the review of income and wealth

Review of Income and Wealth
Series 59, Number 2, June 2013
DOI: 10.1111/j.1475-4991.2012.00499.x

PROGRESSIVITY AND REDISTRIBUTION IN NON-REVENUE NEUTRAL TAX REFORMS: THE LEVEL AND DISTANCE EFFECTS

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Kakwani and Reynolds–Smolensky indices are used in the literature to measure the progressivity and redistributive capacity of taxes. These indices may, however, show some limits when used to make normative assessments about non-revenue neutral tax reforms. Two approaches have traditionally been taken to overcome this problem. The first of these consists of comparing after-tax income distributions through generalized Lorenz (concentration) curves. The second approach is based on the decomposition of changes in the Reynolds–Smolensky index into changes in the average tax rate and variations in progressivity. Nonetheless, this decomposition between the average tax rate and progressivity may be further exploited to obtain some information that can be relevant to assess tax reforms. The main aim of this study is to draw up some indicators that can be useful to quantify the effects of non-revenue neutral tax reforms. These indicators are used to investigate the last personal income tax reforms that have taken place in Spain.

JEL Codes: H23, H24

Keywords: Distance Effect, Level Effect, progressivity, redistribution, tax reforms

1. INTRODUCTION

Kakwani (1977) and Reynolds and Smolensky (1977) indices are used in the literature to measure the progressivity and redistributive capacity of taxes. The former computes the disproportionality of tax payments relative to pre-tax incomes, while the latter captures the difference between pre- and post-tax income distributions. These indices may, however, show some limits when used to make normative assessments about non-revenue neutral tax reforms. Two approaches have traditionally been taken to overcome these limits. The first of these consists of comparing after-tax income distributions through generalized Lorenz (concentration) curves. The second approach is based on the decomposition of changes in the Reynolds–Smolensky index into changes in the average tax rate and variations in progressivity.

Nonetheless, as we will attempt to show in the following pages, this decomposition between the average tax rate and progressivity may be further exploited to obtain some information that can be relevant to assess tax reforms. The main aim of this study is to draw up some indicators that can be useful to quantify the effects

Note: We would like to thank two anonymous referees for providing us with fruitful comments and suggestions.

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Published by Blackwell Publishing, 9600 Garsington Road, Oxford OX4 2DQ, UK and 350 Main St, Malden, MA, 02148, USA.

of non-revenue neutral tax reforms. In order to do so, two concepts that can be separated are used: tax level and the distances between net incomes or tax liabilities. On the basis of this separation, the design of any non-revenue neutral tax reform can be assessed in terms of both progressivity as well as in redistributive capacity. This can be done by means of what we shall name the Level and Distance Effects. These two (measurable) effects incorporate information about the design of tax reforms that links the traditional definition of progressivity (based on relative inequality) to its more intuitive interpretation (based on absolute taxpayer's gains and losses). Policymakers and citizens can have an interest in getting to know the consequences of a tax reform in absolute terms and how it affects the distances between individuals' incomes (or tax liabilities). The goal of the tools developed in this paper is to satisfy this interest.

Section 2 is devoted to analysis of the main characteristics and implications of the traditional tools used to study the impact of non-revenue neutral tax reforms on progressivity and redistribution. In Section 3 we develop our proposal, and in Section 4, we employ our approach to investigate the last personal income tax reforms that have taken place in Spain.

2. Inequality, Progressivity, and Redistribution

Any analysis of the redistributive effects of tax reforms first requires an instrument that can synthesize income distribution in diverse situations. A very commonly used tool for this purpose is the so-called Lorenz curve (*Lx*), which measures the relative share of the cumulative sum of income for a given percentage of population ranked by income. The Gini index (*Gx*), derived from the Lorenz curve, is commonly used to synthesize relative inequality through a single indicator. As is well known, its mathematical expression for continuous income distributions is as follows:

$$G_x = \frac{\int_0^\infty \int_0^\infty |x-y| f(x) f(y) dx dy}{2\mu}, \tag{1}$$

where μ represents average income and $f(x)$ and $f(y)$ are the frequency densities for incomes x and y. Hence, the Gini index captures the average difference between income pairs divided by double the average income, its value ranging from 0 to 1. As in the case of the Lorenz curve, this index indicates relative inequality, but not absolute inequalities. Its interpretation in terms of welfare is therefore difficult when average income levels differ across two samples.[1]

In the same way as the aforementioned indicators could be useful when comparing income distributions, reformulations of such indicators can be derived in order to analyze the impact of the tax on distributions. Thus, if we suppose that all the population units having the same income bear the same tax burden in order to simplify matters—in other words, that the tax burden solely depends on income—it is possible to represent the said tax burden's distribution through a

[1]Nonetheless, an evaluation function equaling the mean times the Gini index can be used.

technique similar to the one described for Lorenz curves. The concentration curve of taxes (Lt) would thus be obtained, as would the concentration coefficient Ct associated to it, an index analogous to the Gini index. If, for simplicity's sake, we suppose no re-ranking is produced ($Cx - t = Gx - t$), we could similarly obtain the after-tax income concentration curve Lx–t and its corresponding concentration coefficient $Cx - t$. More specifically, the tax concentration index would be:

$$C_t = \frac{\int_0^{\infty}\int_0^{\infty} |t(x) - t(y)| f(x) f(y) dx dy}{2\mu t}, \tag{2}$$

where t is the effective average tax rate, and $t(x)$ and $t(y)$ represent the tax burdens borne by incomes x and y. The after-tax income concentration coefficient would be:

$$C_{x-t} = \frac{\int_0^{\infty}\int_0^{\infty} |(x - t(x)) - (y - t(y))| f(x) f(y) dx dy}{2\mu(1-t)}. \tag{3}$$

In the case of a progressive tax, the tax liabilities would be systematically deviated from proportionality with respect to before-tax income. This more unequal distribution of tax burdens compared to incomes implies that the concentration curve for taxes is located further away from the diagonal than the Lorenz curve for before-tax income. In other words, using common notation, $Lx > Lt$. Lx not only represents the Lorenz curve for before-tax income but also the concentration curve of taxes that would be obtained with a proportional tax. It is therefore possible to interpret the separation between such curves ($Lx - Lt$) as a measure of the tax's deviation from proportionality, which is precisely the aim of the Kakwani index:

$$K = C_t - G_x. \tag{4}$$

A progressive tax would also change income distribution. It is common to quantify this redistributive effect through the distances between pre- and post-tax Lorenz curves ($Lx - t - Lx$), synthesized by means of the Reynolds–Smolensky index (RS):

$$RS = G_x - C_{x-t}. \tag{5}$$

These indices are linked by the following equation:[2]

$$RS = \frac{t}{1-t} K. \tag{6}$$

Hence, the redistributive effect would be determined by progressivity and by the tax's level.

[2]See Lambert (2001). This equation was also derived by Silber (1994).

These indices are commonly used to analyze the consequences of tax reforms on progressivity and on income redistribution. Nonetheless, they may show some shortcomings when they are used to analyze tax reforms that involve changes in tax revenue, since we are dealing with relative comparisons in which proportions and not levels matter. Yet, when we compare situations in which levels vary significantly, these tools show important shortcomings.[3] Developments based on the work of Atkinson (1970) and Shorrocks (1983) are used to overcome these shortcomings by employing generalized Lorenz curves.

Nevertheless, when a tax reform is analyzed, such reservations appear to be less strict and it is very common in empirical works to use Lorenz and concentration curves—along with the inequality, progressivity, and redistribution indices associated with them—to obtain "normative" consequences. Such comparisons and normative judgments are correct if total tax revenue remains unchanged. Yet, in a non-revenue neutral tax reform, changes in progressivity and/or redistribution do not have evident normative meaning. Instead of comparing after-tax income distributions using generalized Lorenz concentration curves, which would be correct if the whole picture of taxes and government spending is considered, we advocate using a different decomposition of the RS index. The traditional decomposition of this index enables us to distinguish the variation in the tax's redistributive capacity resulting from changes in the average tax rate ($t/1 - t$) from the variation generated by changes in progressivity (K). A reduction (increase) in "t" would always have a negative (positive) effect on RS when the tax is progressive. A reduction (increase) in progressivity measured by K would likewise have the same effect. It may appear from (6) that one can make a separate analysis regarding what has happened in terms of the tax's yield and in terms of its progressivity. It would therefore be possible to assess the increase in progressivity, but, precisely for a non-revenue neutral tax reform, this separate assessment concerning the consequences of the new tax design raises some doubts, since progressivity does also depend on the tax's level. Only a tax reform that changes tax burdens proportionally would leave K unchanged and attribute any variation of RS to the variation of the tax revenue. In other words, given that

$$(7) \quad RS = \frac{t}{1-t}K = \frac{t}{1-t}(C_t - G_x) = \frac{t}{1-t}\left(\frac{\int_0^\infty\int_0^\infty |t(x)-t(y)|\, f(x)f(y)\,dx\,dy}{2\mu t} - G_x\right),$$

it is clear that the average tax rate affects not only affect the term $\frac{t}{1-t}$ in the r.h.s. of this equation, but also K.

[3]Similarly, another well-known problem occurs when the Lorenz curves cross. See Lambert (2001).

3. Assessing Tax Reforms: An Alternative Proposal Based on the Level and Distance Effects

3.1. *Tax Reforms and Redistribution*

As has already been mentioned, when assessing the design of non-revenue neutral tax reforms, changes in the tax level and variations of progressivity are linked concepts. However, what can indeed be separated are the changes in the level of taxation and in the distances between net incomes or tax liabilities. Our proposal consists of decomposing the variation in the Reynolds–Smolensky index in order to separate the changes in the distances between net incomes from the changes in the average tax rate. Taking into account that:

$$RS' - RS = (G'_x - C'_{x-t}) - (G_x - C_{x-t}), \tag{8}$$

and to simplify, we suppose that the Gini index before and after the reform has not changed[4] ($G'x = Gx$), then:

$$RS' - RS = C_{x-t} - C'_{x-t} = \frac{\int_0^\infty\int_0^\infty |(x-t(x))-(y-t(y))| f(x)f(y)dxdy}{2\mu(1-t)} - \frac{\int_0^\infty\int_0^\infty |(x-t'(x))-(y-t'(y))| f(x)f(y)dxdy}{2\mu(1-t')}, \tag{9}$$

where the symbol (′) represents the variable's corresponding value after the reform. This equation can be decomposed as:

$$RS' - RS = \frac{\int_0^\infty\int_0^\infty |(x-t(x))-(y-t(y))| f(x)f(y)dxdy}{2\mu(1-t)}\left(1-\frac{1-t}{1-t'}\right) + \frac{\int_0^\infty\int_0^\infty |(x-t(x))-(y-t(y))| f(x)f(y)dxdy - \int_0^\infty\int_0^\infty |(x-t'(x))-(y-t'(y))| f(x)f(y)dxdy}{2\mu(1-t')}. \tag{10}$$

In order to show the meaning of this expression more clearly, we let β be the after-tax average variation rate, D the sum of the distances between incomes prior to the reform, and D' the sum of distances between incomes after the reform:

$$\beta = \frac{(1-t')-(1-t)}{(1-t)}, \tag{11}$$

[4]Empirical analyses are usually based on a static pre-tax income distribution, on which different tax reforms are evaluated. However, we shall drop this assumption in Section 3.4.

$$D = \int_0^\infty \int_0^\infty |(x - t(x)) - (y - t(y))| f(x) f(y) dx dy \tag{12}$$

and

$$D' = \int_0^\infty \int_0^\infty |(x - t'(x)) - (y - t'(y))| f(x) f(y) dx dy. \tag{13}$$

Hence, equation (10) can be expressed as:[5]

$$RS' - RS = C_{x-t}\left(1 - \frac{1}{1+\beta}\right) + \frac{D - D'}{2\mu(1-t')}. \tag{14}$$

The variation of the Reynolds–Smolensky index would therefore be the sum of what we could call a Level Effect (LE) and a Distance Effect (DE):[6]

$$LE = C_{x-t}\left(1 - \frac{1}{1+\beta}\right), \tag{15}$$

$$DE = \frac{D - D'}{2\mu(1-t')}. \tag{16}$$

The Level Effect would represent the difference between the net income concentration curve before the reform and the curve that would exist if such a reform were carried out by means of a positive or negative transfer that is equivalent for all individuals, so as to keep the distances between incomes constant. The representation of this effect in the case of a tax cut can be seen in Figure 1, in which $Lx - t$ represents the original concentration curve and $Lx - tn$ represents the concentration curve after such a fictitious reform. The Distance Effect, on the other hand, expresses the difference between the concentration curve that would exist if the reform were carried out by means of positive or negative transfers that are equivalent for all individuals, whilst maintaining the distances between net incomes constant and the concentration curve after the real reform ($L'x - t$). Thus, if a reduction in distances comes about, this effect would be as shown in Figure 1.

This decomposition is capable of identifying the contributory effects produced by each of the two factors: variations in average rate and in distances. Both compare distances under a hypothetical scenario with the same tax revenue, and

[5]Silber (1994) decomposes progressivity into pre-tax income shares and standardized tax rates. The main results of this paper could indeed have been derived using his approach. However, we must note that, unlike Silber, we do not standardize because we intend to investigate the effect of absolute distances and average tax rates on progressivity and redistribution. On the other hand, our proposal is linked to the mean-Gini approach of the portfolio analysis literature (see Yitzhaki, 1982). Finally, it must be remarked that we do not consider the possible re-ranking effects of tax reforms. In this sense, a possible extension of our analysis could be developed following Bourguignon (2011).

[6]Although we have decided to use the terms Level and Distance Effects, they do indeed amount to making a distinction between impacts of changes in the mean and in the dispersion of the relevant variables.

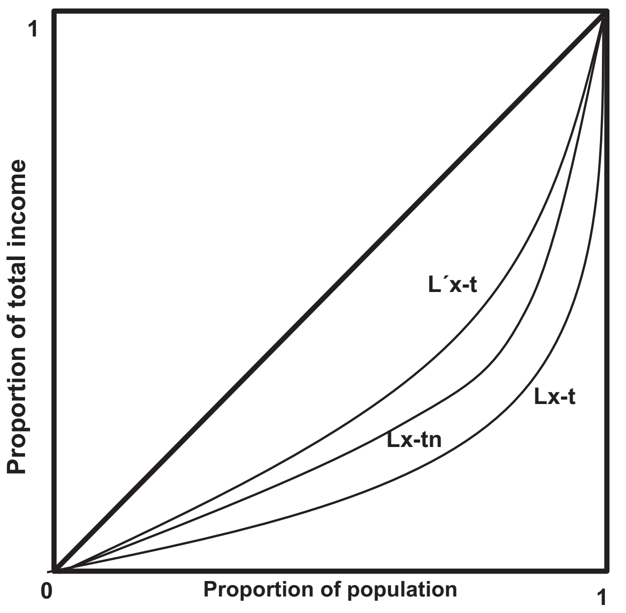

Figure 1. Redistribution; Level and Distance Effects

may take on a positive sign (positive contribution to redistribution) or a negative sign (negative contribution). More specifically, for the Level Effect:

- If t decreases, then $\beta > 0$ and LE > 0
- If t increases, then $-1 < \beta < 0$ and LE < 0
- If t remains constant, then $\beta = 0$ and LE = 0.

While for the Distance Effect:

- If $D > D'$, then DE > 0
- If $D < D'$, then DE < 0
- If $D = D$, then DE = 0.

It is important to highlight that the direction of the effect of any change made to the taxation level is identified with this decomposition. For instance, if we supposed a tax reform that only reduced the average rate without modifying distances between tax liabilities, the traditional decomposition would indicate: (1) that the tax's redistributive capacity has increased; (2) that the reduction in the average rate has contributed negatively to this increase; and (3) that progressivity has therefore been solely responsible for the greater redistributive capacity. Nonetheless, to some extent (2) and (3) are incompatible, given that if progressivity has increased it was solely due to the reduction in the average rate and it has therefore had a positive net contribution to redistributive capacity, being the only factor responsible for its increase as a matter of fact. The decomposition presented herein would, on the contrary, indeed show that the reduction of the average rate has had a positive effect on the tax's redistributive capacity and that it is also the only factor behind its increase. In other words, the traditional decomposition would not tell us if absolute income distances have changed. It would only inform us that relative tax burdens have done so, but not if this is due solely to the average tax rate decrease or also to changes in absolute tax burdens. Our approach can provide this information too, as will be shown in the next section.

3.2. *Tax Reforms and Progressivity*

An increase (reduction) of progressivity is identified with an increase (reduction) of the Kakwani index:

$$K' - K = (C_t' - G_x') - (C_t - G_x). \tag{17}$$

If to simplify, we once again suppose that the Gini index before and after the reform has not changed ($G'x = Gx$), naming β now as the variation rate of the average tax rate and D and D' now as the sum of the distances between tax liabilities before and after the reform:

$$\beta = \frac{t'}{t} - 1, \tag{18}$$

$$D = \int_0^\infty \int_0^\infty |t(x) - t(y)| f(x) f(y) dxdy \tag{19}$$

and

$$D' = \int_0^\infty \int_0^\infty |(t'(x) - t'(y)| f(x) f(y) dxdy, \tag{20}$$

then, following similar steps as above, we get

$$K' - K = C_t \left(\frac{1}{1+\beta} - 1 \right) + \frac{D' - D}{2\mu t'}. \tag{21}$$

Hence, the variation of the Kakwani index would be the sum of the level effect (LE) and the distance effect (DE), now defined as:[7]

$$LE = C_t \left(\frac{1}{1+\beta} - 1 \right) \tag{22}$$

$$DE = \frac{D' - D}{2\mu t'}. \tag{23}$$

[7]It is interesting to note that in Silber's approach the average tax rate is a separate determinant of the change in the Reynolds–Smolensky index, but not in that of the Kakwani index. This is true in Silber's decomposition because it refers to standardized rates. As stated above, we do not standardize because our aim is precisely to investigate absolute changes (distances) and not only relative changes amongst taxpayers.

In this case, the Level Effect would represent the difference between the concentration curve of tax liabilities before the reform and the concentration curve that would be obtained should it be carried out through either a positive or negative transfer that is equivalent for all individuals, thereby maintaining the distances constant. The Distance Effect, on the other hand, expresses the difference between the concentration curve that would exist if the reform had been carried out by means of positive or negative transfers that are equivalent for all individuals, thereby maintaining the distances between tax liabilities constant.

Again, the effect of the average tax level is separated from the effect corresponding to the differences between tax liabilities. In other words, while traditional analyses can only indicate whether progressivity has changed but not if it is due to a change in the average tax rate or to real changes in the differences among tax liabilities, the decomposition put forward herein does indeed allow one to make such a distinction. So, both the Level Effect and the Distance Effect can take on a positive sign (positive contribution to progressivity) or a negative sign (negative contribution).

3.3. *A Classification of Tax Reforms Based on the Level and Distance Effects*

Once the Distance and Level Effects have been defined, the different kinds of tax reforms can be classified on the basis of such effects. Thus, with respect to redistribution the classification would be as shown in Figure 2.

There would be four possible kinds of tax reforms. First, reforms in which RS increases and the distance coefficient is positive (distances among net incomes are reduced), which could be called strong redistributive reforms. Second, reforms in which RS increases and the distance coefficient is negative (distances among net incomes increase), which could be called weak redistributive reforms. Third, reforms in which RS is reduced and DE is positive (distances among net incomes decrease), which would be weak non-redistributive reforms. And lastly, reforms in which RS is reduced while the distances among taxpayers' net incomes increase, which would be strong non-redistributive reforms.

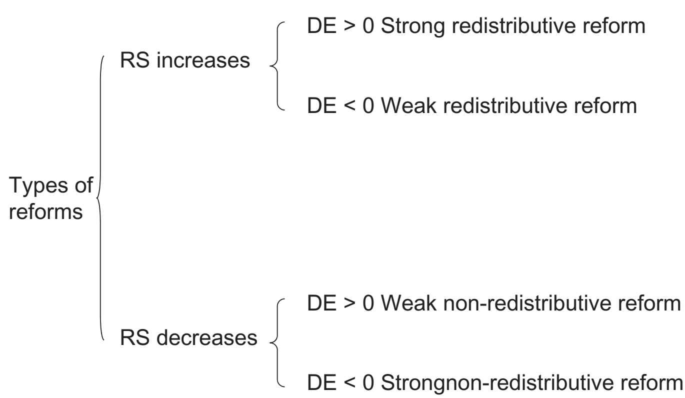

Figure 2. Redistribution; Classification of Tax Reforms

Thus, the use of this classification allows tax reforms to be classified not only on the basis of the tax's redistributive capacity but also on the basis of what happens to the distances among the taxpayers' net incomes. The following indicator (distance-level redistribution index) can be used to analyze tax reforms:

$$I_R = \frac{\Delta RS}{|\Delta RS|}\left(1 + \frac{DE}{|DE| + |LE|}\right). \quad (24)$$

$$\frac{\Delta RS}{|\Delta RS|} = +/-1; \; 0 \leq \left(1 + \frac{DE}{|DE| + |LE|}\right) \leq 2.$$

The $\frac{\Delta RS}{|\Delta RS|}$ component would provide the indicator's sign and $\left(1 + \frac{DE}{|DE| + |LE|}\right)$ would provide its absolute value, which would represent the relative importance of the distance effect in the reform. The reforms would therefore be classified as:

(a) $1 < I_R \leq 2$: strong redistributive reform (RS increases, DE > 0).
(b) $0 < I_R \leq 1$: weak redistributive reform (RS increases, DE < 0).
(c) $-2 \leq I_R < -1$: weak non-redistributive reform (RS decreases, DE > 0).
(d) $-1 \leq I_R < 0$: strong non-redistributive reform (RS decreases, DE > 0).

The analysis would be similar in the case of progressivity. The corresponding indicator (distance-level progressivity index) is as follows:

$$I_K = \frac{\Delta K}{|\Delta K|}\left(1 + \frac{DE}{|DE| + |LE|}\right). \quad (25)$$

$$\frac{\Delta K}{|\Delta K|} = +/-1; \; 0 \leq \left(1 + \frac{DE}{|DE| + |LE|}\right) \leq 2.$$

In sum, our proposal allows to us compare between non-neutral tax reforms, while being coherent with the traditional K and RS indicators, since it adds the terms "strong" and "weak" to the traditional "redistributive" or "progressive" classifications.

3.4. *Level and Distance Effects: A Role for the Shapley Decomposition Rule*

Although our proposal is not intended to compute the individual contributions of average tax rates and post-tax income differences (or tax liabilities) to the variation of RS (K), but just to provide information about the tax burden impact and the design of tax reforms, these contributions can be calculated by means of the Shapley decomposition technique.[8] In the particular case of the Reynolds–

[8]This technique considers the marginal impact of each factor when they are eliminated in sequence. Since individual contributions depend on the order of the elimination sequence, all possible sequences are considered, and therefore the contribution of each factor amounts to the expected value of its marginal impact when the sequences are chosen randomly (see Shapley, 1953; Shorrocks, 2012). In this case, there are only two possible elimination sequences.

Smolensky index, the individual contributions of the average tax rate and post-tax income distances variations to the RS variation are:

(26) $$C(t) = LE - \frac{1}{2}\beta DE$$

and

(27) $$C(D) = DE\left(1 + \frac{1}{2}\beta\right),$$

where $C(t)$ and $C(D)$ stand for the contribution of the average tax rate and post-tax income difference variations, respectively. As expected, these contributions sum up to the overall variation of RS.

On the other hand, we have assumed so far that pre-tax income distribution before and after the reform does not change. Although empirical works on tax reform evaluations usually maintain this assumption, it seems convenient to investigate the consequences of pre-tax income distribution changes on our approach. Thus, if we drop this assumption, we get:

(28) $$RS' - RS = LE_x + DE_x + LE_{x-t} + DE_{x-t},$$

where the subscripts x and $x - t$ stand for pre- and post-tax income, respectively. In other words, there would be a level effect and a distance effect in both pre-tax and post-tax income, the former being analytically equivalent to the latter but referred to pre-tax income. Tax reform may be evaluated by also taking into account its possible impact on pre-tax income level and distribution using the Shapley decomposition (in this case into four components: mean income, mean tax rate, distances between pre-tax incomes, and distances between post-tax incomes):

(29) $$C(\mu) = -\frac{1}{3}(\beta_\mu)\left(\frac{1}{2}(\beta_t + 1) + 1\right)DE_{x-t} - \frac{1}{2}\beta_\mu DE_x + \frac{1}{2}LE_{x-t(\mu)} + LE_x + \frac{1}{2}LE_{x-t} - \frac{1}{2}LE_{x-t(t)}$$

(30) $$C(t) = -\frac{1}{3}(\beta_t)\left(\frac{1}{2}(\beta_\mu + 1) + 1\right)DE_{x-t} + \frac{1}{2}LE_{x-t} + \frac{1}{2}LE_{x-t(t)} - \frac{1}{2}LE_{x-t(\mu)}$$

(31) $$C(D_x) = \frac{1}{2}(\beta_\mu + 2)DE_x$$

(32) $$C(D_{x-t}) = \left[\frac{1}{3}(\beta_\mu + 1)(\beta_t + 1) + \frac{1}{6}(\beta_\mu + 1) + \frac{1}{6}(\beta_t + 1) + \frac{1}{3}\right]DE_{x-t}$$

where $C(\mu)$, $C(D_x)$, and $C(D_{x-t})$ stand for the contribution of the average income, pre-tax and post-tax income difference variations, respectively; β_μ and β_t

are $\left(\frac{\mu'}{\mu}-1\right)$ and $\left(\frac{1-t'}{1-t}-1\right)$, respectively; $LE_{x-t(\mu)}=C_{x-t}\left(1-\frac{\mu}{\mu'}\right)$, and $LE_{x-t(t)}=C_{x-t}\left(1-\frac{1-t}{1-t'}\right)$. Again, as expected, these contributions sum up to the overall variation of RS.

Similar decompositions can be implemented for the Kakwani index. In order to avoid an excessive length of the paper, these decompositions are not developed here.

4. An Application of the Level and Distance Effects: The Spanish Personal Income Tax Reforms

Applying the analysis set out above in its basic version to the Spanish Personal Income Tax reforms which occurred in Spain in 2003 and 2007 gives the following results. In the former, the Reynolds–Smolensky index fell from 0.0433 to 0.0416, while the Kakwani index rose from 0.2926 to 0.3208 (Table 1).[9] Thus, a reduction in the tax's redistributive capacity and an increase in its progressivity would have come about according to the traditional interpretation, and the main cause for the former would have been the reduction in the average rate (and not the changes in the tax burden distribution generated by the tax reform design). On the contrary, according to our approach, what has really happened in both cases is a positive contribution of the Level Effect (due to the reduction in the average rate) and a negative contribution of the Distance Effect (due to a greater distance between net incomes). The indices proposed in this paper therefore indicate that the reform, and its design, was strongly non-redistributive ($I_R = -0.4396$) and weakly progressive ($I_K = 0.59$).

Regarding the 2007 reform (Table 2), both the Reynolds–Smolensky and the Kakwani indices increased, although the former did so to a very slight degree. Hence, according to the traditional interpretation, tax's progressivity increased, as did its redistributive capacity to a lesser degree. Nonetheless, according to the approach proposed herein, what actually happened in both cases was a positive

TABLE 1

2003 Personal Income Tax Reform

	2003	2002	Variation
Reynolds–Smolensky index	0.0416	0.0433	–0.0017
Kakwani index	0.3208	0.2926	0.0282
	RS	K	
Level Effect	0.0063	0.0924	
Distance Effect	–0.0080	–0.0642	
I_R	–0.4396		
I_K		0.5900	

[9]The results of this section have been computed by employing the Personal Income Taxpayers Sample of the Spanish Institute for Fiscal Studies and the Spanish Tax Administration. On the other hand, the €400 reimbursement was eliminated in 2010 for taxpayers whose taxbase is higher than €12,000.

TABLE 2
2007 Personal Income Tax Reform

	2007	2006	Variation
Reynolds–Smolensky index	0.0417	0.0414	0.0003
Kakwani index	0.3476	0.3227	0.0249
	RS	K	
Level Effect	0.0029	0.0475	
Distance Effect	–0.0026	–0.0226	
I_R	0.5198		
I_K		0.6770	

TABLE 3
€400 Tax Reimbursement, 2008

	2008	2007	Variation
Reynolds–Smolensky index	0.0412	0.0417	–0.0005
Kakwani index	0.3834	0.3476	0.0359
	RS	K	
Level Effect	0.0046	0.0894	
Distance Effect	–0.0051	–0.0535	
I_R	–0.4726		
I_K		0.6255	

contribution of the Level Effect and a negative contribution of the Distance Effect. Although the Distance Effect is negative, it is so slight as not to offset the Level Effect, as opposed to the previous reform. In other words, the reduction in the average tax rate in both reforms tended to increase the tax's redistributive capacity in terms of a positive Level Effect. However, in the 2003 reform, the increase in the distances between net incomes exceeded this positive effect, while in the 2007 reform it did not. Hence the total effect of the former was negative while that of the second was positive. That is why the indices indicate that the 2007 reform was weakly redistributive ($I_R = 0.5198$) and weakly progressive ($I_K = 0.6770$).

Lastly, a personal income tax reimbursement to taxpayers amounting to €400 was implemented in 2008. As a result, the Kakwani index increased and the Reynolds–Smolensky index fell, which would traditionally be interpreted as indicating that the tax was more progressive but had less redistributive capacity due to the cut in the average rate (Table 3). Nonetheless, what really occurred in both cases was, once again, a positive contribution of the Level Effect and a negative contribution of the Distance Effect. The first was due to a reduction in the average rate, while the second resulted from the greater differences between net incomes and smaller differences between tax liabilities. Hence, this measure was strongly non-redistributive ($I_R = -0.4726$) and weakly progressive ($I_K = 0.6255$).

In sum, although the traditional progressivity indicator (K) increases in the three reforms studied, the design of these reforms can only be classified as weakly progressive, since the distances between tax liabilities have increased. In addition, although these reforms differ in terms of revenue, the distance-level progressivity index allows us to rank them in terms of progressivity. Thus, the 2007 reform shows the highest value, followed by the "€400 reform"; while the last place belongs to the 2003 reform (2007 > 2008 > 2003). This classification is clearly different to the ranking derived from K variations (2008 > 2003 > 2007).

Concerning redistribution, according to the traditional indicator (RS), both the "€400" and the 2003 reforms are non-redistributive, which is solely due to the tax revenue reductions, since progressivity indices rise. Yet, the distance-level redistribution index indicates that, being true that the reforms were non-redistributive, it was also due to the design of the reform, since the distance between net incomes increased. Therefore, both reforms were strongly non-redistributive. Finally, in the 2007 reform, although its design also contributed negatively to the tax redistributive capacity, the increase in net income distances was so small as to be offset by the tax cut, so the reform was weakly redistributive.

5. Concluding Remarks

Throughout this paper we have tried to show the limits of the Kakwani and the Reynolds–Smolensky indices to analyze the effects of non-revenue neutral tax reforms on progressivity and redistribution. We have put forward some indicators that would allow the effects of a non-revenue neutral tax reform to be investigated on the basis of two concepts that are separable: tax level and the distances between net incomes or tax liabilities.

The Distance and Level Effects developed in this paper allow us to partly recover the intuitive feel of the notions of progressivity and redistribution. Determining "who benefits most" from a tax reform is a difficult matter and subject to value judgments. The traditional indicators provide a view based on relative differences in income or tax burdens, which are useful to make comparisons in reforms that keep the tax revenue constant. But if revenue does vary, the conclusions reached could be in some cases counter-intuitive. For instance, how can a reform that mainly benefits high-income taxpayers increase progressivity? If this is so, is it "good" to increase progressivity? Seen from a different standpoint, would most citizens vote for a reform of this kind if they were well informed? From a tax-increase perspective, this is an important issue, especially in developing low-tax countries. It is quite likely that a tax rise would reduce progressivity, as measured by the Kakwani index, since any increase in the average tax rate tends to decrease this index, although in absolute terms most of the tax rise would be borne by high-income taxpayers.

Our proposal tries to offer up a different solution. The Level Effect isolates the effects a reform would have on the income and tax burden percentages borne by taxpayers should the distances between tax liabilities and incomes remain constant. The Distance Effect reflects the effects of the reform's specific design (namely, the tax elements modified).

Our decomposition of a tax reform's effects shows the effects of the change on the distances between net incomes or between tax liabilities, without giving up the use of traditional instruments based on a relative notion of inequality.

Policy-makers and citizens may have an interest in getting to know the consequences of a tax reform in absolute terms and how it affects the distances between individuals' incomes (or tax liabilities).

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