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The Distributional Effects of Tax-benefit Policies under New Labour: A Shapley Decomposition*

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Abstract

Using counterfactual microsimulations, Shapley decompositions of time change in inequality and poverty indices make it possible to disentangle and quantify the relative effect of tax-benefit policy changes, compared to all other effects including shifts in the distribution of market income. Using this approach also helps to clarify the different issues underlying the distributional evaluation of policy reforms. An application to the UK (1998-2001) confirms previous findings that inequality and depth of poverty would have increased under the first New Labour government, had important reforms like the extensions of income support and tax credits not been implemented. These reforms have also contributed to substantially reduce poverty among families with children and pensioners.

Key Words : Tax-benefit policy; inequality; poverty; Shapley decomposition; microsimulation.

JEL Classification : H23, H53, I32

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1 Introduction

For analysts and policy makers, it is crucial to know whether actual tax-benefit reforms have achieved their objectives in terms of redistribution. A usual way to identify the impact of policy changes on income distribution is to decompose inequality indices by income components, possibly isolating the role of taxes or social transfers, and to repeat the assessment at different points in time (before and after important reforms). Decomposition by income types, as introduced and axiomatised by Shorrocks (1982), has well-known limitations summarized in Shorrocks (1999). In particular, the contribution assigned to a specific factor is not always interpretable in an intuitively meaningful way (cf. Chantreuil and Trannoy, 1997). Moreover, constraints are often placed on the types of poverty and inequality indices which can be used, some indices requiring the introduction of a vaguely defined 'interaction' term in order to maintain the decomposition identity. Equally crucial for policy analyses, measuring the contribution of taxes and transfers to overall inequality/poverty at different points in time does not allow disentangling the pure effect of policy changes from their interaction with the underlying population. For instance, social assistance schemes may appear more redistributive because of their increased generosity or because of automatic increase in welfare payments as unemployment rises.[1]

In this respect, microsimulation models have proven extremely useful over the past two decades (cf. Atkinson, 2005). Indeed they allow us to construct counterfactuals to disentangle the pure effect of policy changes from changes in the environment in which policy operates – in particular changes in market income inequality possibly due to variations in unemployment rates, wage inequality, demographics, etc. However, measures may be sensitive to the choice of indexation factor used in the "no reform" counterfactual scenario. Results may also depend on the underlying population used to evaluate policy change, either the base-period or the final-period data. This issue has been investigated in the literature on tax progressivity.[2] Yet it has received little attention by policy analysts, though results may be sensitive to the choice made.[3] An exception is the study of Clark and Leicester (2004) who carefully investigate the distributional effect of policy changes over the 1980s and 1990s in the UK and provide an extensive sensitivity analysis.

This paper attempts to clarify these issues by embedding policy evaluation in a formal framework based on the Shapley decomposition. The change in the poverty or inequality measures is decomposed

[1] The approach sometimes referred to as the 'actual payments' method is used by Jenkins (1995) and Goodman, Johnson and Webb (1997) to analyse inequality trends in the UK in the 1970s and 1980s. Their finding that the tax-benefit system of the late 1980s was not less redistributive than that of the late 1970s is partly due to the fact that they do not account for changes in the underlying market income distribution.

[2] Musgrave and Thin (1948) show that measures of progressivity (or redistributive power) do not only depend on the tax structure and the average tax burden but also on the actual pre-tax income distribution. Recent analyses include Dardanoni and Lambert (2002) and Lambert and Thoresen (2009).

[3] For instance, Thoresen (2004) extensively analyses the impact of tax changes on progressivity and redistribution in Norway as assessed using base-period data. Adam and Wakefield (2005) analyse the distributional impact of tax-benefit reforms implemented between 1997 and 2005 in the UK as assessed on end-period data.

into three components: (i) the effect of changes in tax-benefit policy, (ii) the effect of adjusting tax-benefit monetary parameters according to market income growth; and (iii) the effect of changes in market income inequality (or more generally all the changes not directly linked to tax-benefit policies). Breaking down factors (ii) and (iii) allows separating changes in underlying gross incomes into a growth component and a redistribution component. It also provides a 'distributionally neutral' backdrop against which the policy effect (i) can be evaluated (cf. Callan et al., 2006, Bargain and Callan, 2008). The policy impact is alternatively assessed on base-period and end-period data. Symmetry arguments also suggest that the two alternative measures should be averaged (see Shorrocks, 1999, and Kolenikov and Shorrocks, 2005). This leads to a third decomposition in which the (averaged) policy effect is the contribution associated with the policy change in a two-way Shapley decomposition.

We apply the three decompositions to revisit the role of tax-benefit policies implemented in the UK over 1998-2001. Interestingly, this corresponds to a period of economic boom, accompanied by an increase in market inequality, as well as a time of significant increase in benefits and tax credits under the first New Labour government (1997-2001). Our main contribution is to quantify precisely the relative role of policy changes on inequality/poverty trends. Importantly, key results are robust with respect to the decomposition method. In line with previous studies, we find that inequality has remained stable or slightly increased overall, but would have risen significantly without Labour's reforms. We also extract from the total policy effect the impact of the most salient policy developments of this period. The extensions of the income support and of the family tax credit seem to be the most redistributive policies, with substantial poverty reduction among pensioners and families with children.

The layout of this paper is as follows. Section 2 presents the decomposition approach. Section 3 describes the data, the microsimulation model and the empirical results. Section 4 concludes.

2 Shapley Decomposition

2.1 Background

We first introduce some notation and terminology. We denote by household 'gross income' or 'market income' the total amount of labour income, capital income and private pensions before taxes and benefits. 'Disposable income' is the household income that remains after payment of taxes/social contributions and receipt of all transfers, as widely used to measure poverty and inequality.[4] Matrix y describes the population contained in the data, i.e. each row contains all the information about a given household (various income sources and socio-demographic characteristics). Denote d the 'tax-benefit function' transforming, for each household, gross incomes and household characteristics into a certain level of disposable income.

[4] For our application to the UK, we consider that the link between contributions and the value of benefits is loose enough so that earnings-replacement incomes provided by the state (job seeker's allowance, basic pension, disability benefits) can be treated as part of the redistribution function.

Tax-benefit calculations depend also on a set of monetary parameters (e.g. maximum benefit amounts, threshold level of tax brackets, etc.), denoted p. Thus, the distribution of disposable income is represented hereafter by $d_i(p^j, y^l)$, for a hypothetical scenario with the underlying population of year l, the tax-benefit parameters of year j and the tax-benefit structure of year i. In the empirical part, we are interested in relative inequality/poverty indices I, computed as a function $I\left[d_i(p^j, y^l)\right]$ of the (simulated) distribution of disposable income for a given year or for counterfactual situations. Also, policy changes under study possibly combine changes in policy structure d and changes in parameters p (the 'uprating policy').

Hereafter, we shall consider the possibility of nominally adjusting income levels by the uprating factor α^1, i.e., the income growth rate between year 0 and year 1. That is, $\alpha^1 y^0$ retains the structural characteristics of year 0 data (in particular the distribution of gross income) but adopts the nominal levels prevailing in year 1. With this notation, we can easily represent counterfactual situations. For instance, $d_1(p^1, \alpha^1 y^0)$ represents disposable incomes obtained by applying tax-benefit rules and parameters of year 1 on nominally adjusted data of year 0. This backdrop, where the new policy is evaluated while holding the population constant, is used in the decomposition below. Symmetrically, we may need to evaluate the distribution obtained with the initial policy applied to the new population. A measure $d_0(p^0, y^1)$ would not be consistent since base-period parameters would be artificially applied to end-period income levels. For instance, previous tax band thresholds would be applied to new and possibly higher income levels, thereby generating artificial 'fiscal drag'. Therefore, we need to construct counterfactuals where tax-benefit parameters can be uprated using the same factor α^1 as used to scale up the distribution of gross income between period 0 and 1. Clearly, the nominally adjusted schedule, denoted $\alpha^1 p^0$, is not identical to the *actual* set of parameters p^1 as decided by the authorities. However, $d_0(\alpha^1 p^0, y^1)$ suggests an interesting backdrop where the only policy change between years 0 and 1 is an uprating of money parameters in line with income growth.

A useful property stems from these adjustments, namely the linear homogeneity of the tax-benefit function:

$$d_i(\alpha p^j, \alpha y^l) = \alpha d_i(p^j, y^l). \tag{1}$$

It states that a simultaneous change in nominal levels of both incomes and parameters should not affect the relative location of households in the distribution of disposable income. It is easily shown that this property holds if the tax-benefit system is linear and continuous in p and y which is the case in many countries (see Bargain and Callan, 2008, for an illustration). We shall test this property empirically for the UK system in the next section. If it holds, the function $I \circ d$ is homogenous and we can write:

$$I\left[d_0(\alpha^1 p^0, \alpha^1 y^0))\right] = I\left[d_0(p^0, y^0)\right], \tag{2}$$

which proves useful in what follows. We make a final remark about the zeros contained in the initial income distribution y^0. Those correspond to unemployed and inactive households without other resources than state transfers. In (2), welfare payments (in the parameter vector p^0) are uprated by the same factor α^1 as market incomes so that the relative position of these households does not decrease.

2.2 Decomposition

Characterize total change Δ in the inequality/poverty index I between initial period 0 and final period 1 as:

$$\Delta = I\left[d_1(p^1, y^1)\right] - I\left[d_0(p^0, y^0)\right]. \tag{3}$$

This change in the distribution of disposable income, as summarized by index I, can be decomposed into the contribution of the change in the tax-benefit policy ('policy effect') and the contribution of changes in the underlying gross income distribution (or any other effects not directly linked to policy changes). The former effect corresponds to a shift from $d_0(p^0, \cdot)$ to $d_1(p^1, \cdot)$ while the latter is simply a move from base year data y^0 to final data y^1. Thus the decomposition consists in a shift in data conditional on the initial policy, followed by a change in policy evaluated on final data (decomposition I). Or, alternatively and symmetrically, a change in policy evaluated on base year data, followed by a change in underlying data conditional on the new policy (decomposition II).

As explained above, we cautiously apply *nominally-adjusted* tax-benefit parameters p^0 to final income y^1 so that the decomposition I is written:

$$\begin{aligned} \Delta \quad = \quad & \left\{I\left[d_1(p^1, y^1)\right] - I\left[d_0(\alpha^1 p^0, y^1)\right]\right\} && \text{(policy effect)} \\ & + \left\{I\left[d_0(\alpha^1 p^0, y^1)\right] - I\left[d_0(\alpha^1 p^0, \alpha^1 y^0)\right]\right\} && \text{(income inequality)} \\ & + \left\{I\left[d_0(\alpha^1 p^0, \alpha^1 y^0))\right] - I\left[d_0(p^0, y^0)\right]\right\} && \text{(income growth).} \end{aligned} \tag{I}$$

The first term captures the effect of the tax-policy change over the period conditional on final year data. Conditional on the policy structure of year 0, and for nominal levels of year 1, the second term gauges the change in market income inequality (and more generally, in the underlying population). Symmetrically, decomposition II can be written:

$$\begin{aligned} \Delta \quad = \quad & \left\{I\left[d_1(p^1, y^1)\right] - I\left[d_1(p^1, \alpha^1 y^0)\right]\right\} && \text{(income inequality)} \\ & + \left\{I\left[d_1(p^1, \alpha^1 y^0)\right] - I\left[d_0(\alpha^1 p^0, \alpha^1 y^0)\right]\right\} && \text{(policy effect)} \\ & + \left\{I\left[d_0(\alpha^1 p^0, \alpha^1 y^0))\right] - I\left[d_0(p^0, y^0)\right]\right\} && \text{(income growth).} \end{aligned} \tag{II}$$

Here, the end-period system is evaluated on *nominally-adjusted* base-period data.

The primary objective of this paper is to quantify the relative effect of policy changes compared to changes in market income distribution. In the above expressions, nominal adjustments naturally lead to further decomposition of the change in income base into a growth component and a redistribution component. This is reminiscent of some of the applications of decomposition procedures to the context of countries in development or in transition. Datt and Ravallion (1992) and Kolenikov and Shorrocks (2005), among others, have studied the decomposition of changes in absolute poverty into the contribution of income growth (holding inequality constant) and the contribution of income inequality (holding mean income constant). In the present context, however, changes in market income levels and market income inequality are expressed after transformation into disposable income via the tax-benefit function $d(p, \cdot)$. Further, the income growth component – the third term in (I) and (II) – corresponds to a uniform growth in market income and in tax-benefit parameters (incl. earnings-replacement income for those with zero market income). It disappears if the homogeneity property (2) holds.

As argued by Shorrocks (1999), the Shapley value procedure can be employed whenever one wishes to assess the relative importance of the explanatory variables. In particular, the decomposition of a poverty/inequality statistic I can be carried out by considering the marginal effect on I of eliminating each of m contributory factors in sequence, and then assigning to each factor the average of its marginal contributions in all possible elimination sequences.[5] In our context, if the homogeneity property is verified, the 'policy effect' and the 'market income inequality effect' under the Shapley decomposition are thus obtained by averaging the contributions from the two decompositions set out above, that is:

$$\begin{aligned}
\text{policy effect} \quad &: \quad \frac{1}{2}\left\{I\left[d_1(p^1, y^1)\right] - I\left[d_0(\alpha^1 p^0, y^1)\right]\right\} + \frac{1}{2}\left\{I\left[d_1(p^1, \alpha^1 y^0)\right] - I\left[d_0(p^0, y^0)\right]\right\} \\
\text{income inequality} \quad &: \quad \frac{1}{2}\left\{I\left[d_0(\alpha^1 p^0, y^1)\right] - I\left[d_0(p^0, y^0)\right]\right\} + \frac{1}{2}\left\{I\left[d_1(p^1, y^1)\right] - I\left[d_1(p^1, \alpha^1 y^0)\right]\right\}.
\end{aligned}$$

In our empirical work, we aim to gauge the relative effect of policy change compare to the change in market income inequality. Importantly for the robustness of the policy analysis, we examine the sensitivity of the results to the choice of the decomposition, either the "end-weighted" measure (I), the "base-period weighted" measure (II) or the averaged Shorrocks-Shapley decomposition.

2.3 Discussion

The policy effect disentangled in the two first decompositions, $I\left[d_1(p^1, \cdot)\right] - I\left[d_0(\alpha^1 p^0, \cdot)\right]$, does not only capture the change in policy structure (d_0 to d_1) on income distribution. It also assesses the *actual* uprating policy (shift from p^0 to p^1) against a scenario where parameters are adjusted in line with average income growth ($\alpha^1 p^0$). This calls for an extensive discussion.

The way tax brackets and welfare payments are uprated by governments can have important implications for income distribution and public spending in the long run. Sutherland et al. (2008) provide a very extensive analysis of this question. Governments have many options to uprate tax-benefit parameters, three of them being fairly standard: (1) no uprating, (2) uprating according to the level of price inflation, (3) uprating according to the level of earnings growth. With non-indexation of tax brackets in progressive

[5] This approach is used by Mookherjee and Shorrocks (1982) to decompose inequality trends in the UK into the contributions of subgroup population shares, subgroup mean incomes and subgroup inequalities. Jenkins and van Kerm (2005) analyse inequality change in the UK in the 1980s and discuss the choice of weights used in the decomposition, either base-period values, end-period values or the Shapley value (averaging of all contributions).

systems, or price indexation when incomes rise faster than prices, the total number of tax payers (and the number of higher-rate taxpayers) increases. This phenomenon of 'fiscal drag' or 'bracket creep' must affect the final distribution of disposable income (see Immervoll, 2005). With price indexation of welfare payments when real income grows, those living on welfare fall further behind those receiving earnings and relative poverty may increase. This phenomenon of 'benefit erosion' tends to have larger distributional effects – especially poverty effects – than fiscal drag (cf. Sutherland et al., 2008).

So we may wish to further decompose the policy effect into the contributions of structural changes and uprating policy respectively. However, these two components are usually intertwined in a way that makes the distinction difficult and, to some extent, arbitrary. For instance, a reduction in the number of tax bands can be interpreted either as a structural change or as a particular nominal adjustment of tax band thresholds. Another example, particularly relevant for the UK during the period under study, is the introduction of the 'working family tax credit' (WFTC) in 1999. This reform is often seen as an important structural change while the WFTC has in fact kept the same structure as the previous family credit. That is, the reform has mainly consisted in the increase in payment levels and especially some changes in child increments (depending on the age of children). Even the decrease in the taper rate – i.e., an extension of the phasing-out of the transfer – can simply be seen as an increase in the income level at which the payment is stopped (cf. Sutherland and Gutierrez, 2004, for a detailed exposition).

Importantly, the actual policy changes are gauged against a "no reform" backdrop $d_0(\alpha^1 p^0, \cdot)$ where tax-benefit parameters are uprated with income growth. This is a natural consequence of the decomposition suggested above. More generally, this benchmark is suggested by several authors as the appropriate one for the purpose of evaluating the distributional effect of policies as compared to other changes in underlying data. Indeed, it provides a "distributionally-neutral" backdrop (Callan et al., 2006, Sutherland et al., 2008) or "constant progressivity" counterfactual (Clark and Leicester, 2004) against which actual policy changes can be evaluated.[6] For instance, benefit erosion when real income increases, as described above, would not be captured by a no-reform scenario adjusted with price inflation. Arguably, distribution-neutrality is only one criterion amongst many. The actual objectives of a government are more complex than mere redistribution and may actually include regressive policy changes. For instance, benefit erosion may be politically smoother than direct cuts in benefits when it comes to improving public finances. Notwithstanding, it seems interesting to provide policy makers with a gauge of the actual distributional implications of general policy actions – and the chosen benchmark seems well-suited for this purpose.

The philosophy behind alternatively no-reform scenarios is different. The one based on price inflation, used in many policy analyses (e.g., Brewer et al., 2004, for the UK), is often justified on historical ground.

[6] The desirability of earnings-related adjustments is also suggested by *actual* uprating policies in Scandinavian countries (and the Netherlands), generally regarded as 'best practice' examples in terms of welfare provision. For instance, Denmark has a unified and comprehensive uprating system where all benefits and tax parameters are systematically indexed on annual average earnings development.

Yet Clark and Leicester (2004) show that it actually captures only part of the uprating practices of the past decades in the UK.[7] While the historical justification aims to guarantee some continuity in the evaluation of policies, it must imply normative assumptions which have not been fully investigated.

For the sake of completeness, we take a look at alternative options within the present framework. A first possibility is to uprate both data and parameters with price inflation, denoted π^1. Assuming homogeneity of the tax-benefit function, decomposition I becomes:

$$\begin{aligned} \Delta &= \left\{ I\left[d_1(p^1, y^1)\right] - I\left[d_0(\pi^1 p^0, y^1)\right] \right\} && \text{(policy effect)} \\ &\quad + \left\{ I\left[d_0(\pi^1 p^0, y^1)\right] - I\left[d_0(p^0, y^0)\right] \right\} && \text{(income inequality).} \end{aligned}$$

Since $\pi^1 p^0$ represents a counterfactual policy where tax band thresholds and welfare payments have been price-indexed, the second term potentially includes fiscal drag / benefit erosion and cannot be interpreted as a pure change in market income inequality. With such decomposition, we cannot quantify the respective roles of policy changes and changes in market income. Instead, we keep on uprating data with average income growth α^1 but now adjust parameters with price inflation. Decomposition I then becomes:

$$\begin{aligned} \Delta &= \left\{ I\left[d_1(p^1, y^1)\right] - I\left[d_0(\pi^1 p^0, y^1)\right] \right\} && \text{(policy effect)} \\ &\quad + \left\{ I\left[d_0(\pi^1 p^0, y^1)\right] - I\left[d_0(\pi^1 p^0, \alpha^1 y^0)\right] \right\} && \text{(income inequality)} \\ &\quad + \left\{ I\left[d_0(\pi^1 p^0, \alpha^1 y^0))\right] - I\left[d_0(p^0, y^0)\right] \right\}. \end{aligned} \tag{I'}$$

In this case, the last term does not vanish, even if homogeneity holds. This residual term captures the distributional effect of a uniform income growth evaluated against a price-indexed system. It necessarily generates some benefit erosion (and fiscal drag) when gross incomes grow faster than prices. It therefore illustrates the non-distributional neutrality of a no-reform scenario based on price indexation. Decomposition II becomes:

$$\begin{aligned} \Delta &= \left\{ I\left[d_1(p^1, y^1)\right] - I\left[d_1(p^1, \alpha^1 y^0)\right] \right\} && \text{(income inequality)} \\ &\quad + \left\{ I\left[d_1(p^1, \alpha^1 y^0)\right] - I\left[d_0(\pi^1 p^0, \alpha^1 y^0)\right] \right\} && \text{(policy effect)} \\ &\quad + \left\{ I\left[d_0(\pi^1 p^0, \alpha^1 y^0))\right] - I\left[d_0(p^0, y^0)\right] \right\}. \end{aligned} \tag{II'}$$

Compared to (II), the policy effect is no longer evaluated as the departure from the true initial measure of income distribution. In what follows, we compare these alternative decompositions to those based on income-indexation.

[7] While key parameters in the income tax code have been price indexed, benefits have been uprated with GDP prior to 1979 and some welfare elements are explicitly income-linked in the recent period (e.g., child tax credit and the pension credit under the second Labour government). Acknowledging this double historical trend, Clark and Leicester thus suggest an alternative backdrop based on RPI uprating of tax parameters and GDP uprating of benefits.

3 Empirical Application

3.1 Data and Simulations

The base and end period data are drawn from the Family Expenditure Surveys (FES) and contain 6,797 and 6,637 households respectively (see Sutherland and Gutierrez, 2004, for an extended description).[8] The uprating factor α^1, calculated as the growth rate of average gross income over the 1998-2001 period, is 6.8%. It is computed as an average of all market incomes (incl. labour income, capital incomes and private pensions).[9] Price indexation π^1 could be performed using the RPI, as traditionally used for the UK. Yet the value over the period is 6.4%, which is too close to α^1 for the decompositions I' and II' using price-indexation to be different from I and II. Since we want to explore the sensitivity of different methods of indexation, we make use of the much smaller CPI index over the period (3.3%), as used in Callan et al. (2006).

Simulations are performed using the tax-benefit calculator EUROMOD. This microsimulation model computes direct taxes and monetary transfers – and hence disposable income – for all the households of a representative dataset (cf. Bargain, 2006 ed.). Note that the analysis below ignores in-kind benefits and uses the information contained in the data when taxes and benefits cannot be simulated.[10] We follow the EUROSTAT recommended assumptions. That is, all measures are based on equivalised household disposable income using the modified OECD scale; the poverty line is fixed at 60% of median equivalised incomes.[11]

EUROMOD has been designed to compare tax-benefit systems across Europe. For this reason, it may be seen as less accurate than national microsimulation models (for instance TAXBEN or POLIMOD in the UK) for specific studies at a country level. Yet the robustness of EUROMOD has been extensively checked through numerous applications (e.g., in Bargain, 2006 ed.) and validation studies (cf. Mantovani and Sutherland, 2003). In particular for the UK, validation of simulated elements of income is carried out by Sutherland and Gutierrez (2004) both in relation to independent external sources and to output from the national UK tax-benefit model POLIMOD.[12] The only drawback with the EUROMOD module

[8] The choice of the period under investigation is driven by what is currently available for the UK module of EUROMOD. Nevertheless, the 1998-2001 period is particularly interesting, as motivated in the introduction.

[9] Note that the decomposition requires the use of a *unique* factor on all types of incomes. If differentiated α coefficients were used for each income source (e.g. labour versus capital income), the distribution of gross income would change, i.e. $I(\alpha^1 y^0) \neq I(y^0)$, while we actually want to hold it constant for the sake of the decomposition.

[10] This is in particular the case of child support (no data on absent parents), statutory sick pay and maternity pay (no data on qualifying conditions), council tax (no data on property value or council tax band and no location information below standard region), disabled persons tax credit and several disability allowances (insufficient information on disability).

[11] The modified OECD scale has also replaced the McClements scale in some of the official statistics produced in the UK, in particular in those published by the Department for Work and Pensions since 2007. Brewer et al. (2004) note that this switch reflects a widespread view that McClements does not give sufficient weight to the costs of very young children relative to older children.

[12] External sources stem from the "Households Below Average Income" annual survey (published by the Department for Work and Pensions and based on the Family Resources Survey), on “The Effect of Taxes and Benefits on Household Income” annual survey (published by the Office for National Statistics in *Economic Trends* and based on the FES and it past-2001

for the UK is the use of the FES rather than the much larger Family Resource Survey (FRS). Clark and Taylor (1999) actually find a greater degree of accuracy when using the FRS to measure inequality. In what follows, we include measures of statistical inference for the main inequality/poverty indices.

More traditionally, small but systematic differences between survey-based and simulation-based results are likely due to the approximations made in the latter. In particular for the UK, simulations do not account for possible non-take-up of means-tested benefits and tax credits, which must explain most of the underestimation of poverty and inequality.[13] We find a Gini of around 31 for the UK (30.9 for the year 1998 and 31.1 for 2001), which is about 3% lower than ECHP-based values reported in Dennis and Guio (2003) and 11% lower than figures reported for 2001 by the Department for Work and Pensions (based on the Family Resources Survey). These approximations are however not specific to the present study and also made in policy assessments based on national microsimulation models (see for instance Clark and Leicester, 2004, or Adam and Wakefield, 2005, using TAXBEN).

3.2 Relative Effect of Tax-benefit Policy Changes

The period under investigation almost coincides with the first term of the New Labour government in the UK. It is characterized by an increased generosity of welfare payments, especially since 1999. Income support for the elderly (now called 'minimum income guarantee') has been increased and has now higher capital limits than for other claimants. Families with children also benefit from an increase in income support and from the replacement of the family tax credit by the more generous WFTC. To limit adverse effects of the WFTC, namely the possibility that employers offset the net gain of the transfer by lowering hourly wages, the government has also introduced a national minimum wage. In addition, a non-refundable children's tax credit has replaced the married couples allowance (except for elderly) and the additional personal allowance. More minor changes in welfare include the introduction of a pensioner's annual winter fuel allowance and nominal adjustments of existing transfers (housing benefit, council tax benefit, child benefit). On the tax side, structural policy changes include the abolition of the tax relief on mortgage interest, the introduction of a 10% lower rate and the reduction in the standard rate (from 23% to 22%) in the income tax schedule, the switch from a trigger to a slice structure of Employers' social insurance contributions. Finally, council taxes have been regularly raised above inflation.[14]

The policy changes under New Labour have already been extensively analysed, in particular using the national microsimulation models TAXBEN (e.g., Brewer et al. 2004) and POLIMOD (e.g., Sutherland, 2001). Our contribution here is simply to disentangle and quantify the relative tax-benefit policy effect

successor, the Expenditure and Food Survey) and on additional calculations conducted by the Institute for Fiscal Studies.

[13] This aspect is carefully investigated by Sutherland and Gutierrez (2004) who reconcile EUROMOD simulations with official figures by imputing non-take-up rates. Hancock et al. (2003) discuss the difficulty to introduce take-up correction within microsimulation. Hancock et al. (2004) emphasize the necessity to carry out specific take-up modelling for each instrument and to account for possible interactions (for instance, housing benefits and income support).

[14] The average real increases in England and Wales was around 17% between 1997 and 2001. This is the fastest increase of any major tax under Labour, although it remains a relatively small tax as it represents less than 5% of government revenues. See Adam and Wakefield (2005) for an extensive analysis of its distributional implications.

by applying the formal decompositions suggested above. Detailed results are shown in table 1 where we report the various counterfactuals used in the decompositions, the overall change in inequality/poverty, the homogeneity check, and complete results for decompositions I, II and the averaged Shorrocks-Shapley decomposition. A battery of indicators is used to analyze precisely the different effects on various parts of the income distribution and to study poverty for different demographic groups (families with children, elderly, all others). In addition, table 2 provides standard errors for the main indices, focusing on both initial and final years, total change, homogeneity test. Most importantly, 95% confidence intervals for the tax-benefit policy effect according to the three main decompositions are reported.

First of all, we can compare the situation in base and end periods as reported by columns indexed (0) and (4) in table 1. It turns out that inequality, as measured by the Gini and percentile ratios, does not change much over time. According to table 2, the small increase in the Gini is not significant, nor are the changes in percentile ratio; only the Atkinson with high inequality aversion ($\varepsilon = 1.25$) indicates a relatively worse off situation for those in the lowest part of the distribution. This twist in the distribution is also reflected by a small, but non significant, increase in the FGT(2) poverty measure, which puts more weights on those that fall well below the poverty line. The square poverty gap increases more markedly for the working-age population without children – a likely reflection of the fact that these households are not affected by the increases in income support and family tax credit. Further, headcount poverty has significantly decreased amongst families with children and, to a lesser extent, old-age households. Yet it is not accompanied by a reduction in the depth of poverty for the latter.[15] These results are overall in line with Brewer et al. (2004): the number of poor decreases but the relative situation of the poorest – especially among working-age households without children – deteriorates over the period.

We now decompose the role of policy changes versus other changes in explaining this overall trend. Beforehand, we test the homogeneity property by reporting the third term of both decompositions I and II, i.e. the difference between $I\left[d_0(\alpha^1 p^0, \alpha^1 y^0))\right]$ and $I\left[d_0(p^0, y^0)\right]$. It turns out that this difference is not statistically different from zero for all reported measures, which confirms that the property holds (cf. table 2). As a result, we can concentrate on the decompositions into two terms only, i.e., policy effects and changes in market income inequality. Decomposition results point towards a significant equalising effect of policy changes in the UK over the period 1998-2001. Differences between methods, as reported in table 1, are small. Table 2 shows that they are actually not significant – with the exception of the Atkinson index ($\varepsilon = 1.25$).[16] Therefore, we can be confident in the weight of the policy effect as measured in these decompositions.

Policy change reduces inequality moderately and almost offsets increased market income inequality

[15] As in Sutherland and Piachaud (2001), we find that (relative) child poverty decreases by a bit more than 29% (about one million children). The policy change has done more than moving children from just below the line above it. It has also reduced the intensity of poverty and the situation of the poorest. A specific assessment of child poverty under the first New Labour government is provided by Sutherland and Piachaud (2001), Dickens and Ellwood (2003) and Brewer et al. (2003).

[16] This index is measured with much less precision when using the end-period data, which leads to an imprecise gauge of the policy effect under decomposition I.

according to most measures. Without policy effects, inequality as measured by the Gini would have increased by around 1.7 points (close to the 1.5 figure reported in Brewer et al., 2004). The policy effect itself reduces the Gini by around 1.5 points (close to the 1.4 points reported in Clark and Leicester, 2004). However, this overall trend hides a more complex pattern when looking at the lower part of the distribution especially. The increase in market income inequality as measured by the Atkinson index with high inequality aversion is very large, only partly compensated by policy changes. The significant decrease in the headcount ratio is entirely due to the policy effect overall and is driven in particular by poverty reduction among children and the elderly. The decrease in FGT(1) and FGT(2) indices due to policy changes is counteracted by changes in market income distribution overall. In contrast, the depth of *child* poverty is not affected by changes in market income and strongly decreases in total in response to policy changes – this likely reflects the expansion of income support and family tax credits. While changes in market income deteriorate the relative position of poor pensioners, reforms seem to move a large number of them just above the poverty line but do not manage to improve the relative situation of the poorest ones.

Figure 1 depicts the change in the overall distribution by plotting the differences between Lorenz curves in base and end periods as well as the decompositions I and II. The slight rise in inequality since 1998 essentially reflects what has happened at the extremes of the income distribution. Precisely, for both the richest and poorest, income growth is increasing with income. Indeed the difference between 2001 and 1998 Lorenz curves ('total change') is negative, indicating that the Lorenz curve has moved downward (i.e., further from the equality line) at these extremes. Confidence intervals (not represented) show that the total change is not significant, except for the first decile where the Lorenz curve has significantly moved away from the equality line. However, both the policy effect and the change in market income inequality are significant all along the distribution, with the exception of the top decile for the policy effect.

Table 3 shows that uprating tax-benefit parameters with price inflation rather than income growth does not affect the relative weight of the policy effect much (standard errors are . The residual term is actually not significantly different from zero for the reported inequality measures. It is however positive and significant for headcount poverty, reflecting the benefit erosion due to price-indexed parameters (and the fact that α is larger than π). Another difference between no-reform counterfactuals is the way they affect tax revenues. It may be argued that counterfactuals that significantly affect the fiscal position of the government are not plausible. Indeed, a counterfactual which generates a lot of redistribution – e.g., in which benefits have been uprated more than income – would also cost much more to the state. Thus we calculate the difference between net tax revenue from the actual 2001 system (evaluated on base year data) and that from the income-indexed and price-indexed 1998 systems (using decompositions II and II' respectively). We find a decrease of £1.08 bn and £1.33 bn in tax revenue respectively. This means that the actual reforms have left the government slightly worse off (and the household sector better off) than in our counterfactual world – a reflection of the redistributive policies of the period. As expected, this effect is larger in the situation where benefits are uprated 'only' by price inflation. The income-adjusted scenario is therefore slightly more revenue-neutral. Note however that distributional neutrality more than revenue neutrality was our primary objective when designing decompositions I and II.

Finally, table 4 provides a few additional simulations aimed to identify which particular policies are responsible for the significant overall redistributive effect. For this exercise, we simply use the 2001 system/population as the reference point, and simulate the change in inequality/poverty in case some of the policies are taken back to what they were in 1998. The second column shows the combined effect of all the 1998 policies – which is nothing else than the policy effect of decomposition I. When policies did not exist in the 1998 system (childcare tax credit, minimum wage), the exercise consists simply in cancelling these policies. For the others, we apply the 1998 version of the policy while adjusting monetary parameters to 2001 using α^1. Note that the Shapley value method could in principle be extended to explain the contribution of these different policies. This is however made difficult by the fact that each policy interacts with the rest of the system. This partly explains why the cumulated effect of the different policies does not sum up to the total policy effect.[17] While the relative contributions of the different policies cannot be exactly quantified, our simulations give nonetheless a fair idea of their relative influences. It comes that the extension of the income support and the replacement of the family tax credit by the WFTC in 1999 have been the most influential reforms as far as progressive effects are concerned. The former reform accounts for half of the poverty reduction amongst pensioners while both reforms account for most of the decline in child poverty. The child tax credit is targeted mainly to middle-income families and pushes up the mean/median income without improving the situation of the worst off.[18] Other policies play a more minor role.

4 Conclusion

Relying on microsimulated counterfactual distributions, we decompose the time change in inequality/poverty into the contribution directly due to tax-benefit policy changes and the contribution of other factors such as changes in market income inequality. The method is applied to inequality/poverty changes in the UK over the period 1998-2001. Results confirm that the redistributive measures of the Labour government have reduced the increase in inequality that would have occurred otherwise. These reforms have contributed to a significant drop in poverty among children and the elderly.

Counterfactual distributions can be conditional on base period data, end period data, or an average of these two contributions. This last measure corresponds to the Shapley value method as reinterpreted by Shorrocks (1999). Results do not reveal a particularly large sensitivity to the population at use to evaluate policy changes, which confirms previous sensitivity analysis by Clark and Leicester (2004)

[17] For inequality measures of the whole distribution (like the Gini), this is also explained by the simple fact that the different policies affect different parts of the distribution.

[18] Indeed, this is a reduction to tax liability that is not refunded to non-taxpayers so that low income families are not eligible; those with high income are not eligible either since the credit is tapered away.

for the UK. This is somehow reassuring for the many analyses using the "base weighted" measure of policy impact as a first approximation, in particular when evaluating budget propositions for coming years. Yet it is not sure that this result can be generalised to all countries and to all types of income distribution measures. We have encountered more imprecise assessment of the Atkinson index with high inequality aversion when using end-period data. Also, results by Bargain and Callan (2008) show that the contribution of the policy effect to changes in headcount poverty in Ireland over the second half of the 1990s is significantly different depending on the decomposition at use.

Results for the UK are also robust to the choice of backdrop used to evaluate the policy effect. Rather than the price-indexation benchmark used in most policy analyses, a scenario where all tax-benefit parameters are adjusted in line with mean income growth seems appropriate when gauging the distributional effect of reforms. Yet the normative judgments incorporated in these different benchmarks require further investigation.

Finally, the present analysis has ignored behavioural responses. Future research should attempt to integrate those, and in particular the modelling of labour supply, into the decomposition framework.[19]

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Table 1: Decomposing Changes in Income Distribution over Time

								Decomposition I		Decomposition II		Shorrocks-Shapley Decomposition	
data year:	0	0	1	0	1	Total change	Homog-eneity check	Tax-benefit policy effect	Market income inequality	Tax-benefit policy effect	Market income inequality	Tax-benefit policy effect	Market income inequality
uprated to:		1		1									
policy year:	0	0	0	1	1								
uprated to:		1	1										
	(0)	(1)	(2)	(3)	(4)	(4)-(0)	(1)-(0)	(4)-(2)	(2)-(1)	(3)-(1)	(4)-(3)	Mean of (4)-(2), (3)-(1)	Mean of (2)-(1), (4)-(3)
Inequality													
Gini	30.9	30.9	32.5	29.3	31.1	0.3	0.0	-1.3	1.6	-1.6	1.8	-1.5	1.7
Atkinson 0.5	7.6	7.6	8.6	6.9	8.0	0.3	0.0	-0.6	1.0	-0.7	1.1	-0.7	1.0
Atkinson 1.25	17.7	17.7	21.8	16.2	20.7	3.0	0.0	-1.1	4.1	-1.6	4.5	-1.3	4.3
P90/P10	4.0	4.0	4.3	3.7	3.9	-0.1	0.0	-0.4	0.3	-0.3	0.3	-0.4	0.3
P90/P50	2.0	2.0	2.1	2.0	2.1	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.1
P50/P10	2.0	2.0	2.1	1.8	1.9	0.0	0.0	-0.1	0.1	-0.1	0.1	-0.1	0.1
Total poverty													
FGT0 (%)	17.5	17.4	17.4	15.0	15.0	-2.4	0.0	-2.4	0.0	-2.5	0.1	-2.5	0.0
FGT1 (%)	3.1	3.1	3.6	2.5	2.9	-0.1	0.0	-0.6	0.5	-0.6	0.5	-0.6	0.5
FGT2 (%)	1.0	1.0	1.3	0.8	1.1	0.1	0.0	-0.2	0.3	-0.1	0.3	-0.2	0.3
Child poverty													
FGT0 (%)	24.2	24.2	23.2	17.5	17.0	-7.1	0.00	-6.1	-1.0	-6.7	-0.5	-6.4	-0.7
FGT1 (%)	3.8	3.8	3.9	2.3	2.4	-1.4	0.00	-1.6	0.1	-1.5	0.1	-1.5	0.1
FGT2 (%)	1.0	1.0	1.0	0.7	0.6	-0.4	0.00	-0.4	0.0	-0.4	-0.1	-0.4	0.0
Poverty age>60													
FGT0 (%)	19.7	19.7	22.3	15.5	18.3	-1.5	0.0	-4.0	2.6	-4.2	2.8	-4.1	2.7
FGT1 (%)	3.0	3.0	4.0	1.8	2.9	0.0	0.0	-1.1	1.1	-1.1	1.1	-1.1	1.1
FGT2 (%)	0.7	0.7	1.1	0.3	0.7	0.1	0.0	-0.4	0.5	-0.3	0.4	-0.4	0.4
Other poor													
FGT0 (%)	12.5	12.5	11.8	13.2	12.2	-0.3	0.0	0.4	-0.7	0.7	-1.1	0.6	-0.9
FGT1 (%)	2.7	2.7	3.1	3.0	3.2	0.5	0.0	0.1	0.4	0.2	0.3	0.2	0.3
FGT2 (%)	1.1	1.1	1.5	1.2	1.6	0.5	0.0	0.1	0.4	0.1	0.4	0.1	0.4
Contribution of child poverty to total poverty (%)													
FGT0 (%)	0.35	0.35	0.31	0.29	0.27	-0.08	0.00	-0.05	-0.03	-0.05	-0.02	-0.05	-0.03
FGT1 (%)	0.31	0.31	0.26	0.24	0.19	-0.12	0.00	-0.07	-0.05	-0.08	-0.04	-0.07	-0.04
FGT2 (%)	0.27	0.27	0.19	0.21	0.13	-0.14	0.00	-0.06	-0.08	-0.06	-0.08	-0.06	-0.08
Contribution of old age poverty to total poverty (%)													
FGT0 (%)	0.32	0.32	0.36	0.29	0.35	0.03	0.00	-0.02	0.04	-0.03	0.05	-0.02	0.05
FGT1 (%)	0.27	0.27	0.32	0.21	0.28	0.01	0.00	-0.04	0.05	-0.07	0.08	-0.05	0.06
FGT2 (%)	0.20	0.20	0.25	0.11	0.19	-0.01	0.00	-0.06	0.05	-0.09	0.08	-0.07	0.06

Measures are based on equivalized income using the modified OECD scale. The poverty line is 60% of the median equivalized income. Gini, Atkinson index and FGT poverty measures are multiplied by 100. Period 0 is 1998 and period 1 is 2001.

Table 2: Statistical Inference

	data & policy 0	data & policy 1	Total change	Homog-eneity check	Policy effect Decompo I	Policy effect Decompo II	Policy effect Shapley
Gini	30.9 (0.21)	31.1 (0.27)	0.3 (0.34)	0.0 (0.30)	[-2.1 ; -0.6]	[-2.2 ; -1.0]	[-2.1 ; -0.8]
Atkinson 0.5	7.6 (0.19)	8.0 (0.33)	0.3 (0.38)	0.0 (0.27)	[-1.6 ; 0.3]	[-1.2 ; -0.2]	[-1.4 ; 0.0]
Atkinson 1.25	17.7 (0.38)	20.7 (1.23)	3.0 (1.29)	0.0 (0.53)	[-4.5 ; 2.2]	[-2.6 ; -0.5]	[-3.5 ; 0.9]
P90/P10	4.0 (0.04)	3.9 (0.04)	-0.1 (0.06)	0.0 (0.05)	[-0.5 ; -0.3]	[-0.4 ; -0.2]	[-0.5 ; -0.2]
P90/P50	2.0 (0.02)	2.1 (0.02)	0.0 (0.03)	0.0 (0.03)	[-0.1 ; 0.0]	[-0.1 ; 0.0]	[-0.1 ; 0.0]
P50/P10	2.0 (0.01)	1.9 (0.01)	0.0 (0.02)	0.0 (0.02)	[-0.2 ; -0.1]	[-0.2 ; -0.1]	[-0.2 ; -0.1]
FGT0(%)	17.4 (0.47)	15.0 (0.46)	-2.5 (0.66)	0.0 (0.67)	[-3.7 ; -1.1]	[-3.8 ; -1.2]	[-3.8 ; -1.2]
FGT1(%)	3.1 (0.12)	2.9 (0.14)	-0.1 (0.18)	0.0 (0.17)	[-1.0 ; -0.2]	[-0.9 ; -0.3]	[-1.0 ; -0.2]
FGT2(%)	1.0 (0.07)	1.1 (0.1)	0.1 (0.12)	0.0 (0.1)	[-0.5 ; 0.1]	[-0.3 ; 0.0]	[-0.4 ; 0.1]

Standard errors are reported in brackets and 95% confidence intervals in square brackets.

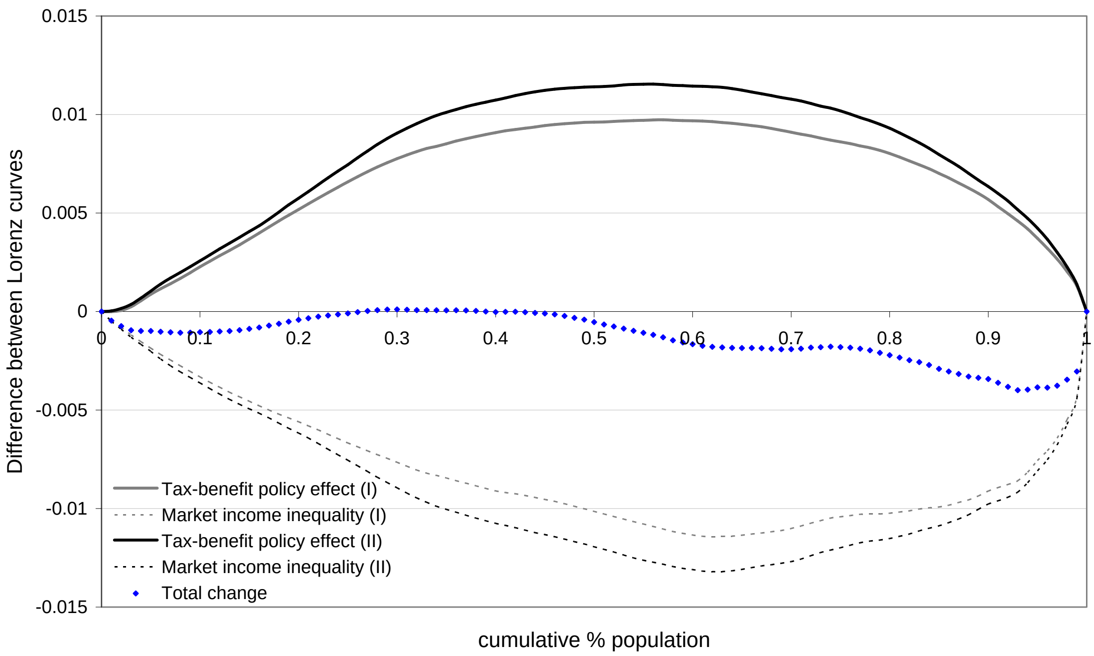

Figure 1: Decomposition of the Shift in the Lorenz Curve

Table 3: Alternative Nominal Adjustments of Tax-Benefit Parameters in the 'No Reform' Counterfactual

	Decomposition I					Decomposition II				
	Income-indexation		Price-indexation			Income-indexation		Price-indexation		
	Tax-benefit policy effect	Market income inequality	Tax-benefit policy effect	Market income inequality	Residual	Tax-benefit policy effect	Market income inequality	Tax-benefit policy effect	Market income inequality	Residual
Inequality										
Gini	-1.3	1.6	-1.6	1.6	0.2	-1.6	1.8	-1.8	1.8	0.2
Atkinson 0.5	-0.6	1.0	-0.8	1.0	0.1	-0.7	1.1	-0.8	1.1	0.1
Atkinson 1.25	-1.1	4.1	-1.4	4.0	0.3	-1.6	4.5	-1.9	4.5	0.3
P90/P10	-0.4	0.3	-0.4	0.3	0.1	-0.3	0.3	-0.4	0.3	0.1
P90/P50	0.0	0.1	0.0	0.0	0.0	0.0	0.1	-0.1	0.1	0.0
P50/P10	-0.1	0.1	-0.2	0.1	0.0	-0.1	0.1	-0.1	0.1	0.0
Total poverty										
FGT0 (%)	-2.4	0.0	-3.0	-0.2	0.7	-2.5	0.1	-3.2	0.1	0.7
FGT1 (%)	-0.6	0.5	-0.8	0.5	0.2	-0.6	0.5	-0.8	0.5	0.2
FGT2 (%)	-0.2	0.3	-0.3	0.3	0.1	-0.1	0.3	-0.2	0.3	0.1
Child poverty										
FGT0 (%)	-6.1	-1.0	-6.8	-1.8	1.4	-6.7	-0.5	-8.1	-0.5	1.4
FGT1 (%)	-1.6	0.1	-1.9	0.1	0.4	-1.5	0.1	-1.9	0.1	0.4
FGT2 (%)	-0.4	0.0	-0.5	0.0	0.1	-0.4	-0.1	-0.5	-0.1	0.1
Poverty age>60										
FGT0 (%)	-4.0	2.6	-4.8	2.6	0.7	-4.2	2.8	-4.9	2.8	0.7
FGT1 (%)	-1.1	1.1	-1.2	1.1	0.1	-1.1	1.1	-1.3	1.1	0.1
FGT2 (%)	-0.4	0.5	-0.5	0.5	0.0	-0.3	0.4	-0.4	0.4	0.0
Other poor										
FGT0 (%)	0.4	-0.7	0.0	-0.7	0.3	0.7	-1.1	0.4	-1.1	0.3
FGT1 (%)	0.1	0.4	0.0	0.4	0.1	0.2	0.3	0.1	0.3	0.1
FGT2 (%)	0.1	0.4	0.0	0.4	0.0	0.1	0.4	0.0	0.4	0.0

Measures are based on equivalized income using the modified OECD scale. The poverty line is 60% of the median equivalized income. Gini, Atkinson index and FGT poverty measures are multiplied by 100. Period 0 is 1998 and period 1 is 2001. Residual terms are not significantly different from zero at the 10% level except for the FGT(0).

Table 4: The Role of Different Policy Changes

	Reference: 2001 tax-benefit system	change if back to						
		1998 system	no childcare tax credit	1998 income support (IS)	1998 income taxation	1998 family tax credit (FTC)	no minimum wage	1998 IS and FTC
Inequality								
Gini	31.1	-1.3	-0.5	-0.9	-0.4	-0.7	-0.5	-1.2
Atkinson 0.5	8.0	-0.6	-0.2	-0.4	-0.1	-0.3	-0.2	-0.5
Atkinson 1.25	20.7	-1.1	-0.1	-0.7	0.1	-0.4	-0.1	-1.0
P90/P10	3.9	-0.4	-0.1	-0.3	-0.1	-0.2	-0.1	-0.3
P90/P50	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P50/P10	1.9	-0.1	0.0	-0.1	0.0	0.0	0.0	-0.1
Total poverty								
FGT0 (%)	15.0	-2.4	0.4	-1.1	0.1	-0.8	-0.2	-1.8
FGT1 (%)	2.9	-0.6	0.1	-0.5	0.0	-0.1	0.0	-0.6
FGT2 (%)	1.1	-0.2	0.0	-0.2	0.0	0.0	0.0	-0.2
Child poverty								
FGT0 (%)	17.0	-6.1	0.3	-2.6	0.2	-3.3	-0.3	-5.7
FGT1 (%)	2.4	-1.6	0.0	-1.2	0.0	-0.6	0.0	-1.8
FGT2 (%)	0.6	-0.4	0.0	-0.4	0.0	-0.1	0.0	-0.5
Old age poverty								
FGT0 (%)	18.3	-4.0	0.4	-1.9	0.1	0.0	0.2	-1.6
FGT1 (%)	2.9	-1.1	0.1	-0.7	0.0	0.0	0.0	-0.7
FGT2 (%)	0.7	-0.4	0.0	-0.3	0.0	0.0	0.0	-0.3

Measures are based on equivalized income using the modified OECD scale. The poverty line is 60% of the median equivalized income. Gini, Atkinson index and FGT poverty measures are multiplied by 100. Simulations are based on 2001 data.