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by

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DISCUSSION
PAPER

Redistributive effects of the shift from Personal Income Taxes to Indirect Taxes: Belgium 1988 - 1993*

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Abstract

Between 1988 and 1993 the Belgian personal income tax system and the indirect tax system have been reformed to a considerable extent. We use microsimulation models to investigate the impact of the reform on the liability progression and the redistributive effect of the combined tax system. The redistributive effect of personal income taxes decreased, notwithstanding an increase in liability

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progression. For indirect taxes, both the liability regressivity and the reverse redistributive effect have been enhanced. We use recently developped statistical tests to gauge the significance of the observed changes.

KEY WORDS: Personal Income Taxes, Indirect Taxes, Tax Reform, Post tax Income Redistribution, Tax liability Redistribution.

JEL Classification: D63, H24

1. Introduction

Between 1988 and 1993 the Belgian personal income tax (PIT) system has been reformed to a considerable extent. Major elements of this reform were the reductions of the top rates, broadening of the tax base and a move from joint taxation into the direction of individual taxation. The whole set of measures implied a tax cut. This revenue loss was partly compensated by an increase in indirect taxes over the period between 1988 and 1993. Simulations show that, despite the increase in indirect taxes, the global tax revenue decreased with 4% (see Decoster, Standaert, Valenduc and Van Camp, 1998, p. 65). The PIT reform, in combination with the reform in the indirect tax system, also led to a change in the mix of both instruments. In 1988, PIT made up 57.8% of the joint PIT and indirect tax revenue. But, its share decreased to 53.8% in 1993[1].

The Belgian PIT reform was very much in line with the Tax Reform Act of 1986 in the USA (TRA86), and hence with the type of income tax reform that swept the Western countries a large decade ago[2]. The shift in the direction of indirect taxes seems much less common. Although such a shift has been advocated for in several other countries, the UK seems to be one of the rare exceptions where it

[1] These shares are also based on the results of simulations in Decoster, Standaert, Valenduc and Van Camp (1998).

[2] See Messere (1998), p. 10 - 12 and Sommerhalder (1992).

really has been implemented[3]. Therefore we document on both reforms separately, and on their joint impact, in this paper.

While one might expect that the increased reliance on indirect taxes implies a regressive move, it is much less obvious to hypothesise about the impact of the PIT reform and consequently about the impact of the global tax reform. Indeed, the reduction of the top rates and base broadening have opposite effects on the tax liabilities to be paid after the reform. Moreover, in the aftermath of TRA86 much attention has been devoted to judge the impact of the PIT reform in the USA and these studies tend to come up with mixed evidence. Some argue that the reform increased progressivity while others say it went down[4].

As it turns out, the conclusions about TRA86 tend to depend on the progressivity concept that is used, on a number of data issues such as the exact tax concept, the income concept and the use of equivalence scales, and on modelling assumptions among which the assumptions about behavioural reactions seem to be the more important ones. Moreover, most studies do not take the recommendation to heart of Bishop, Chow, Formby and Ho (1997) to use statistical tools that check the significance of the changes in progressivity measures. Finally, these TRA86 studies used different data sets for the pre and post reform situation (viz. data sets preceding 1986, and data sets from after 1986). This brings in different pre-tax income distributions, which of course is relevant information if the objective consists of an evaluation of the overall change in the after tax income distribution. But, if the sole concern is to separate out the impact of the tax

[3] See Messere (1998), p. 8 and Giles and Johnson (1994).

[4] For a recent survey of a broad range of studies, see Auerbach and Slemrod (1997) and the references therein. For evidence that TRA86 decreased progressivity, see Bishop, Chow, Formby and Ho (1997).

reform itself, these different pre-tax distributions do more harm than good.

In this paper we try to avoid many of these pitfalls. The reform under study is the 1988 PIT tax reform in Belgium, followed by indirect tax increases up to 1993. We keep the pre-tax income distribution fixed by using the same data set to simulate the tax liabilities of the 1988 and the 1993 system. The simulations are carried out by means of two different microsimulation models, one for PIT, and one for indirect taxes. These models run on two different underlying data sets, but we combine the simulated tax liabilities into one single data set by the aid of a statistical matching technique.

Our aim is to sketch the impact of the tax reform on the redistributive power of the system. A quick plunge into the literature shows how manifold the meanings are, attached to the term "redistributive". Especially in the vulgarizing papers and publications, the distinction between "redistribution" and "progressivity" is often lost from sight[5]. The basic distinction is the one between the change in the after tax income distribution, provoked by the tax system, and the disproportionality of the tax system, measured as the deviation of the distribution of tax shares from the shares obtained from an equal yield proportional tax. Following Lambert (1993) we call the first concept "redistributive effect" and the second one "liability progression".

The Reynolds-Smolensky-index and the Kakwani-index, respectively, are one set of possible indices to summarize these two characteristics of a tax system, and the relation between the two is well understood. In this paper we present

[5]Many policy proposals contain prescriptions such as "designing the tax reform as distributionally neutral", notwithstanding the lack of a precise description of what is meant by this. TRA86, however, is one of the rare exceptions that did specify this distributional neutrality, viz. as equal percentage reductions in tax liabilities at all income levels (see Mc Lure and Zodrow, 1987, p. 44). Clearly, this refers to keeping the *liability progression* constant.

these indices and their standard errors, both for PIT, the indirect taxes and the global system before and after the reform. But our microdata also allow us to go further. In addition to the indices themselves, we likewise provide the detailed Lorenz and concentration curves, underlying these indices. This not only gives a more detailed picture of the effect of the tax reform through the income scale. The main advantage lies in the avoidance of the choice of specific aggregation procedures, indispensably associated with index values. In this we follow the approach, fruitfully applied by Bishop, Chow, Formby and Ho (1997) for TRA86. Moreover, some recently published papers provide the tools to take into account the importance of the sampling errors when Lorenz and concentration curves are compared[6].

In section 2 we discuss the simulated reforms. Section 3 deals with the data and the simulation models that have been used. The methodology to measure the redistributive effect and the liability progression is summarized in section 4, and empirically applied to the Belgian tax reform in section 5. Section 6 concludes.

2. The simulated tax reforms

2.1. The reform of the personal income tax system[7]

The first major element of the tax reform was "base broadening". Many deductions, applied on gross income, were discarded and replaced by tax credits. Therefore, the concept of "taxable income" was altered significantly by the reform. The

[6] See Bishop, Chow and Formby (1994) and Davidson and Duclos (1997).

[7] We sketch the major differences between the 1988 and 1993 PIT system. Hence, so to speak, *the reform* refers to all the measures that have been implemented between 1988 and 1993, although they have not been realised by a single tax reform act. Note that if we refer to 1988 or 1993 for the PIT system, that this implies reference to the administrative tax years 1989 or 1994, respectively.

reform also tightened the possibilities to deduct costs from professional income such as expenses on visiting restaurants and professional clothing. Before the reform, expenses on life insurance contracts were treated partly as a deduction and partly as a tax credit, while after the reform they are entirely treated as a tax credit. This uniformisation has led to a tightening of the compensations for life insurance contracts in the tax system after the reform. In the 1988 PIT system capital redemptions due to mortgage loans, payments to group insurance contracts and contributions to private pension funds could be deducted. The 1993 PIT system uses tax credits instead of a deduction in all these cases. The reform also installed a more generous deduction for charity gifts and some expenses for child care could be deducted after the reform, while not before the reform. But in general, the deduction possibilities were more restricted after the reform.

Secondly, taxable income was imported into different tax schemes before and after the reform. Three major differences can be distinguished.

- A thorough *restructuring of the tax rates*: broader and less brackets, lower marginal tariffs at the top.
- The zero rate bracket, applied before the reform, was abolished. After the reform basic allowances were installed to compensate for family structure (e.g. spouse and dependent children).
- Full *separate taxation* of the main income earned by spouses (labour income, unemployment benefits, pensions, etc.) after the reform.

The reform has reduced the number of tax brackets from 14 to 7. Especially, the changes for the higher income levels are striking. Before the reform 4 different rates ranging from 56.5% to 70.8% were applied on income above BEF 1,574,000. After the reform, these income levels only face rates of 52.5% or 55%.

Before the reform the first bracket of the scheme (BEF 0 to BEF 120,000) was a zero rate bracket and dependent children entitled the taxpayer to tax credits. The reform substituted "exemptions from the bottom up" for the zero rate bracket, and made this basic allowance a function of household composition (i.e. being married and having dependent children). The basic allowance in 1993 amounts to BEF 186,000 for a single person, and BEF 146,000 for each partner of a married couple. Dependent children push the exemption level up by BEF 39,000, BEF 62,000, BEF 127,000 and BEF 141,000 for the first, second, third and fourth child respectively.

Full separate taxation of professional income and the creation of the "wedding - fraction" for spouses was one of the core elements of the PIT reform. Before the reform a rather low joint income ceiling determined whether professional income of a two-income earner family was taxed jointly or separately. Above the threshold, joint taxation was the rule, which in a progressive system could lead to a large discrepancy in the amount of taxes paid by a married couple as compared to a cohabitating, but non - married, couple. To cope with this problem, the new system attributes to each partner the income components that are associated with his own professional activity. This separate income concept covers wages and salaries paid to employees but also replacement incomes such as unemployment benefits and retirement pensions. Other sources of income, such as real estate income or income from movable property, are still attributed to the partner with the highest amount of professional income. To compensate families with only one income earner for this "favourable" tax treatment of double income families, the system of "wedding - fraction", designed to cope with unequally distributed household income, was continued and enlarged. If one of the spouses earns less than 30% of the total amount of professional income of the couple, this partner is attributed an amount as if he would have earned this 30%[8]. The income of the other partner is reduced with this amount. This reshuffling of taxable income among spouses is limited to an amount of 297,000 BEF in the 1993 PIT system.

2.2. The reform of the indirect tax system

The main change in the indirect tax system took place in April 1992. This reform intended to bring the Belgian indirect tax system more in line with EC recommendations that prescribed a normal rate of at least 15% and one or two rates of at least 5%. Before the reform, seven different VAT rates were applied (0%, 1%, 6%, 17%, 19%, 25% and 33%). The newly installed government decided to drop the rates of 17%, 25% and 33%. The normal rate became 19.5%. The reduced rate of 6% was maintained and a second reduced rate of 12% was introduced. Hence, still five different VAT rates are applied after the reform (0%, 1%, 6%, 12% and 19.5%).

To compensate for the decrease of the VAT rate on car fuels, excises on these products were simultaneously increased. This increase in excises was only one step in a continuous increase of excise taxation on these products during the period of investigation. Per litre of gasoline, the consumer paid an excise of 11.2 BEF in 1988 and 18.45 BEF in 1993. For gasoil the figures are respectively 5.25 BEF in 1988 and 11.33 BEF in 1993. The same continuous increase in excise holds to a lesser extent for cigarettes, although in this case it has been offset partially by

[8] Note that this system also applies for two income earner families, if the wedding fraction produces a lower tax liability than the separate taxation does.

a decrease in the ad valorem tax. The excises on most other products remained constant throughout the studied period, which implies an effective decrease of the tax burden. The impact on the consumer price of gasoline (+31%), gasoil (+39%) and tobacco products (+12%) has been substantial. The abolition of the VAT rate of 33% and of 25% shows up in a price decrease of durables (-3%).

3. The data and simulation of the reforms

We use two different microsimulation models, with different data sets, to simulate the PIT reform and the indirect tax reform. We combine these data sets with a statistical matching procedure, to end up with a single data set that could be used to evaluate both reforms.

Personal Income taxes are simulated with the microsimulation model SIRe, which uses a sample of administrative data[9]. This sample, referred to as IPCAL, consists of 10,343 tax forms entered in 1994[10]. As a consequence the units of observation are administrative units. In principle these units are individuals, since each Belgian citizen that is gaining a sufficient amount of income has to enter a tax form separately. However, married couples enter only one tax form. People with income below some threshold do not have to enter a tax form[11]. Therefore, the sample does not cover the whole population.

Both the 1988 and 1993 PIT system have been simulated on the same data set[12]. Since no behavioural responses were available in SIRe, gross income is kept

[9] See Standaert and Valenduc (1996) for more information on SIRe.

[10] Hence, the reported income figures are expressed in prices of 1993.

[11] For some people, such as those receiving only replacement income, it is obvious that they will not have to pay income taxes. After a number of years these people do no longer receive a tax form from the administration. They only have to contact the administration if their income condition has changed.

[12] To express nominal figures in the tax legislation of both systems at the same level, we used

constant between 1988 and 1993.

The indirect tax reforms are simulated with the microsimulation model ASTER[13]. The basic data set of this model is a household budget survey. This survey covers 3,235 households and has been designed as a representative sample of all households living in Belgium. A household is defined as all people living under the same roof, using the same accommodation and deciding commonly on their expenditures. The households in the survey have been asked to register their expenditures between May 1987 and May 1988. Besides the very detailed expenditures at the household level, the budget survey also contains information on labour income and most social security benefits of the individual household members. However, since all income information in the budget survey is net of taxes, it was not possible to simulate the PIT reform on this data set. Hence, we only used the budget survey to simulate the indirect tax liabilities before and after the reform of the indirect tax system. The detailed demand system, available in ASTER allowed to take account of behavioural reactions provoked by the change in relative prices, and real income. The total amount of household expenditures was kept constant for the simulation[14].

A major problem consists of the difference in the unit of observation for both data sets. The budget survey contains households. IPCAL is a set of administrative units. Since the information needed to combine these administrative units in IPCAL into households is not available, households in the budget survey are

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the change in the consumption price index. This index increased from 100 to 115.8 between 1988 and 1993. See Ministerie van Financiën (1994), p. IV.4.

[13] See Decoster (1995) and Decoster, Delhaye and Van Camp (1996) for more information on ASTER.

[14] This amounts to the assumption that the change in disposable income, provoked by the PIT reform, is completely absorbed into savings.

first split into administrative units, similar to those used in IPCAL. To do so, we apply the administrative rules on the information that is available in the budget survey. We then inflate the nominal variables in this disentangled budget survey, to make the levels comparable with those observed in IPCAL[15]. Since the adapted budget survey and IPCAL have a number of variables in common, we can establish a link between the two data sets by minimizing a distance function over these common variables. In Decoster, Standaert, Valenduc and Van Camp (1998) and in Decoster and Van Camp (2000) we describe how we have applied a statistical matching technique to combine both data sets[16]. By the aid of this link, we can transfer the simulated PIT liabilities from IPCAL to the disentangled budget survey. Simply summing then the PIT liabilities of all administrative units within a single household, results in PIT liabilities expressed at the household level. Hence, after this operation, we dispose of PIT and indirect tax liabilities for all households in the budget survey, both before and after the reform.

4. Measurement of redistributive effect and of liability progression

To provide insight in the operation of the different tax systems, we compare distributions realized under the actual tax system with those that would be achieved under an equal yield proportional tax. It is common practice to implement this idea by the aid of the Lorenz curve of pre-tax incomes and concentration curves of post tax incomes and tax liabilities[17]. This approach provides an intuitive view on

[15] The factor we used to inflate these figures is 1.404. This factor captures the nominal growth of national income in the National Accounts between 1987 - 88 and 1993.

[16] See, e.g. Rodgers (1984) on statistical matching

[17] See, among others, Kakwani (1986), Pfähler (1987), Duclos (1993), Lambert (1993), Chapter 7 and Bishop, Chow, Formby and Ho (1997). In this section we only assemble the elements

the impact of the different tax systems. Moreover, statistical tools to test whether these curves differ significantly or not, are directly available.

The Lorenz curve of the pre-tax income variable X is defined in equation (4.1):

$$L_{X;X}(p) = \int_0^y \frac{xf(x)dx}{\mu} \qquad 0 \leq p \leq 1 \qquad and \qquad p = F(y) \qquad (4.1)$$

where $f(x)$ and $F(x)$ refer to the density function and the cumulative distribution function of the pre-tax income variable X, respectively. Throughout we will use the first term in the subscript of L to denote the variable that is used to order the data in ascending order and the second term to denote the variable of analysis. The average amount of pre-tax income is defined by μ, and y denotes the quantile value of X that corresponds with the population share p. The curve in equation (4.1) also provides a summary of the post tax income and tax liability distribution that would realize in the counterfactual proportional tax system with the same revenue as the actual tax system[18].

To measure the redistribution of after tax incomes, provoked by the non-proportional system in comparison with the proportional one, one compares the Lorenz curve in (4.1) with the concentration curve of post tax income, defined in equation (4.2):

$$L_{X;M}(p) = \int_0^y \frac{(x - t(x))f(x)dx}{\mu(1-t)} \qquad 0 \leq p \leq 1 \quad and \quad p = F(y) \qquad (4.2)$$

where we use $t(x)$ to denote the tax liability corresponding with income level x, and t to refer to the overall average tax rate, defined here as the total amount

from this literature which are relevant for the empirical section. Our notation follows quite closely Lambert (1993).

[18] See Lambert (1993), p. 48-49.

of taxes divided by the total amount of pre-tax income. M symbolizes the post tax income variable, X - T.

The comparison of both curves then reveals how the post tax income shares of the actual tax system are distributed, compared to those of the proportional tax system. Hence, the measure $IR(p)$, defined in equation (4.3), can be interpreted as the fraction of post tax income that is shifted from high incomes (the top $100(1-p)$ percent) to low incomes (the bottom $100p$ percent) because of the disproportionality of the tax system[19].

$$IR(p) = L_{X;M}(p) - L_{X;X}(p) \tag{4.3}$$

From (4.3) we proceed in two directions. The first is the common practice of aggregating $IR(p)$-values over the p-range, to end up with one single index value for the redistributive effect. Best known in this case is the index proposed by Reynolds and Smolensky (1977):

$$\begin{aligned} \Pi^{RS} &= 2\int_0^1 \left[L_{X;M}(p) - L_{X;X}(p)\right] dp \\ &= 2\int_0^1 IR(p)dp \end{aligned} \tag{4.4}$$

Of course disposing of an aggregate index of redistributive effect comes at a price, and Π^{RS} is to the $IR(p)$-curve as the Gini coefficient is to the Lorenz curve: detail is lost and eventually more general dominance results are foregone in the process of aggregation. Therefore, after the presentation of the indices

[19]This is a slightly restated version of the interpretation given in Lambert (1993), p. 182 since the tax liabilities in our empirical exercise are defined by more than income alone. IR is an abreviation of post tax Income Redistribution.

in section 5.1, we will also present and discuss the $IR(p)$-curves themselves in section 5.2.

The second track we follow in the presentation of the results is a less common one. The *cumulative* nature of the values of the $IR(p)$-curve, is essential to get dominance results. But it hampers the analysis in terms of mutually exclusive income groups (like deciles). Therefore we will also present the difference in $IR(p)$ for two consecutive population shares:

$$\Delta IR(p_i) = IR(p_i) - IR(p_{i-1}) \tag{4.5}$$

Multiplied with the population share of this income group $(p_i - p_{i-1})$ this gives the amount of post tax income which accrues to, or is taken from, the income group in the interval $[p_{i-1}, p_i]$ as a fraction of the total amount of post tax income, by the redistribution of the tax system[20]. In fact (4.5) identifies gainers and losers of the non proportionality of the tax system as compared to the proportional one. In section 5.3 we will analyse the impact of the tax reform from this perspective.

Evidently, the redistribution of post tax income, captured in (4.3),(4.4) and (4.5) is ultimately based on the disproportionality of the tax liabilities. Hence, alternatively, one can also focus on these tax liabilities, whose concentration curve is defined as follows:

$$L_{X;T}(p) = \int_0^y \frac{t(x)f(x)dx}{\mu t} \qquad 0 \leq p \leq 1 \qquad and \qquad p = F(y) \tag{4.6}$$

The comparison of (4.1) and (4.6) then provides insight in the differences

[20] The individual at position p_i is taken as a representative agent for individuals within the interval $[p_{i-1}, p_i]$.

between the tax shares of the actual tax system and those of the proportional tax system. Similarly to the $IR(p)$-curve we can define the measure $TR(p)$:

$$TR(p) = L_{X;X}(p) - L_{X;T}(p) \tag{4.7}$$

to be interpreted as the fraction of the total tax burden that is shifted from low incomes (the bottom $100p$ percent) to high incomes (the top $100(1-p)$ percent) because of the disproportionality of the actual tax system[21].

Integration of $TR(p)$ over the p-range now yields the Kakwani (1977) index of liability progression:

$$\begin{aligned} \Pi^K &= 2\int_0^1 [L_{X;X}(p) - L_{X;T}(p)]\,dp \\ &= 2\int_0^1 TR(p)dp \end{aligned} \tag{4.8}$$

In section 5.1 we will present the Π^K-indices before and after the reform, and in section 5.2 we sketch the $TR(p)$-curves to investigate the dominance character of the results. Also for the $TR(p)$-curves, the presentation of differences $TR(p_i) - TR(p_{i-1})$ will be useful to identify changes in liability progression for separate income groups.

It is well known that $IR(p)$ and $TR(p)$, and hence Π^{RS} and Π^K are intimately related. The relation is based on the identity (4.9):

$$L_{X;X}(p) \equiv tL_{X;T}(p) + (1-t)L_{X;M}(p) \tag{4.9}$$

which, after subtracting $tL_{X;X}(p)$ at both sides and reshuffling, results in equation (4.10).

[21] Again this statement differs slightly from the one given in Lambert (1993), p. 174 since we use tax liabilities from a heterogenous tax system in our empirical exercise. TR is an abbreviation of Tax Redistribution.

$$IR(p) = \frac{t}{1-t} TR(p) \qquad (4.10)$$

and after integration in

$$\Pi^{RS} = \frac{t}{1-t} \Pi^{K} \qquad (4.11)$$

Both equations (4.10) and (4.11) reveal the importance of the average tax rate t in the transformation of liability progression into the redistributive effect. Hence, in the evaluation of a single tax system both measures will show up with the same sign. But, if the values are compared over tax systems with different average tax rates (e.g. before and after a non revenue neutral tax reform), it is perfectly possible that $IR(p)$ decreases while $TR(p)$ increases. The same holds of course for Π^{RS} and Π^{K}[22].

Since $IR(p)$ is a comparison between a post tax and a pre-tax distribution, it might also be interpreted as the change in post tax income inequality because of taxation. However, if there is reranking, $IR(p)$ provides a biased estimate of this change in inequality[23]. Reranking can be captured as the difference between the post tax income concentration curve and the post tax income Lorenz curve[24]. The post tax income Lorenz curve is defined in equation (4.12).

$$L_{M;M}(p) = \int_0^z \frac{mg(m)dm}{\mu(1-t)} \qquad 0 \leq p \leq 1 \qquad and \qquad p = G(z) \qquad (4.12)$$

where, $g(m)$ and $G(m)$ denote the density function and the cumulative distribution function of the post tax income variable M, respectively. Now, z denotes the

[22] See Formby, Smith and Thistle (1990) and Silber (1994) on this point.
[23] See f.e. Lambert (1993), p. 185.
[24] See Duclos (1993), p. 353.

quantile value that corresponds with the population share p, given the distribution function G.

If there is no reranking, the measure $D(p)$, defined in equation (4.13), takes a value equal to zero at all population shares p.

$$D(p) = L_{X;M}(p) - L_{M;M}(p) \tag{4.13}$$

The values of $D(p)$ are by no means the focus of this paper. We only use the measure to check whether $IR(p)$ measures the inequality impact of taxes appropriately[25].

The ordinates of the Lorenz or concentration curves, corresponding with some predefined population share p, are estimated as the fraction of two sums. The sums, defined in equation (4.14), provide an estimate of the pre-tax income Lorenz curve.

$$\widehat{L}_{X;X}(p) = \frac{\sum_{i=1}^{n} w_i x_i I_{[0,\widehat{y}]}(i)}{\sum_{i=1}^{n} w_i x_i} \qquad 0 \leq p \leq 1 \qquad and \qquad p = \widehat{F}(\widehat{y}) \tag{4.14}$$

where

$$I_{[0,\widehat{y}]}(i) = \begin{cases} 1 & if \quad x_i \leq \widehat{y} \\ 0 & otherwise \end{cases} \tag{4.15}$$

In these equations, n is the sample size, w_i refers to the sample weight of observation i and $\widehat{\ }$ is used to denote estimated values. Similar estimators for $L_{X;T}(p)$ and $L_{X;M}(p)$ are obtained if one replaces x_i in equation (4.14) with t_i

[25] See Duclos (forthcoming) for a possible interpretation of this measure.

and m_i respectively. If one substitutes m for x and G for F in equations (4.14) and (4.15), one obtains an estimator for $L_{M;M}(p)$.

We obtain an estimate of the curves as a whole, by combining a number of ordinates, estimated for different values of p. Beach and Davidson (1983) derived that vectors of such estimators are multivariate normally distributed asymptotically. Davidson and Duclos (1997) extended these results for vectors with differences between two dependent ordinate estimators, as is required for differences between estimators of Lorenz and concentration curves[26]. They proved that such vectors have an asymptotically multivariate normal distribution as well, and give an expression for the asymptotic covariance matrix.

All elements of the covariance matrix, except the conditional expectations of the concentration curve variables, can be estimated in a straightforward way from the expressions they provided. We estimated these conditional expectations of the concentration curve by aid of a Gaussian Kernel estimator[27].

Since there is no obvious criterion to select the population shares for which ordinates should be estimated, any choice is arbitrary. We estimate the ordinates corresponding with *decile* population shares. Bonferroni t - intervals are used to test null hypotheses with respect to the curve as a whole[28]. We choose α equal to 5%. The critical value for a two sided test with 9 sub - null hypotheses and infinite degrees of freedom is then 2.78[29]. Seber (1977) explains that using Bonferonni t - intervals is more conservative than using the critical values from the Student

[26] Bishop, Chow and Formby (1994) provide similar theorems. But, they do not give an explicit expression of the elements of the covariance matrix, which makes their results less accessible for empirical implementation.

[27] See Silverman (1986). We used expression 3.28, p. 45 to determine the bandwidth.

[28] See Seber (1977).

[29] See Seber (1977), table 5.1, p. 131.

Maximum Modulus (SMM) distribution[30]. We did not use SMM values since no critical values were available for it with 9 sub - null hypotheses.

Also the aggregate indices and their corresponding standard errors can be derived from these ordinate estimates[31]. But this entails a loss of information, compared to procedures that use all sample values in the calculation. Bishop, Formby and Zheng (1998) demonstrate the asymptotic normality of Reynolds Smolensky and Kakwani indices and also provide expressions that use all sample values to determine the standard errors of these indices. Therefore, we use these authors results, to calculate the standard errors of the indices.

5. Empirical results

We order households on the basis of equivalized pre-tax income. This is constructed as the sum of DI_i^B, the disposable income of household i as it is registered in the budget survey, and PIT_i^B, the PIT liability of household i, paid before the PIT reform[32],[33]. To equivalize we use the OECD equivalence scales[34]. Also the tax liabilities are equivalized.

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[30] See Seber (1977), p. 130

[31] See Duclos (1997).

[32] The superscript B denotes the situation before the reform. The situation after the reform will get a superscript A .

[33] We do not use the pre tax income concept from IPCAL since some relevant income components, such as family allowances, are not taxed and thus not available in IPCAL. Disposable income in the budget survey covers all household income components.

[34] In this scale, the first adult is given a value of 1, each consecutive adult gets a weight of 0.7 and children counts for 0.5. One is considered a child until the age of 13.

5.1. Aggregate measures of redistributive effect and of liability progression.

Table 1 presents the Reynolds Smolensky measures of the respective tax systems. Not surprisingly, the PIT system shifts, on average, post tax income from top to bottom while the reverse is true for the indirect tax system. This holds both before and after the reform. The PIT system being quantitatively more important than the indirect tax system (see table 2 with the average tax rates), the combined tax system also shifts post tax income from top to bottom before and after the reform. Yet, the reform reduced the positive value of the Reynolds-Smolensky of PIT and it increased (in absolute value) the negative value of this index for the indirect tax system. Consequently, the reform eroded the redistributive effect of the combined system. The standard errors, presented in table 1, indicate that the index values, and the changes induced by the reform, are all statistically different from zero[35].

Table 1: Reynolds Smolensky measures of PIT, indirect and global tax systems

Redistributive effect	Personal Income Taxes (1)	Indirect Taxes (2)	Global Taxes (3)
before the tax reform	0.0596	-0.0077	0.0559
	(0.001860)	(0.000354)	(0.001991)
after the tax reform	0.0582	-0.0083	0.0541
	(0.001719)	(0.000360)	(0.001849)
change	-0.0013	-0.0006	-0.0019
	(0.000369)	(0.000035)	(0.000409)

standard error between brackets

[35] A two sided test with $\alpha = 0.05$ has been applied. The critical value $t_{\infty}^{0.025} = 1.96$.

Table 2: Average tax rates

tax rate	Personal Income Taxes (1)	Indirect Taxes (2)	Global Taxes (3)
before the reform	0.226	0.077	0.303
after the reform	0.211	0.080	0.291
change	-0.016	0.004	-0.012

Equation (4.11) clearly shows the two basic components of the redistributive effect of a tax system: the interplay of the average tax rate (given in table 2) and liability progression. The latter is presented in the form of the Kakwani index in table 3. Since, the average tax rate is always positive, the Kakwani index evidently appears with the same sign as the redistributive effect in table 1. Personal income taxes and the combined system are liability progressive. The indirect tax system is regressive. This holds both before and after the reform. But, due to changes in the average tax rates, the reform can provoke opposite changes in the Kakwani and Reynolds-Smolensky measures. For PIT this is indeed the case. Since the liability progression of PIT has been increased by the reform, the erosion of the redistributive effect of PIT is entirely due to the lower average tax rate. For the indirect taxes, both liability regressivity and the average tax rate increased, leading to an enhancement of the negative redistributive effect. Also the Kakwani indices and the changes therein, because of the reform, are found to be statistically different from zero.

Table 3: Kakwani indices of PIT, indirect and global tax systems

Liability progression	Personal Income Taxes (1)	Indirect Taxes (2)	Global Taxes (3)
before the tax reform	0.2036	-0.0928	0.1287
	(0.005349)	(0.004616)	(0.003980)
after the tax reform	0.2181	-0.0949	0.1316
	(0.005491)	(0.004442)	(0.003937)
change	0.0145	-0.0022	0.0029
	(0.000947)	(0.000468)	(0.000732)

standard error between brackets

These figures contradict the common opinion that the Belgian tax reform of the eighties, reduced redistribution because personal income taxes became less progressive. The reform did indeed lead to a smaller redistributive effect, but this occurred notwithstanding the increased liability progression of PIT. The erosion of the redistributive effect of the global system is due to a combination of two factors: on the one hand the reduction of the tax rate of the progressive PIT, on the other hand the increased reliance on the regressive indirect tax system, which became still more regressive by the reform.

As can be seen from equations (4.4) and (4.8), the Reynolds-Smolensky and Kakawani indices are one specific way of aggregating the underlying $IR(p)$- and $TR(p)$-values. Looking at these curves themselves not only gives a much more detailed picture of what happens at different points of the income distribution. It also allows to test whether the above conclusions are robust with respect to the specific aggregation procedures. This is the topic of the next subsections.

5.2. $IR(p)$- and $TR(p)$-curves

Figure 1a shows the nine estimated ordinates of the post tax income redistribution curves, before the reform[36]. Neither of the three $IR(p)$-curves changes sign. This provides us with a dominance result, and hence a generalisation of the results obtained in section 5.1. Besides the specific aggregation, implicit for Reynolds-Smolensky and Kakwani in equations (4.4) and (4.8) respectively, the conclusion of a positive redistributive effect for PIT and a negative one for indirect taxes, would result for any other aggregation procedure, with positive weights at each quantile share[37]. Moreover, we can always reject the hypothesis that the curves as a whole are equal to zero[38].

The estimated $IR(p)$ curves after the reform lead to the same conclusion. Moreover the post reform curves always lie below their before reform counterparts. Since the difference between the pre and post reform curves is too small to become visible in the same graph, we have chosen to present in figure 1b the difference $IR^A(p) - IR^B(p)$ (superscript A standing for after the reform, and superscript B for before the reform).

Take the case of PIT first. At each p-value, the curve in figure 1b is negative. This means that throughout the whole income range, less post-tax income is redistributed from top to bottom by PIT after the reform. One can say that the redistributive power of PIT decreased at all income levels. Hence also the change in the Reynolds-Smolensky measures, described in section 5.1, can be generalised on the basis of this dominance result. But, the statistical test of $IR^B(p)$ being not

[36] The figures underlying figure 1a and 1b can be found in table A.1 and A.2 of the appendix.
[37] See Duclos (1993).
[38] The detailed test results are given in columns 4, 8 and 12 of table A.1 in the appendix

significantly different from $IR^A(p)$ at all points, cannot be rejected. The reason is a non-rejection at the highest four estimated points[39]. Testing a similar hypothesis over the remaining part of the curve, the hypothesis that this remaining part is equal to zero, can be rejected[40]. Hence, there is evidence to say that there has been a significant decrease in the redistributive impact of PIT at the bottom half of the distribution.

Also for indirect taxes, the curve in figure 1b lies everywhere under the horizontal axis. In this case the overall statistical test reveals that the curve is statistically different from zero. Hence one can safely say that the redistribution from bottom to top by indirect taxes has been enhanced by the reform. Accordingly, the curve for the combined tax system reveals a diminished redistributive effect[41].

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[39] See column 4 of table A.2 in the appendix

[40] The critical values for a two sided test with $\alpha = 0.05$ and 5 and 6 sub null - hypotheses are 2.58 and 2.64 respectively. See Seber (1977), p. 131, table 5.1.

[41] Again the overall test of the curve being equal to zero cannot be rejected. In this case the non-rejection occurs at the three highest estimated points. Also in this case the remaining part of the curve is found to be significantly different form zero.

Figure 1a: IR(p) values Before the Reform

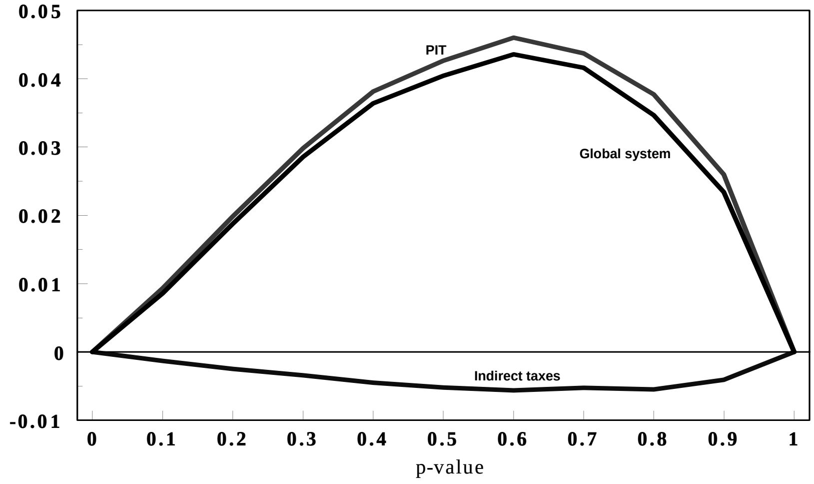
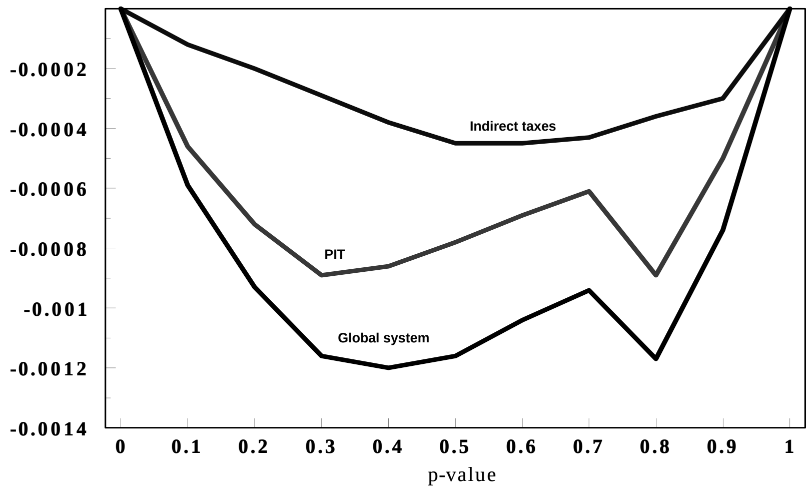


Figure 1b: Change in IR(p) values due to the reform



As far as liability progression is concerned, the same line of reasoning can be followed to generalize the conclusions based on the Kakwani-index. Figure 2a shows the $TR(p)$-curves for PIT, indirect taxes and the combined system before the reform[42]. Both before and after the reform (again we do not show the post reform curves), the curves are significantly different from zero. Hence, independently of the index used, the PIT system is progressive. At all income levels, part of the tax burden is shifted from bottom to top, when compared to a counterfactual proportional personal income tax. For indirect taxes the reverse is the case. Lower deciles face higher tax liabilities than would be the case with proportional indirect taxes. indirect taxes are regressive.

Figure 2b shows the change in $TR(p)$, provoked by the reform. The $TR(p)$ curve after the PIT reform lies entirely above the one before the reform. The hypothesis that the before and after reform curves are similar is rejected. Therefore, all liability progression measures will indicate a significant increase in the liability progression of the PIT system due to the reform. Also the $TR(p)$ curve of the reformed indirect tax system is entirely dominated by the one before the reform. But, these curves do not differ significantly from each other at each point. Non - rejections are observed for the highest two estimated points. However, the remaining parts of these curves differ from each other significantly[43]. Hence, most indices would indicate a significant increase in the liability regressivity of the indirect tax system because of the reform.

[42] The figures underlying figure 2a and 2b can be found in table A.3 and A.4 of the appendix.

[43] The critical values for a two sided test with $\alpha = 0.05$ and 7 sub null - hypotheses is 2.69. See Seber (1977), p. 131, table 5.1.

Figure 2a: TR(p) values before the reform

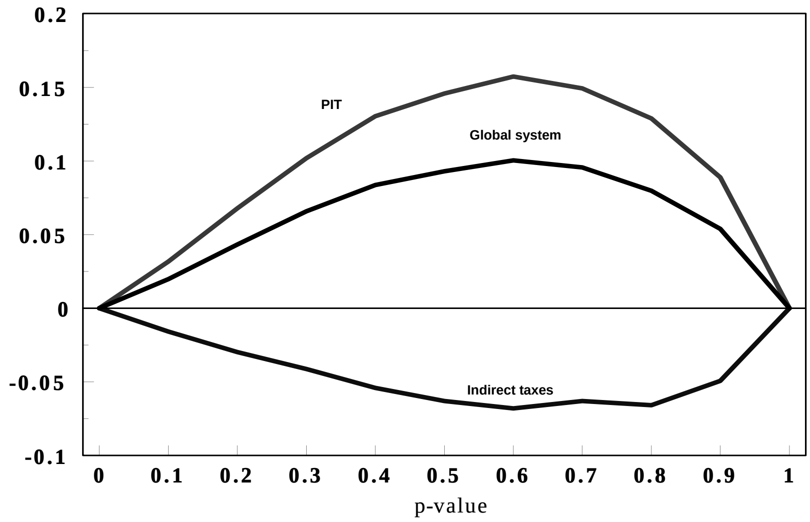
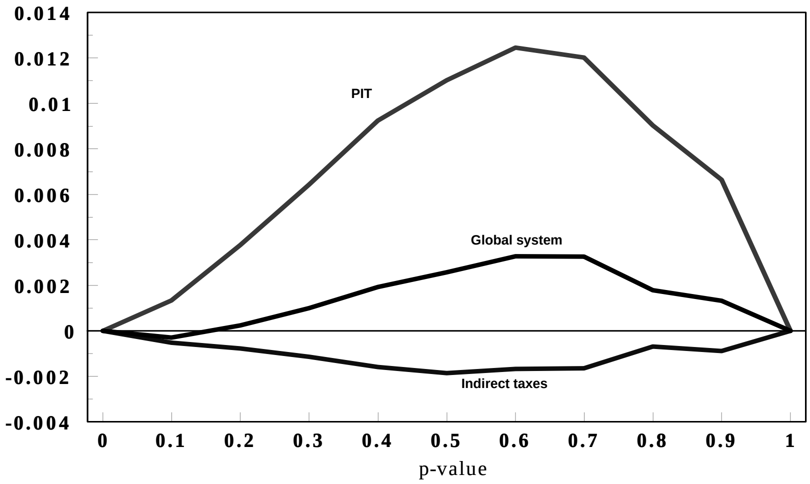


Figure 2b: change in TR(p) values due to the reform



Only for the combined system, we do not find a dominance result as far as liability progression is concerned. For the bottom decile, the combined liability progression of PIT and indirect taxes decreases. This means that after the reform, the bottom decile shifts a smaller share of the total tax burden to the top than it did before the reform. At all higher estimated points liability progression increases. Hence, only an index which gives a very high weight to the bottom decile can indicate that liability progressivity has gone down by the tax reform. But again, we can not reject at each point the hypothesis that the before and after reform curve are similar. Non - rejections are observed for the first two and the last two estimated points. A similar null-hypothesis of no change, applied on the part of the curve in between these rejected points, is rejected. Hence, after the reform, the middle class estimates of the $TR(p)$ curve differ from each other significantly. Moreover, these middle class $TR(p)$ values are always higher after the reform. Therefore, if these significance results are taken into account in the form of zero estimates at the rejected points, aggregate liability measures will either indicate that the reform has not changed the liability progression of the combined tax system or has increased it.

5.3. Differences in $IR(p)$-curves

Figure 1 and 2 are based on *cumulative* shares of post tax income and tax liabilities respectively. Hence, the rising and declining parts of the $IR(p)$- and $TR(p)$-curves in figure 1 and 2, reveals that shares of post tax income and tax liabilities respectively, exceed the shares of a proportional system at some points and are below them at other points. In this and the next subsection we therefore present *differences* in the $IR(p)$- and $TR(p)$-values for two consecutive population shares

p_i and p_{i-1}. As explained in section 4, this difference identifies the effect of redistributing post tax income and reshuffling of tax liabilities, *for one specific decile* (see equation 4.5). Figure 3a shows the difference in $IR(p)$-values. Figure 4a draws a similar picture for differences in $TR(p)$-values[44]. Like in figures 1 and 2, we first show the situation before the reform, and then look at the changes in the picture induced by the reform.

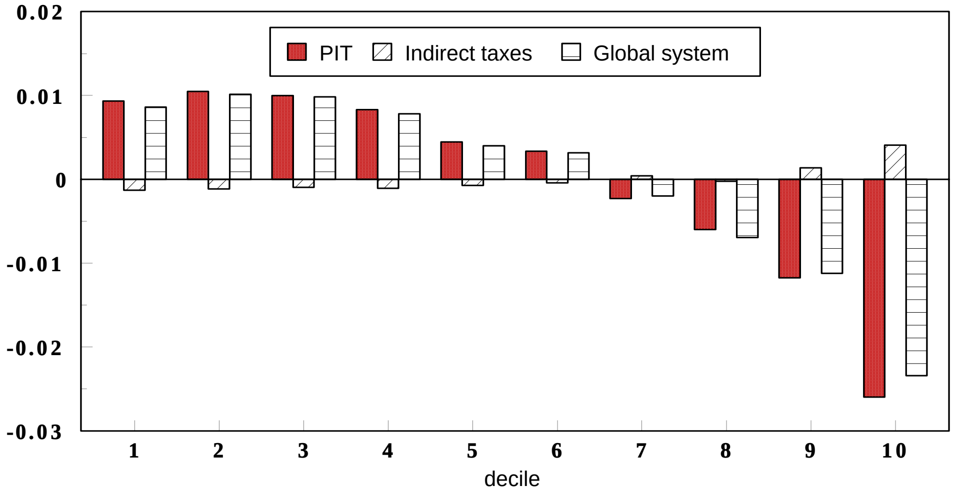
Figure 3 is revealing. It clearly shows how both PIT and the combined system, because of the non proportionality, redistribute post tax income from the four top deciles to the six bottom deciles. The indirect tax system appears with the reverse redistribution: with proportional indirect taxation, the bottom six deciles would end up with a higher after tax income than they do in the actual system. Mainly the two top deciles gain from the regressivity of indirect taxes. We have no explanation for the strange pattern in the eighth decile.

Figure 3b shows the effect of the reform on the structure of redistribution shown in figure 3a. In fact, this panel can be seen as a sophisticated identification of winners and losers of the tax reform. For PIT, the three bottom deciles are faced with a smaller amount of favourable redistribution than before the reform. The reverse side of this coin is the gain of the two top deciles who have to redistribute less after tax income towards lower deciles. The changes in the remaining deciles do not compensate these negative redistributive effects at the bottom and the top. Remember that, according to our statistical tests, applied on $IR(p)$, the changes at the top were not significantly different from zero. We therefore conclude that the reduced redistributive impact of the PIT system is mainly induced by the decreases in the three bottom deciles. Again, note the outlier position of the eight

[44] The figures are in tables A.5 and A.6 of the appendix.

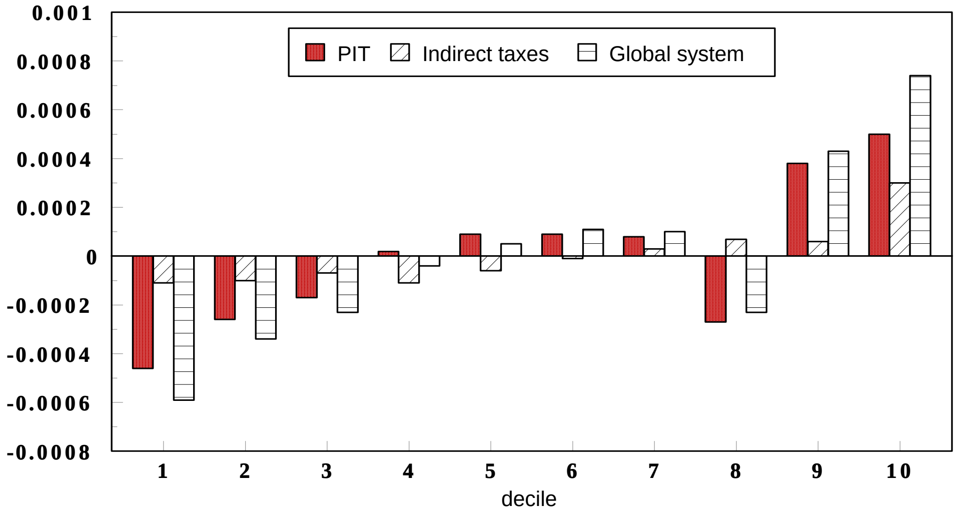
decile.

Figure 3a: Difference in IR(p)-values for PIT, indirect taxes and global system before the reform



value for decile i equals IR(p;i)-IR(p;i-1)

Figure 3b: Effect of the reform on difference in IR(p)-values for PIT, indirect taxes and global system



For these bottom three and top two deciles, the reform of indirect taxes only strengthens the results of the PIT reform. Overall the changes because of the indirect tax reform are relatively modest. And once more the monotone pattern of increasing gains for the upper deciles is interrupted in the eighth decile.

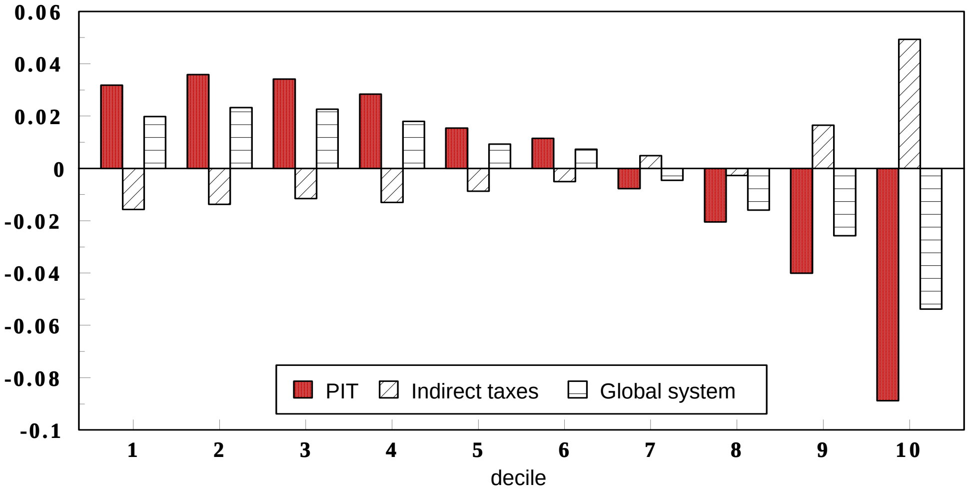
Globally, it is clear that the tax reform has mainly eroded the redistributive activity in the top two deciles and in the bottom three deciles. Deciles 4 to 7 are relatively unaffected and the effects for the eighth decile are, to put it mildly, rather bizarre. According to the significance tests, the changes for the top deciles are not significantly different from zero. Hence we conclude that the diminished redistributive impact of the combined tax system, is mainly due to the impact of the tax reform at the bottom of the distribution.

5.4. Differences in $TR(p)$-curves

The differences in the $TR(p)$-curves, reflect the reductions or increases in the tax liability shares, as compared to the tax liability shares of a proportional tax system with the same revenue. The situation before the reform is shown in figure 4a. A positive figure now means that an income group succeeds in pushing away this share of total tax liability towards other income groups. A negative figure means that the tax liability share in the counterfactual proportional system would be smaller.

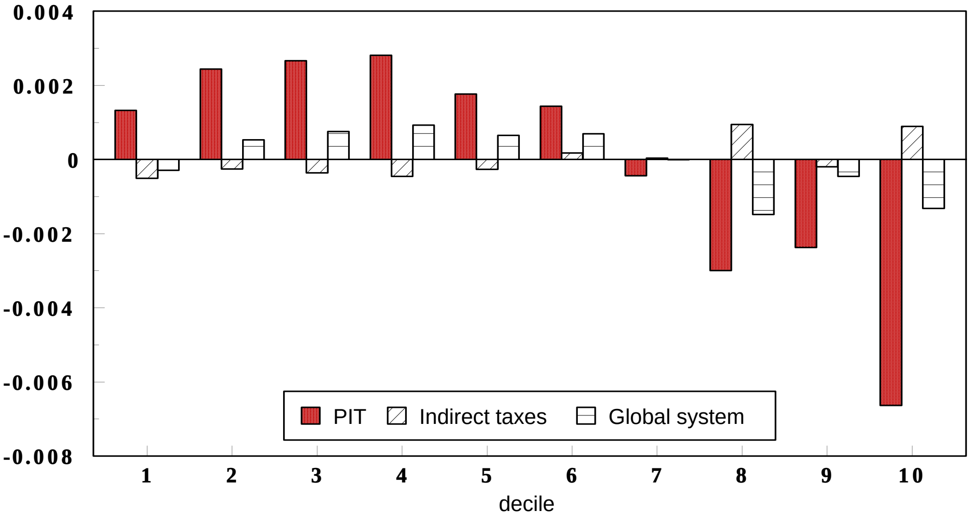
The liability progression of PIT shows up in a shifting of the tax burden from the lowest six deciles to the four highest deciles. Since indirect taxes (again, except for the eighth decile) reveal the reverse pattern, the global liability progression picture is a skimmed version of the PIT picture. But the global pattern never reverses.

Figure 4a: Difference in TR(p)-values for PIT, indirect taxes and global system before the reform



value for decile i equals TR(p;i) - TR(p;i-1)

Figure 4b: Effect of reform on Difference in TR(p)-values for PIT, indirect taxes and global system



The PIT reform has enhanced liability progression at all deciles. The bottom deciles have further increased their share of total tax liability which is pushed to higher deciles. The four top deciles, and especially the tenth decile, have felt a further increase in the share of the tax burden they have to bear. This confirms our conclusion of section 5.1. The erosion of the redistributive impact of personal income taxes is not due to a decrease in liability progression. Quite the contrary. It can entirely be attributed to the lower average tax rate.

For indirect taxes, the effect of the reform on liability regressivity is a bit less clear, certainly for the upper half of the distribution. The bottom half of the distribution undoubtedly is faced with enhanced liability regressivity. Their share in the total indirect tax revenue still increases. The gain of the indirect tax reform is mainly to be found in the eighth and tenth decile. Since the significance test reveals that the changes at the top are not significant, we conclude that the increased regressivity of the system is mainly due to the negative impact of the reform at the lower end of the distribution.

For the combined tax system, the conclusion about liability progression has to be refined. The pronounced pattern of increased liability progression because of the PIT reform is seriously faded out by the effect of indirect taxes. For the bottom decile this even leads to a decrease in liability progression, compared to the before reform situation. Otherwise said, the bottom decile bears a larger share of the total tax burden after the reform. For deciles 2 to 6 the enhanced liability progression of PIT still dominates the picture. The four highest deciles can compensate partially the increase in liability progression of PIT by the increased liability regressivity of the indirect taxes.

5.5. The impact of the different tax systems on post tax inequality

If there is reranking, the $IR(p)$-values, presented above, produce a biased estimate of the inequality impact of the different tax systems . Therefore, we have compared the reranking measure $D(p)$ with the $IR(p)$ values[45]. Sometimes, considerable values are observed but reranking never becomes that large that a sign reversal in the $IR(p)$ values occurs. Moreover, we can never reject the hypothesis that the reranking curve is equal to zero[46]. Therefore, we can also use the $IR(p)$ values to judge the impact of the different tax reforms on inequality of post tax incomes.

The $IR(p)$-curves of the reformed systems are always dominated by their before reform counterparts[47]. Therefore, as far as inequality reduction is concerned, we tend to evaluate the PIT as well as the indirect tax reform, and consequently the joint tax reform, negatively. With a fixed distribution of pre-tax income, post tax income is distributed more unequally than before the reform. But the reforms obtain this qualification for different reasons. The PIT reform has increased the liability progression of the PIT system. But, simultaneously, the government has decided to rely less on this progressive system of revenue collection. Hence, the potential beneficial effects of the more unequal distribution of the tax liabilities have been foregone by a reduction of the average tax rate. The indirect tax reform, on the other hand, strengthened the liability regressivity of the indirect tax system. At the same time, one also collects more taxes by means of this regressive system.

[45] The values of the $D(p)$ measure before and after the reform are in tables A.7 and A.8 of the appendix.

[46] At none of the nine points we could reject the sub null - hypothesis that this estimate was different from zero given the critical value of 2.78.

[47] Albeit not always in a significant way.

6. Conclusion

We have evaluated the differences between the Belgian personal income tax (PIT) system and indirect tax system of 1988 and 1993. Within this period both the PIT and the indirect tax system have been reformed considerably. The PIT reform was very much in line with what happened in other OECD countries. The tax base was broadened, top rates were reduced and the system moved away from joint taxation of married couples in the direction of individual taxation. The indirect tax reform discarded the rates of 17%, 25% and 33% and increased the rate of 19% to 19.5%. Excises on fuels and tobacco products were increased. As a consequence, less revenue was collected via the PIT system while the indirect tax revenue increased. Since the cut in PIT was quantitatively more important than the increase in indirect taxes, the overall revenue decreased.

To evaluate the joint impact of these reforms, the tax liabilities of both systems have been simulated on micro data sets. For each tax system, we have compared the distribution of equivalised pre-tax income with the distributions of equivalised post tax income and equivalised tax liabilities. These comparisons have been summarised both with indexes and Lorenz and concentration curves. We have applied recently developed statistical tools to test whether the indexes and curves are significantly different from zero. Our conclusions are the following:

- The positive redistributive impact of the personal income tax system has been eroded by the tax reform. The negative redistributive impact of the indirect tax system increased. Evidently, for the joint tax system, this implies that the redistributive impact has also decreased.
- These conclusions about the change in the redistributive effect are fairly

general. Estimates of the relevant Lorenz and concentration curves at nine points show that the systems before the reform always dominate those after the reform in terms of the redistributive impact.

- Not all before and after reform $IR(p)$-curves differ from each other significantly over the entire p-range. But, they differ significantly over at least certain ranges of the distribution. Hence, indices would at best indicate a status quo or otherwise a reduction in the redistributive impact of the respective tax systems.

- The reduction in the redistributive effect of the combined tax system is mainly due to the negative impact of both the reform of PIT and indirect taxes at the bottom end of the distribution. With pre-tax income fixed, and given the change in the average tax rates because of the reform, the bottom three deciles are the losers of the reform. The middle income classes are relatively unaffected. The two top deciles are the winners of the reform.

- The PIT reform increased the liability progression of the personal income tax system. The liability regressivity of indirect taxes has been enhanced by the reform. Since the PIT effect largely dominates the effect of indirect taxes, also the liability progression of the combined tax system has increased.

- Again these conclusions are fairly general. In the case of PIT and indirect taxes we obtain dominance results. For the combined tax system there is no dominance. The liability progression decreases for the first decile, but is faded out by the increase in liability progression for all the other deciles. Yet, the point at which the violation is observed is not significantly estimated.

The before and after reform curves of each system differ significantly over a considerable range of the distribution.

- The reranking coefficients do not differ significantly from zero. Therefore, the changes in the redistributive effect can also be interpreted as changes in the reduction of post tax income inequality.

- The reform has reduced the power of the combined tax system to narrow post tax income inequality. Although this reduction is due to a decrease of both the positive redistributive effect of PIT and an increase of the negative redistributive effect of indirect taxes, this occurs for different reasons in both systems. Since PIT became more progressive, the decline in the redistributive effect is entirely due to the lower average tax rate. For indirect taxes, both increasing liability regressivity and an increasing average tax rate work together to adversely affect the inequality of post tax incomes.

Probably it does not come as a surprise that indirect taxes became more regressive. The highest VAT rates have been discarded and excises have been increased. But the observations about the PIT reform are more intriguing. Despite the reduction of the top rates and the move into the direction of more individual taxation, liability progression increased. This issue can only be elucidated by proceeding through the different stages of the PIT process before and after the reform. In Decoster, Standaert, Valenduc and Van Camp (2000) we sketch the contributions made by deductions, tax rates and tax credits, to the final redistribution of tax liabilities before and after the reform.

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7. Appendix

Table A.1: Measure of redistributive effect before the reform ($\widetilde{IR}(p)$-curves of Figure 1a)

	Personal Income Taxes				Indirect Taxes				Global Taxes			
	$\widehat{L}_{X;M}(p)$	$\widehat{L}_{X;X}(p)$	$\widetilde{IR}(p)$		$\widehat{L}_{X;M}(p)$	$\widehat{L}_{X;X}(p)$	$\widetilde{IR}(p)$		$\widehat{L}_{X;M}(p)$	$\widehat{L}_{X;X}(p)$	$\widetilde{IR}(p)$	
p	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
0.1	**0.04660**	**0.03728**	**0.00933**		**0.03597**	**0.03728**	**-0.00131**		**0.04590**	**0.03728**	**0.00862**	
	(0.00078)	(0.00055)	(0.00035)		(0.00073)	(0.00055)	(0.00028)		(0.00083)	(0.00055)	(0.00041)	
0.2	**0.10798**	**0.08816**	**0.01982**		**0.08571**	**0.08816**	**-0.00245**		**0.10691**	**0.08816**	**0.01875**	
	(0.00124)	(0.00109)	(0.00046)		(0.00118)	(0.00109)	(0.00021)		(0.00129)	(0.00109)	(0.00054)	
0.3	**0.17915**	**0.14933**	**0.02983**		**0.14592**	**0.14933**	**-0.00341**		**0.17792**	**0.14933**	**0.02859**	
	(0.00169)	(0.00160)	(0.00070)		(0.00164)	(0.00160)	(0.00018)		(0.00177)	(0.00160)	(0.00079)	
0.4	**0.25831**	**0.22016**	**0.03815**		**0.21568**	**0.22016**	**-0.00448**		**0.25656**	**0.22016**	**0.03640**	
	(0.00217)	(0.00210)	(0.00097)		(0.00214)	(0.00210)	(0.00023)		(0.00227)	(0.00210)	(0.00107)	
0.5	**0.34312**	**0.30047**	**0.04264**		**0.29526**	**0.30047**	**-0.00521**		**0.34090**	**0.30047**	**0.04042**	
	(0.00261)	(0.00259)	(0.00124)		(0.00265)	(0.00259)	(0.00029)		(0.00273)	(0.00259)	(0.00136)	
0.6	**0.43905**	**0.39304**	**0.04601**		**0.38741**	**0.39304**	**-0.00563**		**0.43664**	**0.39304**	**0.04360**	
	(0.00308)	(0.00305)	(0.00148)		(0.00315)	(0.00305)	(0.00032)		(0.00322)	(0.00305)	(0.00160)	
0.7	**0.54383**	**0.50012**	**0.04372**		**0.49489**	**0.50012**	**-0.00522**		**0.54172**	**0.50012**	**0.04160**	
	(0.00347)	(0.00347)	(0.00171)		(0.00362)	(0.00347)	(0.00036)		(0.00366)	(0.00347)	(0.00183)	
0.8	**0.66114**	**0.62342**	**0.03772**		**0.61796**	**0.62342**	**-0.00546**		**0.65806**	**0.62342**	**0.03464**	
	(0.00378)	(0.00376)	(0.00188)		(0.00398)	(0.00376)	(0.00043)		(0.00398)	(0.00376)	(0.00200)	
0.9	**0.79929**	**0.77331**	**0.02598**		**0.76922**	**0.77331**	**-0.00409**		**0.79673**	**0.77331**	**0.02342**	
	(0.00384)	(0.00380)	(0.00189)		(0.00403)	(0.00380)	(0.00039)		(0.00407)	(0.00380)	(0.00199)	

(a) Standard Errors between brackets in even lines

(b) The critical value $t_{\infty}^{\frac{\alpha}{2k}}$ for $\alpha = 0.05$ and $k = 9$ is equal to 2.78, see Seber (1977), table 5.1, p. 131.

(c) ns in column (4), (8) and (12) indicates that respectively the sub null-hypothesis of column (3), (7) or (11) is not rejected, given the critical value of 2.78.

Table A.2: Effect of the reform on the redistributive effect (Figure 1b)

	Personal Income Taxes				Indirect Taxes				Global Taxes			
	$\widehat{L}^A_{X;M}(p)$	$\widehat{L}^B_{X;M}(p)$	$\widehat{L}^A_{X;M}(p)$ - $\widehat{L}^B_{X;M}(p)$		$\widehat{L}^A_{X;M}(p)$	$\widehat{L}^B_{X;M}(p)$	$\widehat{L}^A_{X;M}(p)$ - $\widehat{L}^B_{X;M}(p)$		$\widehat{L}^A_{X;M}(p)$	$\widehat{L}^B_{X;M}(p)$	$\widehat{L}^A_{X;M}(p)$ - $\widehat{L}^B_{X;M}(p)$	
p	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
0.1	**0.04614**	**0.04660**	**-0.00046**		**0.03585**	**0.03597**	**-0.00012**		**0.04530**	**0.04590**	**-0.00059**	
	(0.00078)	(0.00078)	(0.00005)		(0.00074)	(0.00073)	(0.00001)		(0.00083)	(0.00083)	(0.00006)	
0.2	**0.10726**	**0.10798**	**-0.00072**		**0.08551**	**0.08571**	**-0.00020**		**0.10598**	**0.10691**	**-0.00093**	
	(0.00123)	(0.00124)	(0.00010)		(0.00119)	(0.00118)	(0.00001)		(0.00129)	(0.00129)	(0.00011)	
0.3	**0.17827**	**0.17915**	**-0.00089**		**0.14564**	**0.14592**	**-0.00029**		**0.17676**	**0.17792**	**-0.00116**	
	(0.00168)	(0.00169)	(0.00015)		(0.00165)	(0.00164)	(0.00002)		(0.00176)	(0.00177)	(0.00017)	
0.4	**0.25744**	**0.25831**	**-0.00086**		**0.21529**	**0.21568**	**-0.00038**		**0.25536**	**0.25656**	**-0.00120**	
	(0.00216)	(0.00217)	(0.00020)		(0.00214)	(0.00214)	(0.00002)		(0.00225)	(0.00227)	(0.00022)	
0.5	**0.34234**	**0.34312**	**-0.00078**		**0.29481**	**0.29526**	**-0.00045**		**0.33974**	**0.34090**	**-0.00116**	
	(0.00259)	(0.00261)	(0.00024)		(0.00265)	(0.00265)	(0.00003)		(0.00271)	(0.00273)	(0.00027)	
0.6	**0.43835**	**0.43905**	**-0.00069**	ns	**0.38695**	**0.38741**	**-0.00045**		**0.43560**	**0.43664**	**-0.00104**	
	(0.00306)	(0.00308)	(0.00029)		(0.00315)	(0.00315)	(0.00003)		(0.00320)	(0.00322)	(0.00032)	
0.7	**0.54322**	**0.54383**	**-0.00061**	ns	**0.49446**	**0.49489**	**-0.00043**		**0.54078**	**0.54172**	**-0.00094**	ns
	(0.00345)	(0.00347)	(0.00033)		(0.00363)	(0.00362)	(0.00003)		(0.00364)	(0.00366)	(0.00037)	
0.8	**0.66026**	**0.66114**	**-0.00089**	ns	**0.61760**	**0.61796**	**-0.00036**		**0.65689**	**0.65806**	**-0.00117**	ns
	(0.00375)	(0.00378)	(0.00037)		(0.00399)	(0.00398)	(0.00003)		(0.00396)	(0.00398)	(0.00041)	
0.9	**0.79879**	**0.79929**	**-0.00050**	ns	**0.76892**	**0.76922**	**-0.00030**		**0.79599**	**0.79673**	**-0.00074**	ns
	(0.00383)	(0.00384)	(0.00037)		(0.00404)	(0.00403)	(0.00003)		(0.00406)	(0.00407)	(0.00041)	

(a) Standard Errors between brackets in even lines

(b) The critical value $t_{\infty}^{\frac{\alpha}{2k}}$ for $\alpha = 0.05$ and $k = 9$ is equal to 2.78, see Seber (1977), table 5.1, p. 131.

(c) ns in column (4), (8) and (12) indicates that respectively the sub null-hypothesis of column (3), (7) or (11) is not rejected, given the critical value of 2.78.

Table A.3: Measure of liability progression before the reform ($TR(p)$-curves of Figure 2a)

	Personal Income Taxes				Indirect Taxes				Global Taxes			
	$\widehat{L}_{X;X}(p)$	$\widehat{L}_{X;T}(p)$	$\widehat{\widehat{TR}}(p)$		$\widehat{L}_{X;X}(p)$	$\widehat{L}_{X;T}(p)$	$\widehat{\widehat{TR}}(p)$		$\widehat{L}_{X;X}(p)$	$\widehat{L}_{X;T}(p)$	$\widehat{\widehat{TR}}(p)$	
p	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
0.1	**0.03728**	**0.00540**	**0.03188**		**0.03728**	**0.05303**	**-0.01576**		**0.03728**	**0.01744**	**0.01984**	
	(0.00055)	(0.00077)	(0.00069)		(0.00055)	(0.00128)	(0.00121)		(0.00055)	(0.00076)	(0.00062)	
0.2	**0.08816**	**0.02043**	**0.06774**		**0.08816**	**0.11776**	**-0.02960**		**0.08816**	**0.04503**	**0.04314**	
	(0.00109)	(0.00157)	(0.00136)		(0.00109)	(0.00197)	(0.00178)		(0.00109)	(0.00142)	(0.00107)	
0.3	**0.14933**	**0.04740**	**0.10193**		**0.14933**	**0.19044**	**-0.04111**		**0.14933**	**0.08355**	**0.06578**	
	(0.00160)	(0.00246)	(0.00209)		(0.00160)	(0.00251)	(0.00228)		(0.00160)	(0.00214)	(0.00159)	
0.4	**0.22016**	**0.08980**	**0.13036**		**0.22016**	**0.27424**	**-0.05408**		**0.22016**	**0.13641**	**0.08375**	
	(0.00210)	(0.00341)	(0.00278)		(0.00210)	(0.00309)	(0.00280)		(0.00210)	(0.00294)	(0.00210)	
0.5	**0.30047**	**0.15473**	**0.14574**		**0.30047**	**0.36335**	**-0.06288**		**0.30047**	**0.20746**	**0.09301**	
	(0.00259)	(0.00455)	(0.00356)		(0.00259)	(0.00356)	(0.00327)		(0.00259)	(0.00385)	(0.00266)	
0.6	**0.39304**	**0.23579**	**0.15724**		**0.39304**	**0.46095**	**-0.06792**		**0.39304**	**0.29270**	**0.10034**	
	(0.00305)	(0.00560)	(0.00434)		(0.00305)	(0.00399)	(0.00373)		(0.00305)	(0.00465)	(0.00321)	
0.7	**0.50012**	**0.35071**	**0.14941**		**0.50012**	**0.56312**	**-0.06300**		**0.50012**	**0.40439**	**0.09572**	
	(0.00347)	(0.00669)	(0.00510)		(0.00347)	(0.00417)	(0.00410)		(0.00347)	(0.00546)	(0.00375)	
0.8	**0.62342**	**0.49450**	**0.12892**		**0.62342**	**0.68923**	**-0.06582**		**0.62342**	**0.54372**	**0.07970**	
	(0.00376)	(0.00750)	(0.00565)		(0.00376)	(0.00425)	(0.00422)		(0.00376)	(0.00610)	(0.00417)	
0.9	**0.77331**	**0.68451**	**0.08879**		**0.77331**	**0.82262**	**-0.04932**		**0.77331**	**0.71942**	**0.05389**	
	(0.00380)	(0.00784)	(0.00602)		(0.00380)	(0.00408)	(0.00431)		(0.00380)	(0.00618)	(0.00433)	

(a) Standard Errors between brackets in even lines

(b) The critical value $t_{\infty}^{\frac{\alpha}{2k}}$ for $\alpha = 0.05$ and $k = 9$ is equal to 2.78, see Seber (1977), table 5.1, p. 131.

(c) ns in column (4), (8) and (12) indicates that respectively the sub null-hypothesis of column (3), (7) or (11) is not rejected, given the critical value of 2.78.

Table A.4: Effect of the reform on the liability progression (Figure 2b)

	Personal Income Taxes				Indirect Taxes				Global Taxes			
	$\widehat{L}^B_{X;T}(p)$	$\widehat{L}^A_{X;T}(p)$	$\widehat{L}^B_{X;T}(p)$ - $\widehat{L}^A_{X;T}(p)$		$\widehat{L}^B_{X;T}(p)$	$\widehat{L}^A_{X;T}(p)$	$\widehat{L}^B_{X;T}(p)$ - $\widehat{L}^A_{X;T}(p)$		$\widehat{L}^B_{X;T}(p)$	$\widehat{L}^A_{X;T}(p)$	$\widehat{L}^B_{X;T}(p)$ - $\widehat{L}^A_{X;T}(p)$	
p	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
0.1	**0.00540**	**0.00406**	**0.00133**		**0.05303**	**0.05354**	**-0.00051**		**0.01744**	**0.01773**	**-0.00029**	ns
	(0.00077)	(0.00071)	(0.00015)		(0.00128)	(0.00126)	(0.00011)		(0.00076)	(0.00073)	(0.00012)	
0.2	**0.02043**	**0.01665**	**0.00377**		**0.11776**	**0.11853**	**-0.00077**		**0.04503**	**0.04479**	**0.00024**	ns
	(0.00157)	(0.00152)	(0.00027)		(0.00197)	(0.00192)	(0.00018)		(0.00142)	(0.00138)	(0.00021)	
0.3	**0.04740**	**0.04096**	**0.00644**		**0.19044**	**0.19157**	**-0.00113**		**0.08355**	**0.08255**	**0.00100**	
	(0.00246)	(0.00242)	(0.00041)		(0.00251)	(0.00244)	(0.00025)		(0.00214)	(0.00209)	(0.00031)	
0.4	**0.08980**	**0.08055**	**0.00925**		**0.27424**	**0.27583**	**-0.00159**		**0.13641**	**0.13448**	**0.00193**	
	(0.00341)	(0.00340)	(0.00055)		(0.00309)	(0.00300)	(0.00031)		(0.00294)	(0.00290)	(0.00042)	
0.5	**0.15473**	**0.14371**	**0.01102**		**0.36335**	**0.36521**	**-0.00186**		**0.20746**	**0.20488**	**0.00258**	
	(0.00455)	(0.00460)	(0.00067)		(0.00356)	(0.00343)	(0.00037)		(0.00385)	(0.00382)	(0.00050)	
0.6	**0.23579**	**0.22334**	**0.01246**		**0.46095**	**0.46263**	**-0.00168**		**0.29270**	**0.28942**	**0.00328**	
	(0.00560)	(0.00568)	(0.00079)		(0.00399)	(0.00382)	(0.00042)		(0.00465)	(0.00461)	(0.00060)	
0.7	**0.35071**	**0.33869**	**0.01202**		**0.56312**	**0.56476**	**-0.00164**		**0.40439**	**0.40112**	**0.00327**	
	(0.00669)	(0.00682)	(0.00094)		(0.00417)	(0.00398)	(0.00046)		(0.00546)	(0.00542)	(0.00071)	
0.8	**0.49450**	**0.48547**	**0.00903**		**0.68923**	**0.68993**	**-0.00069**	ns	**0.54372**	**0.54194**	**0.00178**	ns
	(0.00750)	(0.00763)	(0.00109)		(0.00425)	(0.00406)	(0.00046)		(0.00610)	(0.00606)	(0.00083)	
0.9	**0.68451**	**0.67788**	**0.00664**		**0.82262**	**0.82352**	**-0.00089**	ns	**0.71942**	**0.71809**	**0.00132**	ns
	(0.00784)	(0.00791)	(0.00114)		(0.00408)	(0.00390)	(0.00044)		(0.00618)	(0.00608)	(0.00086)	

(a) Standard Errors between brackets in even lines

(b) The critical value $t_{\infty}^{\frac{\alpha}{2k}}$ for $\alpha = 0.05$ and $k = 9$ is equal to 2.78, see Seber (1977), table 5.1, p. 131.

(c) ns in column (4), (8) and (12) indicates that respectively the sub null-hypothesis of column (3), (7) or (11) is not rejected, given the critical value of 2.78.

Table A.5: $IR(p)$-curves and effect of the reform on differences in $IR(p)$-curves (Figure 3)

	Personal Income Taxes			Indirect Taxes			Global Taxes		
	Before	After	Change	Before	After	Change	Before	After	Change
$\widetilde{IR}(p_i)$ - $\widetilde{IR}(p_{i-1})$	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0.1 - 0.0	0.00933	0.00887	-0.00046	-0.00131	-0.00142	-0.00011	0.00862	0.00803	-0.00059
0.2 - 0.1	0.01049	0.01023	-0.00026	-0.00114	-0.00124	-0.00010	0.01013	0.00979	-0.00034
0.3 - 0.2	0.01001	0.00984	-0.00017	-0.00096	-0.00103	-0.00007	0.00984	0.00961	-0.00023
0.4 - 0.3	0.00832	0.00834	0.00002	-0.00107	-0.00118	-0.00011	0.00781	0.00777	-0.00004
0.5 - 0.4	0.00449	0.00458	0.00009	-0.00073	-0.00079	-0.00006	0.00402	0.00407	0.00005
0.6 - 0.5	0.00337	0.00346	0.00009	-0.00042	-0.00043	-0.00001	0.00318	0.00329	0.00011
0.7 - 0.6	-0.00229	-0.00221	0.00008	0.00041	0.00044	0.00003	-0.00200	-0.00190	0.00010
0.8 - 0.7	-0.00600	-0.00627	-0.00027	-0.00024	-0.00017	0.00007	-0.00696	-0.00719	-0.00023
0.9 - 0.8	-0.01174	-0.01136	0.00038	0.00137	0.00143	0.00006	-0.01122	-0.01079	0.00043
1.0 - 0.9	-0.02598	-0.02548	0.00050	0.00409	0.00439	0.00030	-0.02342	-0.02268	0.00074

Table A.6: $TR(p)$-curves and effect of the reform on differences in $TR(p)$-curves (Figure 4)

	Personal Income Taxes			Indirect Taxes			Global Taxes		
	Before	After	Change	Before	After	Change	Before	After	Change
$\widetilde{TR}(p_i)$ - $\widetilde{TR}(p_{i-1})$	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0.1 - 0.0	0.03188	0.03321	0.00133	-0.01576	-0.01627	-0.00051	0.01984	0.01955	-0.00029
0.2 - 0.1	0.03586	0.03830	0.00244	-0.01384	-0.01410	-0.00026	0.02330	0.02383	0.00053
0.3 - 0.2	0.03419	0.03686	0.00267	-0.01151	-0.01187	-0.00036	0.02264	0.02340	0.00076
0.4 - 0.3	0.02843	0.03124	0.00281	-0.01297	-0.01343	-0.00046	0.01797	0.01890	0.00093
0.5 - 0.4	0.01538	0.01715	0.00177	-0.00880	-0.00907	-0.00027	0.00926	0.00991	0.00065
0.6 - 0.5	0.01150	0.01294	0.00144	-0.00504	-0.00486	0.00018	0.00733	0.00803	0.00070
0.7 - 0.6	-0.00783	-0.00827	-0.00044	0.00492	0.00496	0.00004	-0.00462	-0.00463	-0.00001
0.8 - 0.7	-0.02049	-0.02349	-0.00300	-0.00282	-0.00187	0.00095	-0.01602	-0.01751	-0.00149
0.9 - 0.8	-0.04013	-0.04251	-0.00238	0.01650	0.01630	-0.00020	-0.02581	-0.02627	-0.00046
1.0 - 0.9	-0.08879	-0.09543	-0.00664	0.04932	0.05021	0.00089	-0.05389	-0.05521	-0.00132

Table A.7: Reranking measures before the reform ($D(p)$-curves)

	Personal Income Taxes				Indirect Taxes				Global Taxes			
	$\widehat{L}_{X;M}(p)$	$\widehat{L}_{M;M}(p)$	$\widehat{D}(p)$		$\widehat{L}_{X;M}(p)$	$\widehat{L}_{M;M}(p)$	$\widehat{D}(p)$		$\widehat{L}_{X;M}(p)$	$\widehat{L}_{M;M}(p)$	$\widehat{D}(p)$	
p	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
0.1	**0.04660**	**0.04535**	**0.00125**	**ns**	**0.03597**	**0.03571**	**0.00026**	**ns**	**0.04590**	**0.04418**	**0.00171**	**ns**
	(0.00078)	(0.00064)	(0.00101)		(0.00073)	(0.00058)	(0.00093)		(0.00083)	(0.00068)	(0.00107)	
0.2	**0.10798**	**0.10556**	**0.00242**	**ns**	**0.08571**	**0.08571**	**0.00000**	**ns**	**0.10691**	**0.10354**	**0.00337**	**ns**
	(0.00124)	(0.00109)	(0.00165)		(0.00118)	(0.00110)	(0.00162)		(0.00129)	(0.00114)	(0.00172)	
0.3	**0.17915**	**0.17452**	**0.00464**	**ns**	**0.14592**	**0.14578**	**0.00014**	**ns**	**0.17792**	**0.17181**	**0.00610**	**ns**
	(0.00169)	(0.00160)	(0.00233)		(0.00164)	(0.00164)	(0.00232)		(0.00177)	(0.00165)	(0.00242)	
0.4	**0.25831**	**0.25225**	**0.00605**	**ns**	**0.21568**	**0.21531**	**0.00037**	**ns**	**0.25656**	**0.24880**	**0.00776**	**ns**
	(0.00217)	(0.00205)	(0.00298)		(0.00214)	(0.00215)	(0.00303)		(0.00227)	(0.00211)	(0.00310)	
0.5	**0.34312**	**0.33763**	**0.00549**	**ns**	**0.29526**	**0.29496**	**0.00030**	**ns**	**0.34090**	**0.33383**	**0.00707**	**ns**
	(0.00261)	(0.00248)	(0.00360)		(0.00265)	(0.00265)	(0.00374)		(0.00273)	(0.00257)	(0.00375)	
0.6	**0.43905**	**0.43127**	**0.00778**	**ns**	**0.38741**	**0.38710**	**0.00030**	**ns**	**0.43664**	**0.42700**	**0.00964**	**ns**
	(0.00308)	(0.00289)	(0.00422)		(0.00315)	(0.00313)	(0.00444)		(0.00322)	(0.00300)	(0.00440)	
0.7	**0.54383**	**0.53583**	**0.00801**	**ns**	**0.49489**	**0.49375**	**0.00115**	**ns**	**0.54172**	**0.53145**	**0.01027**	**ns**
	(0.00347)	(0.00328)	(0.00478)		(0.00362)	(0.00357)	(0.00509)		(0.00366)	(0.00342)	(0.00501)	
0.8	**0.66114**	**0.65305**	**0.00809**	**ns**	**0.61796**	**0.61785**	**0.00012**	**ns**	**0.65806**	**0.64880**	**0.00925**	**ns**
	(0.00378)	(0.00357)	(0.00520)		(0.00398)	(0.00391)	(0.00558)		(0.00398)	(0.00375)	(0.00547)	
0.9	**0.79929**	**0.79141**	**0.00788**	**ns**	**0.76922**	**0.76903**	**0.00019**	**ns**	**0.79673**	**0.78794**	**0.00879**	**ns**
	(0.00384)	(0.00360)	(0.00527)		(0.00403)	(0.00397)	(0.00566)		(0.00407)	(0.00382)	(0.00558)	

(a) Standard Errors between brackets in even lines

(b) The critical value $t_{\infty}^{\frac{\alpha}{2k}}$ for $\alpha = 0.05$ and $k = 9$ is equal to 2.78, see Seber (1977), table 5.1, p. 131.

(c) ns in column (4), (8) and (12) indicates that respectively the sub null-hypothesis of column (3), (7) or (11) is not rejected, given the critical value of 2.78.

Table A.8: Reranking measures after the reform ($D(p)$-curves)

	Personal Income Taxes				Indirect Taxes				Global Taxes			
	$\widehat{L}_{X;M}(p)$	$\widehat{L}_{M;M}(p)$	$\widehat{D}(p)$		$\widehat{L}_{X;M}(p)$	$\widehat{L}_{M;M}(p)$	$\widehat{D}(p)$		$\widehat{L}_{X;M}(p)$	$\widehat{L}_{M;M}(p)$	$\widehat{D}(p)$	
p	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
0.1	**0.04614**	**0.04509**	**0.00106**	ns	**0.03585**	**0.03561**	**0.00025**	ns	**0.04530**	**0.04400**	**0.00130**	ns
	(0.00078)	(0.00064)	(0.00101)		(0.00074)	(0.00057)	(0.00093)		(0.00083)	(0.00067)	(0.00107)	
0.2	**0.10726**	**0.10492**	**0.00234**	ns	**0.08551**	**0.08569**	**-0.00018**	ns	**0.10598**	**0.10267**	**0.00331**	ns
	(0.00123)	(0.00111)	(0.00166)		(0.00119)	(0.00109)	(0.00161)		(0.00129)	(0.00116)	(0.00174)	
0.3	**0.17827**	**0.17418**	**0.00409**	ns	**0.14564**	**0.14529**	**0.00035**	ns	**0.17676**	**0.17136**	**0.00540**	ns
	(0.00168)	(0.00160)	(0.00232)		(0.00165)	(0.00165)	(0.00233)		(0.00176)	(0.00164)	(0.00241)	
0.4	**0.25744**	**0.25189**	**0.00555**	ns	**0.21529**	**0.21503**	**0.00027**	ns	**0.25536**	**0.24837**	**0.00699**	ns
	(0.00216)	(0.00205)	(0.00298)		(0.00214)	(0.00215)	(0.00303)		(0.00225)	(0.00211)	(0.00309)	
0.5	**0.34234**	**0.33722**	**0.00512**	ns	**0.29481**	**0.29441**	**0.00040**	ns	**0.33974**	**0.33357**	**0.00617**	ns
	(0.00259)	(0.00248)	(0.00359)		(0.00265)	(0.00265)	(0.00374)		(0.00271)	(0.00257)	(0.00374)	
0.6	**0.43835**	**0.43161**	**0.00674**	ns	**0.38695**	**0.38669**	**0.00026**	ns	**0.43560**	**0.42673**	**0.00887**	ns
	(0.00306)	(0.00289)	(0.00421)		(0.00315)	(0.00314)	(0.00445)		(0.00320)	(0.00300)	(0.00439)	
0.7	**0.54322**	**0.53603**	**0.00719**	ns	**0.49446**	**0.49367**	**0.00079**	ns	**0.54078**	**0.53167**	**0.00911**	ns
	(0.00345)	(0.00328)	(0.00476)		(0.00363)	(0.00358)	(0.00510)		(0.00364)	(0.00343)	(0.00500)	
0.8	**0.66026**	**0.65329**	**0.00697**	ns	**0.61760**	**0.61742**	**0.00019**	ns	**0.65689**	**0.64901**	**0.00788**	ns
	(0.00375)	(0.00356)	(0.00517)		(0.00399)	(0.00391)	(0.00559)		(0.00396)	(0.00376)	(0.00546)	
0.9	**0.79879**	**0.79180**	**0.00699**	ns	**0.76892**	**0.76860**	**0.00032**	ns	**0.79599**	**0.78793**	**0.00805**	ns
	(0.00383)	(0.00363)	(0.00528)		(0.00404)	(0.00397)	(0.00566)		(0.00406)	(0.00383)	(0.00558)	

(a) Standard Errors between brackets in even lines

(b) The critical value $t_{\infty}^{\frac{\alpha}{2k}}$ for $\alpha = 0.05$ and $k = 9$ is equal to 2.78, see Seber (1977), table 5.1, p. 131.

(c) ns in column (4), (8) and (12) indicates that respectively the sub null-hypothesis of column (3), (7) or (11) is not rejected, given the critical value of 2.78.