3	0.069
Total	0.776

Source: own calculations.

For the group of poor taxpayers, redistribution coefficient is equal to 0.32%. It means that redistribution of income within a group of taxpayers with lower income is significantly lower than in the whole analyzed sample. Moreover, results presented in Table 2 suggest that in this group all three rules are almost satisfied. And overall loss resulting from tax inequity is quite low – only 0.78 percentage point. This value may suggest relatively smaller usage of deductions and exemptions in this group (in relation to the whole sample).

Applying analogous criterion, we have constructed the group of rich taxpayer, classifying to this group 25% of taxpayers with the highest income. Income x_i of these taxpayers had to satisfy the condition:

$$Q_3(x_1, x_2, \dots, x_n) \leq x_i \leq x_{max},$$

where:

- x_{max} – the maximum income before taxation in the analyzed sample,
 $Q_3(x_1, x_2, \dots, x_n)$ – value of the third quartile for the incomes of all taxpayers.
 Results for this group are given in Table 3.

Table 3. Losses in redistribution for the group of rich taxpayers

Rule	Losses in RE, resulting from violation of consecutive rules $S_i \cdot 100\%$
Rule 1	0.714
Rule 2	1.436
Rule 3	0.097
Total	2.246

Source: own calculations.

Redistributive effect (RE) of taxes for this group is equal to 4.6%. It means that the personal income tax reduces inequality in the group by 4.6 percentage points, and that violation of rules 1-3 is much more severe than for the whole sample. It results in much higher redistribution loss.

For the Rule 1 this loss is equal to 0.71 percentage point. It is worth observing that in case of poorer taxpayer, overall loss in redistribution (resulting from violation of all three rules) was approximately equal to value of S_1 for the richer taxpayers.

The highest loss in redistribution, as in case of previous groups, was caused by the violation of Rule 2. This indicates that local (observed in some subgroups) regressivity is much stronger than in other analyzed groups.

The lowest loss in redistribution is caused by the violation of Rule 3. It suggests that despite strong inequity indicated by S_2 , reordering of incomes is not a common phenomenon.

Presented comparative analysis indicates that Polish personal income tax system seems to be significantly more equitable for taxpayers with lower income. We expect that it results from differences in usage of tax deductions and exemptions.

4. Conclusions

Applying methodology of Kakwani and Lambert to the Polish personal income tax system, we came to the following conclusions:

The Polish personal income tax system reduces inequality by 2.7 percentage points. This is the overall (actual) redistributive effect.

The total inequity in the Polish tax system reduces the redistributive effect of taxation by 1.4 percentage points.

Results suggest existence of regression in the tax system. This regression, however, concerns only subgroups of the analyzed sample.

Tax system causes almost no reranking in taxpayers' after-tax income.

The Polish personal income tax system could have reduced the inequality of income by 4.1 percentage points instead of 2.7 percentage points in case of no tax inequity. In this way, removing all inequities can potentially improve the redistributive effect of taxation without increasing the marginal tax rates for higher income groups.

The analyzed tax system is more equitable for poor than for rich taxpayers.

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POMIAR NIERÓWNOŚCI W POLSKIM PODATKU DOCHODOWYM OD OSÓB FIZYCZNYCH

Streszczenie

Tematem artykułu jest analiza sprawiedliwości opodatkowania dochodów. W celu opisu sprawiedliwości opodatkowania przyjęto jej definicję, zaproponowaną w 1998 r. przez Kakwaniego i Lamberta. Obejmuje ona trzy postulaty, których spełnienie przez system podatkowy weryfikowane jest na podstawie analizy zmian w wartościach współczynników koncentracji dla dochodów i podatku. Naruszenie któregośkolwiek z postulatów jest uznawane za przejaw niesprawiedliwości systemu podatkowego i ma negatywny wpływ na zakres redystrybucji realizowanej poprzez system podatkowy.

Analizy zostały przeprowadzone na podstawie danych z dwóch dolnośląskich urzędów skarbowych oraz z badania budżetów gospodarstw domowych, prowadzonego przez Główny Urząd Statystyczny.