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REDISTRIBUTION AND EQUITY OF POLISH PERSONAL INCOME TAX: MEASUREMENT USING MICRO DATA FROM TAX RETURNS

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SUMMARY

The redistribution effect of taxation is widely analyzed in literature. General findings could be summarized as follows: actual redistribution depends both on construction of tax schedule and unintended effects, such as reranking of incomes, caused by taxation. To separate both components, several decompositions of redistribution index have been described. In this paper, authors analyze decomposition proposed by Kakwani and Lambert (1998), who describe three principles of tax equity and three related measures of inequity. Authors apply outcomes of this decomposition in quest for the equivalence scale that implicitly results from the construction of tax system. Taking into account decomposition outcomes and the implicit equivalence scale found, we try to assess inequity of Polish income tax system in the context of its welfare consequences. All analyses are made basing on data from revenue offices and Central Statistical Office.

Keywords: *decomposition of redistribution index, welfare, taxation.*

1. INTRODUCTION

Analyses of personal income tax system from the point of view of social justice and welfare involve several basic doubts. One of the most controversial issues concerns equalizing income distributions after taxation – with respect to those before taxation. Such a reduction in inequality, being a consequence of redistribution within a tax system, is actually typical for developed countries (related issues are thoroughly analyzed by Boadway and Keen, 2000; Kakwani, 1980; Lambert, 1999 and Sen, 2000).

However, observed over last few years growth in popularity of flat income tax systems enhances discussion concerning legitimacy and effectiveness of redistribution made through the tax system (cf. Hall and Rabushka 1995). Nevertheless, this discussion often takes into account only nominal progression, given by marginal tax rates, defined in the tax schedule. It means that asymmetry and inequality observed in case of income distribution is not – in fact – taken into consideration (for a detailed analysis see, for example, Lambert, 2001).

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In this context, the first aim of this paper is the assessment of the actual extent of redistribution – income transferred from richer to poorer taxpayers, given as a percentage of the overall income – and its impact on social welfare. This analysis is broadened on decomposition of redistribution coefficient. This additional information allows isolating intended and unintended effects in overall redistribution. In this way, it enables evaluation of quality of the tax system, understood as an identification of inequity areas.

The second aim of the presented analysis is a trial to present inequality-based measures of tax inequity in the context of their impact on social welfare – in order to assess social cost of tax inequity.

The structure of the paper is as follows. In the second section we characterize concepts of tax equity and its relation to decomposition of redistribution coefficient. Then we introduce notion of equivalence scale (Section 3) and social welfare (Section 4). In the fifth section empirical results for Polish personal income tax system are presented. The last section concludes.

2. TAX EQUITY AND DECOMPOSITION OF THE REDISTRIBUTION INDEX

There are two basic aspects of tax equity, usually analyzed in the literature: horizontal tax equity and vertical tax equity. The former one postulates ''equal treatment of equals'' and is widely accepted as a very general rule. The problem arises, however, when an attempt is made at defining ''equals''. Trivial definition, covering only income level, could be easily applied in practical solutions, but fails to reflect complexity of real situations (as, for example, differences in household composition or health status). More general definitions, on the other hand, are usually not applicable, because enhanced equality of people (accounting of many aspects) is not like to occur.

Much bigger problem arises, however, in case of the latter aspect – vertical tax equity. It is defined as ''unequal treatment of unequals'' and, besides the problem with definition of equality of taxpayers, involves discussion on the interpretation of unequal treatment. The basic question, concerning this inequality is: how changes in taxes should depend on changes in income (or welfare)? One of the consequences of any answer given to this question is the extent of progressivity and redistribution in taxation.

This problem of tax progression has been structuralized by Kakwani and Lambert (1998) in the form of three equity axioms:

- Minimal progression:

$$x_i \geq x_j \Rightarrow t_i \geq t_j \tag{1}$$

  where x_i and x_j denote income before taxation for i-th and j-th taxpayer and t_i, t_j – taxes paid respectively.

- Progression principle:

$$x_i \geq x_j \quad and \quad t_i \geq t_j \Rightarrow \frac{t_i}{x_i} \geq \frac{t_j}{x_j} \tag{2}$$

- No-reranking principle:

$$x_i \geq x_j \quad \text{and} \quad t_i \geq t_j \quad \text{and} \quad \frac{t_i}{x_i} \geq \frac{t_j}{x_j} \Rightarrow x_i - t_i \geq x_j - t_j \tag{3}$$

Presented set of axioms could be treated as a particular interpretation of vertical equity principle. The first principle guarantees that taxes paid by richer taxpayers are not lower than those of poorer. This postulate seems to be quite obvious. It is satisfied even by the taxation in the form of a lump sum.

While the first postulate defines the minimal progression level, the third one gives the maximum: taxation should not change the order of taxpayers' income. The most controversial is, however, the second axiom. Tax system satisfying this axiom should be characterized not only by a progression of tax amount, but also by progression of tax rates. In this way, the tax system satisfying all three axioms should be progressive (or, at least, flat – if we take into account that tax amounts and tax rates could be equal). This progressivity results in redistribution of income. The most popular coefficient of redistribution is given by a formula:

$$RE = G_X - G_Y \tag{4}$$

where G_X and G_Y denote Gini coefficients for vectors of incomes before and after taxation respectively. Redistribution – calculated according to formula (4) – covers overall impact of taxation on income distribution. Detailed studies (e.g. Aronson, Johnson and Lambert, 1994) show, however, diversity of factors – starting from distortions in income distribution and ending with changes in order of taxpayers. Some of these effects are intentional consequences of progressive taxation, but others should be classified as ''errors'' of the system. In order to separate both groups of effects, several decompositions of *RE* coefficient have been proposed in the literature (e.g. Urban and Lambert, 2008; van de Ven, Creedy and Lambert, 2001; Vernizzi and Pellegrino, 2008). Among all these decomposition, one proposed by Kakwani and Lambert (1998) is worth of a special attention. Unlike other decompositions, it reflects an axiomatic basis. This basis is given by formulae (1) - (3) and results in the following decomposition:

$$RE = V - S_1 - S_2 - S_3 \tag{5}$$

where *RE* denotes actual redistribution, given by formula (4), and V is a potential redistribution that could be reached in case of no ''errors'' in tax system. Thus, V may be interpreted as the percentage of income that could be transferred – through the tax system – from richer to poorer taxpayers, in the hypothetical situation when none of the three principles is violated.

Possible ''errors'' in the tax system, resulting in redistribution loss, are divided into three groups:

- S_1 – loss resulting from violation of minimal progression principle:

$$S_1 = \frac{\sum_i t_i}{\sum_i y_i} \cdot \left(G_T - C_{T,X}\right) > 0$$

where y_i denotes income after taxation of i-th taxpayer, G_T is a Gini coefficient for vector of taxes and $C_{T,X}$ – concentration coefficient for taxes (**T**), but with ordering of income before taxation (**X**). This concentration coefficient is calculated in the same way as Gini coefficient: if tax is a non-decreasing function of income, both indexes are equal.

- The minimal progression principle is violated when tax amount (in currency or welfare units) *does not increase monotonically with respect to people's ability to pay* (Kakwani and Lambert, 1998). It means that order of incomes before taxation (vector **X**) is different from order of tax amounts (vector **T**). This difference is measured by S_1: for tax system satisfying axiom (1) S_1 is equal to 0.
- S_2 – loss resulting from violation of progression principle:

$$S_2 = \frac{\sum_i t_i}{\sum_i y_i} \cdot \left[\left(G_A - C_{A,X} \right) - \left(G_T - C_{T,X} \right) \right] > 0$$

where G_A and $C_{A,X}$ denote Gini and concentration coefficients for vector of tax rates (**A**).

Progression principle postulates non-decreasing order of tax rates (vector **A**) for taxpayers ordered with respect to income before taxation. When this condition is satisfied, $G_A = C_{A,X}$. If it is not satisfied, this difference accounts both for violation of minimal progression and progression principle (violation of minimal progression results in violation of progression principle). In order to capture inequity resulting solely from violation of progression principle, S_1 is subtracted.

- S_3 – loss resulting from violation of no-reranking principle:

$$S_3 = G_Y - C_{Y,X} > 0,$$

where G_Y and $C_{Y,X}$ are Gini and concentration coefficients for vector of income after taxation (**Y**).

No-reranking principle postulates the same order of incomes before taxation (vector **X**) and after taxation (vector **Y**). Every case of re-ranking causes change in income order, thus increasing value of S_3.

The nature and importance of three above mentioned effects (S_1, S_2 and S_3) differ considerably. The most serious violation of tax equity is measured by S_3 – taxation should not cause changes in income ordering (before and after taxation). Slightly less important is postulate 1. Violation of this principle means that richer taxpayers pay lower tax than poorer. Such a situation, possible in case of some other taxes, is generally not acceptable in case of income taxation. The least serious are violations of progression principle. This controversial rule, concerning progressivity of tax rates (not only tax amounts), can be quite easily violated.

It is worth mentioning that all definitions given above suggest that both income and tax are given in currency units. This, however, does not reflect the original idea of Kakwani and Lambert (1998). They suggest analysis in welfare units: application of this idea demands usage of equivalent income instead of nominal one. The suitable procedure is characterized in the next section.

3. SCALES OF EQUIVALENCE IN THE ASSESSMENT OF A TAX SYSTEM

The main disadvantage of analyses made in income (currency) units is one-dimensional character. The only aspect taken into account in such a case is income. The direct consequence of this approach is neglecting of non-income characteristics: household composition, health status and so on. Such simplification, however, could result in erroneous conclusions.

One of the possible methods to face this problem is an application of equivalence scales. They enable transformation of nominal incomes into equivalent ones:

$$x^e = x/e$$

where x denotes nominal income, x^e – equivalent income and e – equivalence scale. Unlike nominal, equivalent income hold the information concerning non-income characteristics. In most cases scale depends on demographic structure of taxpayer's household, but the set of factors could be extended.

In the next of this paper, two equivalence scales will be used:

- modified OECD scale:

$$e\left(n_i^a, n_i^c\right) = 1 + 0,5(n_i^a - 1) + 0,3n_i^c,$$

  wheren_i^a denotes number of adults in i-th household (household of i-th taxpayer) and n_i^c – number of children in i-th household.
- Cutler scale:

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

  where $0 \leq \alpha \leq 1, \quad 0 \leq \beta \leq 1$ are parameters.

Both scales take into account only household demographic structure that is considered as the most important factor, influencing tax capacity of taxpayers.

The first one – modified OECD – is the scale adopted by the Statistical Office of the European Union (EUROSTAT). Choice of this scale could be justified in two ways. Firstly, analysis concerns fiscal policy and should be based on the official parameters. Secondly, this scale seems to be quite well adjusted to the actual situation of Polish households (Betti, 1999).

The second scale is more flexible and can be adjusted to the situation of a specific population: by choosing values α and β, relative cost of adults and children is being defined respectively. This scale offers a wide spectrum of possible outcomes. Therefore, it was chosen as a reference point for the official scale in order to assess the impact of changes in the equivalence scale on tax system characteristics.

In case of this scale, two procedures for choosing parameters' values can be applied. In the first one, values of α and β can be arbitrarily chosen and then tax system characteristics are assessed for these values. The second one is the quest for equivalence scale that is implicitly written in the transfer policy (tax system). As suggested by van de Ven and Creedy (2005), this implicit scale could be approximated by the scale that minimizes horizontal inequity – S_3 coefficient in KakwaniLambert decomposition. This approximation, described by van de Ven and Creedy (2005), was the

main argument for this scale. Moreover, results presented in the next of this paper suggest that the choice of equivalence scale is not crucial in this kind of analyses.

4. WELFARE CONSEQUENCES OF TAX INEQUITY

The main arguments for progressivity in taxation concern improvement in social welfare. Thanks to redistribution of income from richer to poorer taxpayers, the social welfare is improved – under certain assumptions – by progressive taxation. Assuming utilitarian-type social welfare function and diminishing marginal utility of income, reduced-form social welfare function can be defined as (Cowell, 2000)

$$W = \bar{y}(1 - G_Y) \tag{6}$$

where $\bar{y}$ denotes mean income after taxation. Despite very strong assumptions (intensely discussed for about one century), utilitarian-type social welfare functions are often used in empirical analyses. And its reduced form seems to be coherent with definition of tax inequity, adopted in this paper. Presented analysis of tax inequity is entirely based on inequality indexes, and this form of welfare function offers direct linkage between welfare and inequality.

Having defined social welfare function and decomposition of redistribution coefficient, we could define the change in social welfare, being a consequence of income taxation:

$$\Delta W_{actual-taxation} = W_{post-tax} - W_{pre-tax} = \bar{y}(1 - G_Y) - \bar{x}(1 - G_X).$$

Taking into account that (cf. formula 5):

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

maximal redistribution for taxation with all inequities removed, is given by:

$$V = G_X - G_y + S_1 + S_2 + S_3.$$

Then, assuming no changes in distribution of income before taxation and in average income after taxation (removing inequities should not influence overall tax amount), we have:

$$\Delta W_{ideal-taxation} = W_{post-tax} - W_{pre-tax} = \bar{y}(1 - G_Y + S_1 + S_2 + S_3) - \bar{x}(1 - G_X).$$

Then, change in social welfare, resulting from tax inequities, can be written as follows:

$$\Delta W_{inequities} = \Delta W_{actual-taxation} - \Delta W_{ideal-taxation} = \bar{y}(-S_1 - S_2 - S_3) \tag{7}$$

Analogously, loss in welfare, resulting from horizontal tax inequity, will be defined as:

$$\Delta W_{horizontal\ inequity} = \bar{y}(-S_3) \tag{8}$$

Formula (7) takes into account all three effects, distinguished in decomposition of

redistribution coefficient and considered as violation of tax equity. Formula (8) concentrates on horizontal inequity that could be identified with reordering of incomes.

5. EMPIRICAL RESULTS FOR POLISH TAX SYSTEM

Empirical analysis of redistribution, tax inequity and their impact on social welfare will be performed for Polish personal income tax system. Data used in this analysis concern fiscal year 2001 and come from two sources.

The first data set includes information on tax returns from two Lower-Silesian tax offices – Wroclaw and Walbrzych. This set includes complete data on income before taxation and taxes from 130 524 tax returns (some taxpayers were taxed individually and some jointly with a spouse). This data could be acknowledged as the most reliable data available even though the information about shadow economy is completely missed. However, it concerns only two tax offices, and analyzed population is significantly richer than whole the population of Polish taxpayers. Average income before taxation was equal to 21 204 PLN (about 5 780 EURO) per taxpayer in the analyzed data set, comparing to 16 662 PLN (4 542 EURO) per taxpayer for the whole population (Ministry of Finance, 2002). But it seems not to be an important disadvantage in the context of the aim of this paper.

The most serious fault of this data is that it holds no information on the taxpayers' household composition (besides the information about joint taxation of spouses). To overcome this problem, the data from tax returns was supplemented with data from Household Budget Survey. Results of this survey – conducted yearly by Polish Central Statistical Office on the sample of about 32 000 randomly chosen households (31 847 households in year 2001) – offer both information on income and demographic characteristics of each household. Reliability of this data, however, seems to be far lower – especially in terms of income and taxation.

To combine these two sources of data, we have decided to split data from both sets into classes with respect to the income. For each class in the HBS data set, we have calculated percentage of couples and singles with certain number of dependent children. On the basis of such distributions we have randomly attributed children to couples and single taxpayers in respective income brackets.

In this way we have obtained the final data set, comprising of 130 524 households – singles and couples, with and without children. Then, for each household we had the information about taxable income, taxes paid, number of adults (one or two) and number of children.

As suggested in Section 3, choice of an equivalence scale is generally considered as arbitrary. Therefore, before going to the welfare analysis, influence of equivalence scale on the decomposition of redistribution coefficient was verified.

In Table 1 there are presented results of decomposition for the OECD modified scale. For this official scale actual redistribution (*RE*) is 2.53%. This means that 2.53% of the overall income is transferred – as a result of non-proportional income taxation – from richer to poorer taxpayers. This value, however, could be signifi-

cantly higher. Loss in redistribution (*RL*), being a consequence of postulates' violation, amounts at 1.64%. In case of a system satisfying all Kakwani-Lambert's postulates, expected redistribution (*V*) would achieve 4.16%.

TABLE 1. - *Decomposition results for modified OECD equivalence scale*

RE	V	S1	S2	S3	RL
2.53%	4.16%	0.37%	1.24%	0.03%	1.64%

What is worth observing, the main source of redistribution loss is a consequence of violation of postulate 2 (measured by S_2). The worst kind of ''errors'' – reversal of taxpayers' ordering before and after taxation – causes only slight loss ($S_3 = 0.03\%$).

The modified OECD scale, being one of the official scales, does not require choosing their parameters. This is, however, not the case for Cutler scale. Before starting calculation, values for α and β have to be chosen. To reduce arbitrariness of this choice, authors decided to get values that minimize reranking of incomes (S_3). As mentioned above, these values are supposed to reflect implicit tax scale, i.e. the scale that implicitly results from tax rules. This implicit scale is not officially known and could be deduced from actual tax distribution. The dependence of α and β parameters on S_3 values is presented in Figure 1.

Minimal values of S_3 are observed for $\alpha = 0.1$ and $\beta = 0.5$ and a resulting scale takes the form:

$$e\left(n_i^a, n_i^c\right) = \left(n_i^a + 0,1 n_i^c\right)^{0,5}$$

This form of equivalence scale suggests that presence of children is generally not considered by the tax law ($\alpha = 0.1$). Obtained results seem to be coherent with authors' intuition concerning Polish personal income tax system.

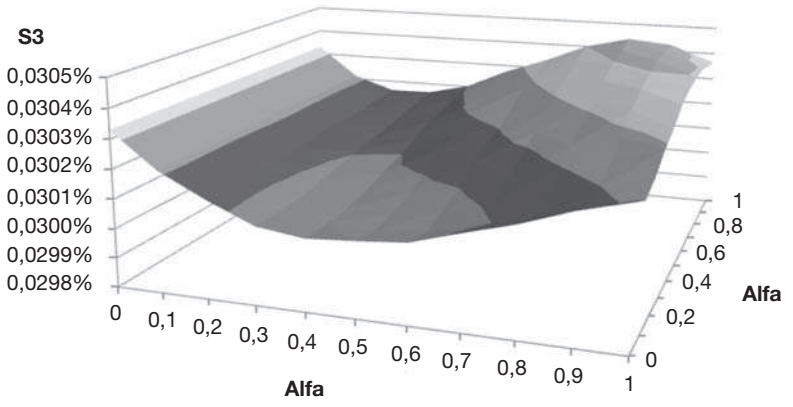

FIGURE 1. - *Influence of equivalence scale on reranking measure* S_3

Results of the decomposition for the reranking-minimizing Cutler scale are given in Table 2. These indices would help to determine the welfare consequences of differences between the unknown scale, implicitly written in the tax code, and the official (and well reflecting actual costs of living) modified OECD scale. Discrepancies between the results obtained for these two scales could be treated as an additional factor increasing tax inequity.

TABLE 2. - *Decomposition results for reranking-minimizing equivalence scale*

RE	V	S1	S2	S3	RL
2.41%	4.31%	0.34%	1.53%	0.03%	1.90%

Decomposition results indicate slightly lower actual redistribution and slightly higher expected redistribution in case of the Cutler scale. Higher value of V is mainly a consequence of significantly higher S_2. It means that changing the equivalence scale does not influence the most important characteristics of the tax system (measured by S_1 and S_3), but changed a situation in the field of actual progression of tax rates.

Estimates of redistribution coefficient and its decomposition enable us to assess welfare consequences of personal income tax. For the official, modified OECD scale and average EUR/PLN rate in year 2001, following results have been obtained:

- welfare level:

  $W = \bar{y}(1 - G_Y) = 3763$ EURO,

  loss of welfare resulting from overall tax inequity:

  $\Delta W_{inequity} = \bar{y}\left(-S_{1,OECD} - S_{2,OECD} - S_{3,OECD}\right) = -120$ EURO,

- loss of welfare resulting from horizontal tax inequity:

  $\Delta W_{horizontal\ inequity} = \bar{y}\left(-S_{3,OECD}\right)$ before -2.37 EURO.

Welfare level was assessed under assumption that welfare function takes the form given by formula (6). Value W may be interpreted as the income level in the hypothetical, perfectly equal population. This equally distributed income is supposed to ensure this hypothetical population the same social welfare level as observed in analyzed population, characterized with certain inequality (equally distributed equivalent – Duclos and Araar, 2006). Analogously, losses of welfare denote decrease in value of this equally distributed income.

Presented results suggest that influence of ''errors'' in Polish personal income tax system is generally not substantial. Especially low values are observed for welfare loss, being a consequence of reranking of incomes.

Very similar results are obtained for Cutler, reranking-minimizing scale. Minimal value of S_3 for this scale is $S_{3,Cutler} = 0.0300\%$, while for OECD modified scale

$S_{3,OECD} = 0.0322\%$. Calculating change in welfare (related to overall inequity and horizontal inequity respectively) caused by the change of scale, we got:

$$\Delta W_{scale,\ overall\ inequity} = \\ = \bar{y}\left(S_{1,IS} + S_{2,IS} + S_{3,IS} - S_{1,OECD} - S_{,OECD} - S_{3,OECD}\right) = -19 \text{ EURO},$$

$$\Delta W_{scale,\ horizontal\ inequity} = \bar{y}\left(S_{3,IS} - S_{3,OECD}\right) = -0.16 \text{ EURO}.$$

6. CONCLUSIONS

Obtained results suggest that welfare consequences of progression in the Polish personal income tax are not very significant. Although observed redistribution level is comparable to other developed countries, there is no unambiguous answer to the question, if such a change in welfare justifies progressivity in taxation. Of course, this remark does not diminish importance of other argument for progressivity, such as regressive character of Value Added Tax and other consumption taxes.

Rather low impact of progression and redistribution on social welfare does not depend on equivalence scale applied. For both analyzed scales, estimates of main indexes were quite similar.

The presented analysis suggests that Polish personal income tax system should be judged as quite good. The most important system ''errors'', as regressivity or reordering of incomes, are not at a significant level. This positive evaluation, however, is restricted by some important assumptions. The most important of them is the assumption concerning lack of family taxation: the present system acts well only for individual taxation. When we change point of view and try to take into account household characteristics of the taxpayer, analyzed system (from the year 2001) seems to be completely inadequate and unjust.

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RIASSUNTO

L'effetto redistributivo della tassazione è ampiamente analizzato nella letteratura, in cui in generale si afferma che la redistribuzione effettiva dipende sia dal regime di tassazione sia dagli effetti non voluti della tassazione, come il reranking dei redditi. In letteratura, sono state proposte diverse scomposizioni dell'indice di redistribuzione con il fine di separare le due componenti. Nel presente lavoro si analizza la scomposizione proposta da Kakwani e Lambert (1998), i quali presentano tre principi di equità fiscale e tre misure di disuguaglianza ad essi collegate. I risultati di tale scomposizione vengono applicati nel presente lavoro al fine di individuare una scala di equivalenza che risulta, implicitamente, dalla costruzione di un sistema fiscale. Sulla base dei risultati della scomposizione e della scala di equivalenza implicita individuata, si studia infine la disuguaglianza del sistema fiscale polacco e le sue conseguenze sul sistema di welfare. Le analisi proposte si basano sui dati provenienti dagli uffici fiscali e dall'ufficio statistico centrale.

REFERENCES

Aronson J.R., Johnson P., Lambert P.J. (1994). Redistributive Effect and Unequal Income Tax Treatment. *The Economic Journal*, **104**, 262-270.

Betti G. (1999). Nonparametric equivalence scales with application to Poland. *Statistics Research Report*, London School of Economics, **49.**

Boadway R., Keen M. (2000). Redistribution. In Atkinson A., Bourguignon F. (Eds.), *Handbook of Income Distribution, vol. 1* (pp. 677-789). Elsevier Science, Amsterdam.

Cowell F.A. (2000). Measurement of Inequality. In Atkinson A., Bourguignon F. (Eds.), *Handbook of Income Distribution, vol. 1* (pp. 87-166). Elsevier Science, Amsterdam.

Duclos J.-Y., Araar A. (2006). *Poverty and Equity: Measurement, Policy and Estimation with DAD*. Springer, New York.

Hall R.E, Rabushka A. (1995). *The Flat Tax.* Hoover Institution Press, Stanford.

Kakwani N. (1980). *Income Inequality and Poverty: Methods of Estimation and Policy Applications.* Oxford University Press, New York.

Kakwani N., Lambert P.J. (1998). On measuring inequity in taxation: a new approach. *European Journal of Political Economy*, **14**, 369-380.

Lambert P.J. (1999). Redistributional Effects of Progressive Income Taxes. In Silber J. (Ed.), *Handbook of Income Inequality Measurement* (pp. 485-511). Kluwer Academic Publishers, Dordrecht.

Lambert P.J. (2001). *The distribution and redistribution of income.* Manchester University Press, Manchester.

Ministry of Finance of the Republic of Poland (2002). *Information concerning personal income tax in year 2001*. Warszawa (in Polish).

Sen A.K. (2000). Social Justice and Distribution of Income. In Atkinson A., Bourguignon F. (Eds.), *Handbook of Income Distribution, vol. 1* (pp. 59-85). Elsevier Science, Amsterdam.

Urban I., Lambert P.J. (2008). Redistribution, horizontal inequity and reranking: how to measure them properly. *Public Finance Review*, **36**, 563-587.

van de Ven J., Creedy J., Lambert P.J. (2001). Close equals and calculation of the vertical, horizontal and reranking effects of taxation. *Oxford Bulletin of Economics and Statistics*, **63**, 381-394.

van de Ven J., Creedy J. (2005). Taxation, Reranking and Equivalence Scales. *Bulletin of Economic Research*, **57**, 13-36.

Vernizzi A., Pellegrino S. (2008). On Determining ‘‘Close Equals Groups’’ in Decomposing Redistributive and Reranking Effects. *SIEP University of Milan Working Paper*, **602.**