INCOME DISTRIBUTION, GROWTH AND WELL-BEING: EVIDENCES FOR SELECTED OECD COUNTRIES

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Abstract

In this paper we provide evidences on the cross-country and intertemporal dynamics of aggregate welfare. Firstly, we apply and compare alternative inequality indexes to have an insight on the actual within-country income distribution. The same measures, combined with information on average incomes, are then used to address the impact of inequality on social welfare and to obtain a comparative assessment of well-being levels across space and time.

In this respect, we limit the attention to the class of social welfare functions implied by the Atkinson index and the single parameter Gini index (Donaldson and Weymark, 1980), which allow to compute the corresponding equally distributed equivalent incomes by correcting actual income distribution by the extent of inequality aversion and relative deprivation, respectively.

The empirical application has been carried out on 10 selected OECD countries for the period 1970-2000, using a dataset that combines comparable data on per capita incomes from Penn World Tables (Heston et al., 2002) with income distribution information drawn from the World Income Inequality Database (WIID, 2007).

The results obtained highlight how inequality-accounting welfare measures significantly modify the perception of well-being, affecting both the within-country evolution of aggregate welfare and inter-countries well-being levels. Finally, for selected sub-periods, the issue of progressivity of income growth process has been considered to evaluate whether or not income growth leads to lower inequality over time.

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(Preliminary, comments are welcome)

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1 INTRODUCTION

Despite there is a wide agreement that real national income per capita or mean household income, and the corresponding growth rates, are inadequate measures of aggregate social welfare, they are still the most widely used indicators for cross-country and intertemporal comparisons of economic well-being.

While many of these issues, such as measurement problems, have no easy and univocal solution, the necessity of overcoming the complete disregard for the welfare implications of income inequality, implicit in such measures, has received a broad and growing consensus in theoretical and empirical studies (Jenkins, 1997; Gruen and Klasen, 2007). In particular, cross-national studies on real income levels have shown how economic well-being not only depends on the size of national income but also on distributional considerations, suggesting that, *ceteris paribus*, high income inequality reduces aggregate welfare. Moreover, the huge debate on the relationship between economic growth and income inequality (Deininger and Squire, 1998; Dollar and Kraay, 2002) has not only highlighted the complexity of the interpretation of the growth-inequality causality nexus, but has also renewed, through the analysis of income production and distribution processes, the debate on the central topic of the existing links between the quantitative and qualitative aspects of economic growth.

Since Pigou's (1912) contribution, the proposition that economic well-being depends upon the size, distribution and variability of national income has been at the basis of the economic analysis of social welfare[1]. However, only recently theoretical and empirical studies have been concerned with considering distribution-weighted measures, which goes beyond aggregate income statistics by explicitly incorporating distributional components, to appraise the levels of economic well-being in different countries and their evolution over time.

Cross-country differences or changes over time in real per capita income can be interpreted as differences in social welfare only under stringent assumptions, requiring that either all consumers are identical and consume the same commodity bundle or the distribution of income is optimal or constant (Samuelson, 1947; Graaff, 1957; Sen, 1976). One way of overcoming these limitations is to directly assess income distribution in welfare evaluation, rather than treating growth and distribution as two separate issues (Graaff, 1957). Most

[1] Pigou, in his *Wealth and Welfare* (1912) asserted that "*the economic welfare of the country is intimately associated with the size of the national dividend, and changes in economic welfare with changes in the size of the dividend*" and "*any cause which increases the absolute share of real income in the hands of the poor, provided that it does not lead to a contraction in the size of the national dividend from any point of view, will, in general, increase economic welfare*".

theoretical and empirical studies on economic welfare (Atkinson, 1970; Sen, 1976) have highlighted the importance of including a distributional component that penalizes rising income inequality in defining indexes well-being.

In this paper, we propose an integrated approach to real welfare measurement, which incorporates both size and distributional considerations, and introduce and compare alternative measures of well-being. A parametric class of real income indices is proposed, which combines mean per capita incomes and measures of income inequality along the line of the approach proposed by Atkinson (1970), Kolm (1969) and Sen (1973). In particular, following Ebert (1988) and Araar and Duclos (2003, 2005), we consider a general class of inequality indexes that merges the features of the family of Atkinson and single-parameter Gini (Donaldson and Weymark, 1980; Yitzhaki, 1983) indices to derive alternative measures of social welfare. This framework allows to define a range of well-being measures (including Atkinson and Sen measures as special cases), which accounts for both aversion to income inequality and rank inequality aversion and explicitly incorporates interpersonal comparisons of utility in the assessment of social welfare. These indexes complement quasi-ordering methods such as generalized Lorenz dominance criterion, by providing cardinal measures of social welfare, and allow us to carry out cross-country comparisons and to trace well-being dynamics over time, exploiting the recent availability of internationally comparable data on per capita incomes and their distribution across countries and time (Heston *et al.*, 2002; WIID, 2007).

The rest of the paper is organized as follows. Section 2 discusses theoretical and methodological issues connected to measurement and comparisons of social welfare levels across countries and time. Specific attention is devoted to the analysis of different the measures of well-being proposed, which account for differently types of inequality in income distribution. The dataset used for the empirical application, based on internationally comparable data on income distribution taken from World Income Inequality Database (WIID, 2007), is presented in Section 3. Section 4 presents the results of the empirical analysis, focusing on both international and intertemporal trends in aggregate well-being. In particular, besides measuring and comparing welfare levels by means of alternative cardinal indexes, we also focus on the relationship between real income growth and welfare dynamics. Section 5 concludes the paper.

2 THEORETICAL FRAMEWORK

2.1 Social choice and welfare comparisons

One of the main aims of welfare economics is the ordering of alternative social states in terms of social welfare. Welfare rankings of different income distributions inevitably involve comparisons of gain and losses of utility of different income groups.

However, as pointed out by Sen (1973), "traditional" welfare economics has focused on issues that involve no conflict between individuals and offers very little help when distributional issues has to be concerned. Following Robbins's (1932, 1938) critique to the utilitarian and neoclassical welfare theory, welfare economics should avoid interpersonal comparisons of utilities and refrain from yielding any distributional judgment. The basic theorems of welfare economics address the relationship between competitive equilibria and Pareto optimality and were therefore deemed the only acceptable criterion since they involve only considerations on efficiency of income distribution among individuals and cut out any distributional judgement.

The inadequacy of the Pareto principle and the necessity of extending the Paretian social welfare judgements beyond the unlikely cases non-conflicting situations have generated a huge debate. The Bergson-Samuelson social welfare function approach (Bergson, 1938; Samuelson, 1947) went in this direction and was partly motivated by the necessity of going beyond the Pareto optimality. The social welfare function (SWF) is a real vale function defined over a set of alternative social states. If X is the set of social states, a SWF is then an ordering defined over X and can be numerically defined as a functional relation that assigns a welfare value $W(x)$ to each social state x belonging to X. The most general Bergson-Samuelson SWF can be expressed as:

$$W(x) = W(u_1(x_1), u_2(x_2), ..., u_n(x_n)) \quad (1)$$

where $u_i(x_i)$ is the utility function of individual i ($i = 1, 2, ..., n$). This formulation rests on the assumption that social welfare is a function of individual utilities (individualistic SWF). Assuming that social welfare increases if the utility of any of the individuals increase and none decrease, the Pareto optimality can be obtained by maximizing W. However, the Bergson-Samuelson SWF has a more general purpose, which is to go beyond the Pareto principle by ranking all the Pareto optimal states (Sen, 1973). The distributional judgments will then depend on the form of the welfare function chosen.

Despite the definition of the function $W(\cdot)$ allows using cardinal measures of individual utilities and assuming interpersonal comparability, welfare economists have usually avoided such assumptions and focused on ordinal measures of W, aiming at defining social welfare exclusively on the basis of the set of individual orderings of X. The situation significantly changed after Arrow's (1951) seminal contribution to social choice theory. Arrow demonstrates in his fundamental theorem (the "impossibility theorem") that, if the only information that can be used in social evaluation is ordinally measurable and interpersonally non-comparable utility information, there do not exists any procedure for aggregating such individual utility information into collective preference orderings. Under ordinal measurability and without interpersonal comparability, no satisfactory welfarist principle, which satisfies minimal conditions[2], exists. Sen (1970) further extend this result, by showing that the conclusion of Arrow's theorem remains true if ordinal non-comparability of individual utility is replaced by a cardinal interpretation without interpersonal comparisons of well-being. It became evident that, in order to avoid these impossibility results, richer informational environments, which consider profiles of individual utility functions together with conditions ensuring interpersonal comparisons of well-being, has to be considered (see, Sen, 1970, 1977; D'Aspremont, 1985).

Moreover, as highlighted by Sen (1973), if the approach of social welfare functions has to be profitably adopted in measuring inequality and judging alternative distributions of income, the framework must be extended to include interpersonal comparisons of welfare.

In this sense, the line of research proposed by Atkinson (1970) and Kolm (1969) which basically consists in the reconsideration and generalization of an essentially utilitarian perspective in evaluating welfare and inequality, as earlier anticipated by Pigou (1912) and Dalton (1920), proved to be very effective. The welfare economics of utilitarianism is however very limited since it ranks alternative social states on the basis of the value of the sum of individual utilities. Utilitarian approach, pioneered by Bentham (1789), focuses only on maximizing the sum of individual utilities and is therefore completely unconcerned with the distribution of this sum. In particular, the indifference to the distribution of individual utilities rests entirely on this "sum ranking" hypothesis, but despite this limitation, utilitarian framework can be broadened and appropriately generalized by dropping the dependence on

[2] Arrow identifies the following four conditions: *Universal Domain*, *Weak Pareto Principle*, *Independence of Irrelevant Alternatives* and *Non-Dictatorship*, and demonstrates that, given ordinal non-comparability, there exists no SWF satisfying these four conditions simultaneously. For a complete discussion on the implications of Arrow's theorem see Blackorby, Bossert and Donaldson (2002) and Blackorby and Bossert (2006).

simple summation of untransformed utilities (Sen, 1973). The possibility of going beyond simple utilitarianism, by dropping "sum ranking" while keeping "consequentialism" and "welfarism"[3], was therefore at the basis of the Atkinson-Kolm-Sen approach to the analysis of social welfare, based on a distributional-sensitive evaluation of individual utilities, which gave rise to a new strand of literature on the analysis of social well-being and its connections to inequality evaluation.

In the next sub-section, we illustrate Atkinson approach to social welfare and income inequality, highlighting the differences with respects to the purely utilitarian approach by Dalton (1920). In Section 2.3 we present an extended framework for ranking alternative social states that generalizes Atkinson's approach by including non-utilitarian elements in the SWF. Following recent works by Ebert (1988), Lovell (1998) and Araar and Duclos (2005), this formulation differs from both the traditional utilitarian and Atkinsonian approaches through the use of rank-dependent weights on individual utilities and explicitly links the Atkinson family of SWF with the single-parameter Gini social evaluation functions, which emphasize the importance of interpersonal comparisons in social welfare analysis.

2.2 Social welfare and income inequality

As previously discussed, the pure utilitarian approach is considered to be unsuitable for welfare economics, given its substantial indifference to the distribution of individual utilities. However, by generalizing utilitarian principles it is possible to include distributional considerations in the assessment of social welfare.

In is pioneering work, Dalton (1920) followed Bernoulli[4] in assuming that individual utility (or welfare) equals the logarithm of income:

$$U(y_i) = f(y_i) = \ln y_i \qquad (2)$$

thus hypothesizing a strictly concave function (i.e. with diminishing marginal utility of income). In addition, Dalton defined a purely utilitarian separately additive social welfare function:

[3] *Consequentialism* (choices are evaluated according to the resulting states), *Welfarism* (alternative states are evaluated only by means of individual utility information) and *Sum-Ranking* (the judging criterion is simply the sum of individual utilities) are the three elements in which utilitarianism is usually factorized. See Sen and Williams (1982).

[4] See D. BERNOULLI, *Specimen theoriae novae de mensura sortis,* 1738, pp 177-178 (published in English as: Exposition of a New Theory on the Measurement of Risk, 1954, *Econometrica*, 22, pp 23-36)

$$W = \sum_{i=1}^{N} U(y_i) = \sum_{i=1}^{N} \ln y_i \tag{3}$$

with aggregate social welfare adding up individual utilities. Dalton argued that inequality could be defined by comparing actual social welfare, specified by equation (3), with the level of social welfare that would be attained if the same total were to be equally distributed (Lovell, 1998). In the two extreme cases of highest inequality (lowest welfare) and lowest inequality (highest welfare) the social welfare function is equal to:

$$W^{\min} = \ln Y \tag{4a}$$

and

$$W^{\max} = \sum_{i=1}^{N} U(\mu) = N \ln \mu \tag{4b}$$

where Y is total income and $\mu = \sum_i y_i \big/ N$ is the arithmetic mean income. In the two extreme cases, total income is possessed only by the richest individual or is equally distributed among individuals, respectively. In particular, Dalton defined inequality as:

$$I_D = W^{\max} / W = N \ln \mu / \sum_i \ln y_i = \ln \mu / \ln \mu_g \tag{5}$$

that is as the ratio of the logarithm of the arithmetic mean of income μ to the logarithm of the geometric mean μ_g [5].

The merit of the approach of Dalton is that it shows that any inequality measure must be concerned with economic welfare, thus highlighting the close connection between social welfare and distribution of incomes (and vice versa). However, it is restrictive in assuming a strictly utilitarian framework.

Atkinson (1970)[6] extended Dalton's analysis by introducing the concept of *equally distributed equivalent income* (y_{EDE} or *EDEI*), which is the level of per capita income which, *if it were equally distributed*, would give the same level of social welfare generated by the actual income distribution[7] y_{EDE} is the level of per capita income such that:

$$W = \sum_{i=1}^{N} U(y_i) = NU(y_{EDE}) \;\Rightarrow\; y_{EDE} = U^{-1}\left(\sum_{i=1}^{N} U(y_i) \big/ N\right) \tag{6}$$

In particular, accepting the Bernoullian hypothesis ($U(y_i) = \ln y_i$), from (6) we obtain:

[5] Atkinson (1970) pointed out that the main limitation of this measure is that it is not invariant with respect to positive linear transformations of the utility function.

[6] A similar approach to that of Atkinson, but less focused on the distributional analysis of incomes, has been also developed by Kolm (1969).

[7] An earlier use of the "equally distributed equivalent income" approach can be found in Champernowne (1952).

$$\ln(y_{EDE}) = \frac{1}{N}\sum_{i=1}^{N} U(y_i) = \frac{1}{N}\sum_{i=1}^{N} \ln(y_i) = \ln(\mu_g) \quad \rightarrow \quad y_{EDE} = \mu_g \tag{7}$$

Atkinson, however, considers a broader class of symmetric, additively separable, increasing and strictly concave $U(\cdot)$ functions:

$$U(y_i) = a + b\frac{y_i^{1-\varepsilon}}{1-\varepsilon} \qquad \text{with } \varepsilon \geq 0 \tag{8}$$

which has the logarithmic function as a limiting case as ε approaches to 1. The ε parameter, which can be interpreted as a measure of the degree of social aversion to income inequality, is the elasticity of marginal utility with respect to y_i and defines the degree of concavity of $U(y_i)$[8].

From the definition of y_{EDE}, Atkinson proposed a measure of inequality, defined as the percentage reduction in income that would be sufficient, if equally distributed, to yield the same total welfare of the actual income distribution:

$$I_A = \frac{\mu - y_{EDE}}{\mu} = 1 - \frac{y_{EDE}}{\mu} \tag{9}$$

and can be interpreted as the proportion of total income that is lost because income is not equally distributed[9].

Obviously, the index I_A has the convenient property of lying between 0 (complete equality, when $y_{EDE} = \mu$) and 1 (complete inequality). Moreover, Atkinson's measure clearly depends on the utility function, i.e. on the value of ε. In particular, I_A would necessarily equal zero if there is no aversion to income inequality ($\varepsilon = 0$), regardless of how income were distributed, and rises as the value of ε grows ($\partial I_A / \partial \varepsilon > 0$).

However, it is worth remarking the subtle but essential difference between Dalton's and Atkinson's approaches. Dalton, anticipated by Pigou (1912), used a strictly utilitarian approach to welfare economics that is basically unconcerned of the inequality in utility distribution. He expressed the idea that income inequality could be measured as the distance between the actual distribution and the equal distribution. But his measure is primarily

[8] The SWF proposed by Dalton, even if it is can be then considered as a particular case of that proposed by Atkinson, when the inequality aversion parameter is equal to 1. This restriction, which implies a logarithmic utility function, can not only be justified by appealing to the Bernoulli hypothesis, but also because the logarithmic scale, as pointed out by Lovell (1998), is used in measuring many natural phenomena and may have a psychological basis in the concept of "just-noticeable difference".

[9] When $U(y_i) = \ln(y_i)$, this inequality index correspond to the I_3 index discussed in Champernowne (1974).

concerned with the inefficiency of income inequality in generating aggregate utility, which only reflects the loss of total utility sum due to the unequal distribution of individual incomes. On the other hand, Atkinson's approach is not exclusively utilitarian, even though it invoked an additively separable framework, with total social welfare expressed as the sum of the individual values of U_i. Such framework can be restrictive in imposing additive separability, but it does not require the SWF to be completely utilitarian in taking U_i to be individual utility. That would be one possible interpretation, and Atkinson himself does not define U_i as a utility function. In general, it is the individual component of social welfare and can be thought as a strictly concave transform of individual utility (Sen and Foster, 1997).

This general approach to inequality and welfare measurement developed by Atkinson has the merit of allowing to base inequality evaluation not only on efficiency considerations, but also to take into account the equity implications of inequality of incomes, thus reflecting the loss of social welfare due inequality in individual utilities.

In particular, Atkinsonian perspective makes the relationship between social welfare and inequality evident. In welfare economics, as previously discussed, several approaches, including utilitarian welfarism with declining marginal utility of incomes, Sen's capability approach or Rawlsian framework suggest that aggregate welfare reduces as (income) inequality rises, all other things being equal.

With respect to this point, Atkinson approach provides a simple method of converting welfare functions in to inequality measure and vice versa. In fact, a convenient feature of the Atkinson's index is that it allows to directly deriving a social evaluation function in abbreviated terms. In fact, by solving (9) for y_{EDE} we obtain:

$$y_{EDE} = \mu(1 - I_A) = W \tag{10}$$

which highlights how the EDE income can be interpreted as a direct measure of social welfare.

This formulation shows an alternative way of representing the SWF, which is referred to as the abbreviated social welfare function (Lambert, 1989), and expresses social welfare W as a function of both mean income and inequality ($W = f(\mu, I)$), increasing as mean income rises ($\partial W / \partial \mu > 0$) and decreasing with higher inequality ($\partial W / \partial I < 0$). This reveals how social welfare depends on both efficiency and equity considerations. Equation (10) represents a specific form of abbreviated SWF, which is valid for inequality measures ranging from zero to one, and clearly states that the existing degree of inequality corrects mean income downwards reflecting the welfare loss associated with the unequal distribution of income. In

particular, when all incomes are equal, $I = 0$ and $W = \mu$, while when total income is held by the richest individual only, $I = 1$ and $W = 0$; in all the other intermediate situations $I > 0$ and $W < \mu$. Welfare can be then increased by either increasing mean income μ or by increasing income equality $1 - I$. In this setting, inequality I provides a measure of the per capita proportion of income that is lost in social welfare terms because of its unequal distribution among individuals. Moreover, it is worth noting that two distributions of income can be characterized by the same level of social welfare even when their average incomes differ, provided that income differences are offset by differences in inequality.

Within this framework several inequality measures can be considered, differing in either the intensity of welfare penalty they impose or in the way they account for different types of inequality. In particular, it is interesting to consider the social welfare measure proposed by Sen (1976) that incorporates inequality by means of the Gini coefficient *G*:

$$W = \mu(1 - G) \tag{11}$$

This measure is derived by using a non-utilitarian approach and assumes a rank-order weighting of individual utilities. Yitzhaki (1979) and Dagum (1990) have shown that this measure can also be derived from an interdependent view of income distribution according to which individuals consider not only their own income, but the entire income distribution. This social evaluation function thus indirectly incorporates interpersonal comparisons of utility in the assessment of social welfare.

In the next Section, we present and discuss a generalized family of SWF, which merges the Atkinsonian and single-parameter Gini approaches and capture both income inequality aversion, by means of decreasing marginal utility, and rank inequality aversion, by assuming rank-dependent weights on individual utilities.

2.3 Social welfare and relative deprivation

Both the approaches of Bernoulli-Dalton and Atkinson are based on additively separable and individualistic social welfare functions: individual well-being is completely unaffected by the utility enjoyed by others and therefore aggregate welfare does not directly reflect interpersonal comparisons of utility. An explicit evaluation of such interpersonal comparisons would allow to introduce the effect of relative economic and social distances in welfare analysis.

This theme has always received specific attention in welfare economics, highlighting the relative nature of welfare evaluations. In particular, according to Pigou (1912) "*the satisfaction a man obtains from his economical environment is, in great part, derived not from the absolute, but from the comparative magnitude of his income*" and, in this respect, cites Mill (1907) who asserted that "*men do not desire merely to be rich, but to be richer than other men, or than certain other men*".

Moreover, there is a broad socio-psychological literature on interpersonal comparisons of well-being, which shows that interpersonal differences have a significant impact on individual well-being and as well as on social cohesion and welfare. In particular, the theory of relative deprivation suggests that people compare their individual fortune with that of others in establishing their own degree of satisfaction. Runciman (1966) emphasized that relative deprivation involves the comparison of one's own position with the "*situation of some other person or group*" taken as the comparative reference group.

As underlined in Section 2.1, because of the general tendency to avoid cardinal measurements and interpersonal comparisons of utility, attempts to consider interpersonal comparisons of well-being in inequality measurement and in social welfare evaluation has been developed only recently. In particular, Sen (1973), Yitzhaki (1979) and Hey and Lambert (1980), following Runciman suggestion, propose an indicator of relative deprivation for each individual, which measures the distance between his income and the incomes of those to whom he feels deprived (namely those who have a higher rank in the income distribution) and show that the aggregation of such relative deprivation measures allows to obtain the family of single-parameter Gini indexes of inequality.

However, the comparative approach to welfare evaluation can be also profitably carried out by appropriately extending a cardinal social welfare function, as that in equation (5), to directly include comparisons of utility among individuals and to account for aversion to rank inequality.

In order to account for interpersonal comparison, following the works of Berrebi and Silber (1981), Ebert (1988) and Araar and Duclos (2003; 2005), the typical "utilitarian-looking" SWF proposed by Atkinson can be extended by considering a more general specification:

$$W = \frac{\sum_{i=1}^{N} g_i U(y_i)}{\sum_{i=1}^{N} g_i} \tag{12}$$

where $U(y_i)$ is the individual component of social welfare (which is continuous and increasing in y) and g_i are positive weights applied on the individual $U(y_i)$ arranged in decreasing order. Formulation (12) thus differs from the Atkinsonian specification by the presence of rank-dependent weights. Araar and Duclos (2003) demonstrate that the family of SWF (12) is increasing in y_i and yields a Lorenz-consistent relative inequality index if and only if the weights g_i are defined as:

$$g_i = g_i(\rho) = i^{\rho} - (i-1)^{\rho} \tag{13}$$

and $U(y_i)$ assumes the flexible form proposed by Atkinson:

$$U(y_i) = U_{\varepsilon}(y_i) = \begin{cases} a + b\dfrac{y_i^{1-\varepsilon}}{1-\varepsilon} & if \quad \varepsilon \neq 1 \\ a + b\log(y_i) & if \quad \varepsilon \neq 1 \end{cases} \tag{14}$$

with $\rho \geq 1$, $\varepsilon \geq 0$ and $b > 0$. This result leads to the following specification of the SWF:

$$W_{(\rho,\varepsilon)} = \sum_{i=1}^{N} \frac{[i^{\rho} - (i-1)^{\rho}]U_{\varepsilon}(y_i)}{N^{\rho}} \tag{15}$$

The two coefficients ε and ρ represent parameters of inequality and rank inequality aversion, respectively. This dual-parameter SWF offers therefore greater flexibility in the specification of the type of inequality aversion that can be considered in social welfare judgements and merges the features of both the families of Atkinson and of single-parameter Gini (Donaldson and Weymark, 1980; Kakwani, 1980; Yitzhaki, 1983) evaluation functions. In particular, as it can be easily checked, standard Atkinson SWF subclasses are obtained for $\rho = 0$ and $\varepsilon > 0$ (i.e. disregarding the rank-dependent weighting structure). On the other hand, single-parameter Gini social evaluation functions can be obtained by setting the parameter of risk aversion ε to zero, so that $U_{\varepsilon}(y_i) = a + by_i$; if we further restrict the specification by imposing $\rho = 2$, the traditional Gini welfare function is obtained:

$$W_{(\rho=2,\varepsilon=0)} = \sum_{i=1}^{N} \frac{(2i-1)y_i}{N^2} \tag{16}$$

In this case the weighting scheme attaches the same weight to all the individuals, irrespective of their rank, while for $\rho > 2$ the differences between weights are increasing in the rank *i*. An increase in ρ thus increases the weights attached to the lower part of income distribution in evaluating social welfare.

For all the other intermediate cases ($\rho > 1$ and $\varepsilon > 0$) we obtain hybrid social welfare functions, accounting for both the types of inequality aversion. The ethical criteria of these generalized social evaluation functions rest on the use of decreasing marginal utilities of incomes to capture the dispersion of incomes around the mean, and on the use of rank-dependent weights to capture the dispersion of ranks in the population.

According to the Atkinson-Gini evaluation function (15), social welfare is decreasing in both aversion parameters ρ and ε. However, for the Atkinson family only the level of income is relevant, while for the Gini family and for mixed welfare functions both the levels and rankings of incomes are taken into account (Ebert and Welsch, 2004). In this sense, it is particular interesting to show how equation (15) extends the traditional Atkinsonian approach by incorporating interpersonal utility comparisons in the assessment of social welfare. In particular, the theory of relative deprivation (Runciman, 1966) suggests that people compare their individual income with that of others in establishing their own degree of satisfaction. Following Sen (1973), Yitzhaki (1979), Hey and Lambert (1980) and Araar and Duclos (2003), it is possible to define for each individual an indicator of relative deprivation which measures the distance between his welfare and that of those towards whom he feels deprived (i.e. those who are well-off than him). Formally, we define the relative deprivation D_{ij} of an individual at rank *i* when he compares his situation with that of and individual at rank *j* as

$$D_{\varepsilon ij} = \max[0, U_\varepsilon(y_j) - U_\varepsilon(y_i)] \tag{17}$$

No relative deprivation is therefore felt by individual *i* when he compares himself to an individual *j* that is less well-off then him. This is a particular type of asymmetric interdependence, originally considered by Duesenberry (1952), where "*low-income groups are affected by the consumption of high-income groups but not vice versa*". Summing-up this relative deprivation over all individuals *j*, we find the following expected relative deprivation for the individual *i*:

$$D_{\varepsilon i} = \sum_J D_{ij} = \sum_j \max[0, U_\varepsilon(y_j) - U_\varepsilon(y_i)] \tag{18}$$

and averaging D_i across all individuals *i*, weighting each observation by the ethical weight $g_i(\rho)$, we obtain:

$$\bar{D}_{\varepsilon,\rho} = \frac{\sum_i g_i(\rho) D_i}{\sum_i g_i(\rho)} \tag{19}$$

Araar and Duclos (2003) demonstrate that the class of social evaluation function (15) can be interpreted as average welfare corrected by average relative deprivation in utility:

$$W_{(\rho,\varepsilon)} = \mu_{U_\varepsilon(y_i)} - \bar{D}_{\varepsilon,\rho} \tag{20}$$

which reveals how the loss of social welfare due to inequality in utility can be interpreted as an ethically weighted average of individual relative deprivation. Expression (20) clearly shows how the class of social welfare functions considered measures well-being by penalizing mean income for both income inequality (by assuming increasing and strictly concave functions $U_\varepsilon(y_i)$) and rank inequality (by accounting for relative differences in individual welfare), thus extending both Atkinsonin and Gini-based evaluation functions. The SWF proposed by Atkinson is in fact completely unconcerned of income rankings and accounts only for inequality in incomes; on the other hand, with respect to the welfare function implied by the family of single-parameter Gini indexes, this formulation explicitly introduce more flexibility by means of the inequality aversion parameter ε.

In terms of well-being measures, specification (15) allows us to derive the social evaluation function in abbreviated terms as:

$$W_{(\rho,\varepsilon)} = \mu(1 - I_{\rho,\varepsilon}) \tag{21}$$

where $I_{\rho,\varepsilon} = 1 - [U^{-1}(W_{(\rho,\varepsilon)}) / \mu] = 1 - (y_{EDE} / \mu)$.

Expression (21) provides a class of cardinal measures of well-being that accounts for income inequality and explicitly assesses the issue of interpersonal comparisons of welfare, comprising the well-being measures (10) and (11), already discussed in Section 2.2, as special cases. The relevance of this generalized framework to inequality and welfare measurement is further confirmed by previous empirical studies. In particular, Ebert and Welsch (2004), applying this approach to compare welfare levels among European countries, finds that the conventionally used Atkinson ($\varepsilon = 0.5$ and $\rho = 1$) and Gini ($\varepsilon = 0$ and $\rho = 2$) measures are inadequate with respect to the implied degree of equality preference, as the inequality aversion intrinsic to these indices appears to be too small.

For the aim of the present analysis, such framework allows easily to check the ethical sensitivity to rank and income dispersion in measuring inequality and aggregate well-being. By letting the ε and ρ coefficients appropriately vary, it is possible to illustrate how the choice of the two inequality aversion parameters affects welfare judgements. Despite every combination is admissible (provided that $\varepsilon \geq 0$ and $\rho \geq 1$), allowing for large values of ρ

and ε would imply an ethical judgment of inequality that would be almost completely wasteful in terms of social welfare. Following Duclos (2000), Ebert and Welsch (2004) and Araar and Duclos (2005), reasonable representation of social welfare orderings can be obtained considering values of ε between 0 and 1.0, and for ρ between 1 and 4. For these reasons, in the empirical application presented in Section 4 we only focus on these ranges of the ethical parameters to analyze differences in well-being across countries and their evolution over time.

3 THE DATA

The recent availability of comparable statistical data on personal income distribution provides useful information for a cross-country analyses and intertemporal comparisons of well-being. For the aims of the present research, the necessity to improve data comparability both under qualitative and quantitative aspects is a fundamental issue. The use of good quality data allow us to reach a better level of comparability among them.

Unlike national accounts data, which are homogeneous in general, data on income distribution are collected and estimated according to different criteria which influence results of distributional analyses and significantly affect their comparability across space and time.

Several assumptions are necessary for determining usable dataset, which primarily concern the individuation of the more suitable statistical information to analyze the distributional inequality phenomenon and the definition of the reference unit of income receivers. Further problems concern the existing lack of homogeneity on data quality, and most of all on their reliability and on the way statistical information are collected gathering of statistical data and on their comparability between space and time. Basically, the available statistics on inequality include observations that may differ on measured concepts, (consumption or gross or net income) reference units (individuals, household or family) and sources, and all these differences should be appropriately taken into account when dealing with international and intertemporal comparisons of inequality and welfare measures.

The data used in the present analysis are derived from different sources. The main source of distributional data is the *World Income Inequality Database* version 2.0b[10] (henceforth WIID). This database is the essential basis of our research since it provides data on income

[10] United Nations University, World Institute for Development Economics Research, 2007.

distribution across countries and over time. The WIID is a data collection that is sourced from different household level surveys, mainly of micro-aggregate type. The distributional information provided by this database consist basically in standard Gini indexes, average and median incomes, and, particularly important for our aims, income shares by decile or quintile of population.

Through the use of this information, it is possible to explore the connection between income growth, distribution and inequality within an international and intertemporal contest. The feasibility of this kind of analysis, which is the focus of our research, strictly depends on the availability of comparable data and it is for this reason that only recently empirical literature has investigated, in an international dimension, the relationships between income distribution and economic well-being and their evolution over time (Deininger and Squire, 1996; Gruen and Klasen, 2003, 2007; Sala-i-Martin, 2006).

The WIID database has the advantage of providing an extensive data coverage, but as already anticipated the comparability of inequality measures both across countries and over time may be seriously undermined by the varying quality and reliability of the data and by the measurement concepts adopted. All this limitations, connected to the use of such "secondary datasets", are extensively discussed in Atkinson and Brandolini (2001).

The empirical analysis has been carried out considering data for 10 OECD countries[11]; these countries are a representative sample of the main geographical area of the world. Their choice has been also influenced by the necessity of observing the evolution of income distribution in an extended time series. Especially, in order to correctly represent the distributive dynamics of income over time, we have considered only countries with available data for the period of 1970-2000.

In order to obtain homogeneous and comparable information, we have introduced further selection criteria. In particular, we have restricted our attention only to data drawn from survey that sampled the entire population of the country, without any ex ante restrictions on geographical coverage, or on the age or other demographic characteristics of the respondent[12]. Most of the data considered have been adjusted for household composition by using an equivalence scale and then take account of the size and the composition heterogeneity of the

[11] The countries considered are: Australia, Canada, Finland, France, Germany, Italy, Mexico, Norway, United Kingdom and United States.

[12] In the WIID there is a variable that describes the data quality and reliability. This variable assumes different values from 1, for the best quality data, to 4 for the worst quality. In this research we have considered only data with quality equal to 1 or 2.

family unit. With respect to the underlying income concept, data must be based on after tax disposable income.

Despite these restrictions, some differences in the selected data still remains. According to dominant literature (Gruen and Klasen, 2007; Lundberg and Squire, 2003; Dollar and Kraay, 2002) we have also made a regression-based adjustment to deal with the inconsistencies in terms of measurement concepts and reference units. The income shares per decile have been regressed on several variables reflecting the various measurement concepts, while controlling for country and temporal fixed effects. The coefficients of this regression are then used to correct all the information on country data that differs from the excluded reference unit considered (i.e. income data on disposable income, deflated by equivalence scale to correct for household heterogeneity).

The WIID database provides only the percentage shares of income by quantile of population, but it does not give any information on income levels. We therefore merge WIID data with data on per capita real Gross Domestic Product in purchasing power parity (2000 international US$) from *Penn World Table* version 6.2 (PWT, Heston, Summers and Aten, 2006). The data for each of 10 countries are then assembled for seven benchmark years (1970, 1980, 1985, 1990, 1995 and 2000). In case of no data point for a particular benchmark years, the closest available information is chosen, as shown in Table A1.

Finally, the WIID dataset gives a simplified representation of income distribution. Using quintile or deciles grouped data (as shown in Table A2) does not allow to correctly compute of the inequality indexes discussed in Section 2, leading to an underestimation of actual income concentration. For these reasons, some authors have emphasized the opportunity to interpolate data from quantile information to get better assessment of income distribution. in order to do that, two different approaches are usually considered: a first approach relies on the parametric estimation of the density function and/or of the Lorenz curve (Datt, 1998; Chen and Ravallion, 2001; Bhalla, 2002). A second approach involves nonparametric estimation of income density (e.g. kernel density) functions (Sala-i-Martin, 2006; Ackland et al., 2004; Dhongde, 2004). In the empirical literature the software POVCAL, developed and distributed by World Bank (Chen, Datt and Ravallion, 2001) is widely used to implement the first of the above mentioned approaches and to parametrically interpolate the Lorenz curve[13]. In our

[13] Minoiu and Reddy (2007) evaluate the performance of the POVCAL software in estimating Lorenz curves from grouped data and finds that the interpolation techniques employed by the software provide a good fit to the Lorenz curve for a wide range of income distribution. Moreover, Minoiu and Reddy (2006) also finds that the parametric interpolation provided by POVCAL often outperforms kernel density methods in the estimation of poverty and inequality.

study, POVCAL has been used to estimate income distributions by percentiles for all the considered countries and reference years,, allowing us to obtain different and more accurate inequality measures. In order to assess the effect of our adjustments on inequality measures, in Table A1 we present the Gini coefficients reported by the WIID and the same indexes computed from our elaborations on interpolated income data by percentile of population. It should be remarked that the traceable differences between the values are mainly due to the *regression based* correction described before.

4 EMPIRICAL APPLICATION

In this Section we present the results of the application of the social welfare measures discussed in Section 2 to the analysis of levels and rankings of well-being in the ten selected OECD countries for the period 1970-2000.

We start discussing the issues connected with the use of ordinal and cardinal measures, by comparing the welfare orderings that can be obtained using the (Generalized) Lorenz Dominance approach and the SWF normative approach. In Section 4.2 we present cross-countries welfare comparison and their evolution over time, based on the two cardinal measures of well-being considered, which allow us to account for different types of inequality. Finally, we focus on the analysis of the growth-inequality nexus.

4.1 Partial and complete orderings: Lorenz dominance and SWF approaches

The approach to welfare and inequality analysis advanced by Atkinson (1970) and Kolm (1969) has the further merit to establish the close connection between the statistical concept of Lorenz curve (Lorenz, 1905), inequality indexes and the principle of progressive transfer (Dalton, 1920), shedding light on the welfare implication of statistical inequality measures and promoting the use of dominance rankings.

The Lorenz curve ($L(p)$) is one of the most common tools used for visualizing, describing and comparing income distributions; it is defined as the relationship between the cumulative percentage of total income held by a cumulative proportion p of the population, when individuals are ordered in increasing income values.

In his fundamental theorem, Atkinson (1970) showed how the Lorenz ranking can be interpreted as a welfare ranking and proved that if the Lorenz curve of an income distribution dominates (i.e. lies northeast) that of another distribution with the same mean income, then

the distribution with the dominating Lorenz curve has a higher level of per capita social welfare. Formally, given two income distributions X_1 and X_2 with the same mean income μ, then $L_{X_1}(p) > L_{X_2}(p) \Leftrightarrow W_{X_1} > W_{X_2}$, for any symmetric, monotonically increasing, strictly concave and additive social welfare function *W*. Atkinson theorem states that Lorenz dominance is a necessary and sufficient condition to detect welfare superiority in the dominating distribution, provided that it has the same (or higher) mean income than that of the dominated one. The relevance of this result lies in the fact that it explicitly links distributional dominance and social welfare-based measures, providing a unifying framework for ordinal and cardinal approaches to inequality and well-being analysis. Dominance approach, being independent of the exact functional form of the SWF, provides an ordinal ranking of distribution, without aiming at quantifying the differences between distributions. Because of their lower information requirement, the robustness of dominance rankings is stronger than that of SWF-based measures, since they remain valid for wider classes of measurement assumptions.

However, the main limitation of Lorenz curves for inequality and welfare analysis is that they only provide a partial ranking of income distributions, as it only records unambiguous comparisons and may be silent on many cases. If two Lorenz curves intersect it is not possible to rank one distribution as more equal than another distribution by the dominance criterion and it is always possible to find different concave social welfare functions that rank two social states differently. In social welfare analysis, the Lorenz dominance criterion prevents the comparison of incomes distributions with different mean incomes, thus making cross-country and/or intertemporal comparisons of well-being impossible. Moreover, the Lorenz dominance criterion is completely unconcerned with the efficiency/growth aspect of a social welfare analysis.

In order to overcome these issues, Shorrocks (1983) extends Atkinson's approach by introducing the generalized Lorenz curve $GL(p)$, defined as the Lorenz curve $L(p)$ scaled by the mean income μ (i.e. $GL(p) = \mu L(p)$).

Generalized Lorenz dominance is then defined to Lorenz dominance: if the generalized Lorenz curve of one state lies above that of another distribution, the social welfare of the first is higher than the latter. More formally, Shorrock's Theorem (1983) states that, given two distributions X_1 and X_2, $GL_{X_1}(p) > GL_{X_2}(p) \Leftrightarrow W_{X_1} > W_{X_2}$, for any social welfare function W satisfying the conditioned mentioned earlier. Thus, two income distributions have an

unambiguous social welfare ranking only if the generalized Lorenz curves do not intersect, and the distribution with the higher curve is the socially preferred one.

Even though the generalized Lorenz criterion significantly extends welfare comparisons by removing the requirement of equal means, it still provides only a partial ordering of social states. As it can be easily checked, generalized Lorenz criterion may not succeed in resolving all the ambiguities of Lorenz dominance and it may also generate new crossings. Then, as for the Lorenz dominance, if generalized Lorenz curves cross it is always possible to find two increasing and concave social welfare functions which will rank the two income distributions differently.

As already discussed, a partial order may be very valuable in its own right as it serves to locate the areas of disagreement. In order to arrive at a complete ordering, however, further structure has to be imposed on our social values. To obtain a complete ordering of all possible social states, and to quantify the distance between income distributions in terms of their welfare content, a cardinal social evaluation function that assigns numerical values to all possible social states is needed. Obviously, this can be done by specifying the exact form of the SWF adopted and comes at the cost of tightening the informational requirements and of weakening the robustness of welfare measures.

For the aims of the present analysis, generalized Lorenz dominance criterion represents one of the possible approaches to analyze the levels and rankings of well-being across countries and to track their evolution over time.

Insert Figure 1 here

The first two panels in Figure 1 show the generalized Lorenz curves for all the ten countries considered in two reference years (1970 and 2000). As it can be noted, this dominance approach provides few unambiguous cross-country comparisons of absolute welfare levels. In both the years considered, Mexico is generalized Lorenz-dominated by all the other countries, resulting as the country with the lowest level of well-being. On the other hand, in 1970 welfare is unambiguously higher in the United States than all the other countries. However, in 2000 the generalized Lorenz curve of the USA is lower than that of Norway up to the 95th percentile and then the two curves cross, indicating that welfare is higher in the USA than in Norway only for the richer 5 percent of the population. The crossings of the generalized Lorenz curves are much more frequent when welfare levels for

the remaining countries are compared, with intersections often occurring in the middle part of the distribution. In Table A3 in the Appendix we report the full set of pair wise welfare comparisons between the countries in 2000: only in the 36% of the cases (32 out of 90 pair wise comparisons) the generalized Lorenz curves do not cross and lead to unambiguous welfare comparisons.

The last two panels of Figure 1 shows intertemporal welfare comparisons for two countries of the sample, namely Italy and USA. As it can be notices, crossings are much more infrequent, because of the positive growth rates of average national income. However, in Italy the curves for 1990 and 1995 intersect at the 8^{th} decile, and in comparing 1980 and 1985 we also notice a crossing. For the USA, the generalized Lorenz curves of 1970 and 1975 and that of 1980 and 1985 intersect in the first and the last part of the distributions, respectively. This evidences, suggest that generalized Lorenz dominance does not provide complete welfare orderings even in intertemporal comparisons of well-being.

Therefore, in our empirical analysis we find that the generalized Lorenz dominance approach still generates several crossing, in both cross-country and intertemporal welfare comparisons, and provides only a partial ordering of social states. For this reason, in order to obtain complete orderings, we proceed by using the cardinal SWF-based approach, by appropriately specifying the form of the social welfare function along the lines discussed in Section 2. The use of two different types of social evaluation function, which accounts for different types of income inequality, allows us to assess the robustness of the empirical evidences obtained.

4.2 Welfare comparison across countries and over time

The impact of including distributional-considerations in the assessment of economic well-being across space and time is analyzed by firstly comparing welfare levels across countries for the selected benchmark years and by analyzing how the alternative measure considered affect welfare rankings.

Table 1 shows mean per capita incomes and distribution adjusted welfare levels both in levels and as a proportion of per capita GDP (i.e. as the ratio of the corresponding equally distributed equivalent income to mean income) using different measures for each country in year 1970, 1980, 1990 and 2000[14].

[14] All the estimations has been carried out using the software DAD 4.4 (Duclos et al., 2006)).

Given the approach to welfare measure illustrated in the Section 2, the inequality-adjusted welfare measures are obviously smaller than mean incomes. However, the size of the inequality penalty imposed on mean income significantly varies with the values considered for the parameters of inequality (ε) and rank-inequality (ρ) aversion. The generalized framework adopted allows to obtain conventional Atkinson and Gini-based welfare measures, as well as hybrid indexes. In Table 1 we present and compare some of the most frequently used measures, including conventional Atkinson index with $\varepsilon = 0.5$ and $\rho = 1$ and its logarithmic version based on the Bernoullian hypothesis ($\varepsilon = 1$ and $\rho = 1$) and standard Gini measure ($\varepsilon = 0$ and $\rho = 2$). The flexibility of our approach, however, allows to go beyond these measure, by appropriately combining aversion coefficients. As previously introduced, this choice depends on how we assume that society evaluates inequality and weights income and rank dispersions. One of the main aims of the current analysis is therefore to show how the choice of ethical parameters can affect our inequality and welfare judgments. Previous empirical studies (Ebert and Welsch, 2004) have highlighted that levels and ranking of well-being drastically change with ε and ρ and that hybrid functions provide a better accounting for inequality than conventional indexes.

Insert Table 1 here

To assess the sensitivity to ethical parameters, in Figure 2 we graphically represent the values of inequality (panel *a*) and economic welfare measures (panel *b*) for different ε and ρ (with ranges $0 \le \varepsilon \le 1$ and $1 \le \rho \le 4$) taking the situation of USA in year 2000 as reference. The two graphs are two sides of the same coin: welfare is obtained by penalizing mean income for inequality and then rising inequality lead to lowering economic well-being. In particular, welfare is a decreasing function of both ε and ρ and as those parameters rise the ethical relevance of inequality may become almost completely wasteful in terms of social welfare. As it can be noted from inspection of the graphs, combining values of ε and ρ respectively higher than 0.6 and 3 leads to welfare losses constantly above the 60% of mean income and then remain stable, suggesting that the inequality penalty for aversion parameters in that range is excessive.

Insert Figure 2 here

From these evidences, it is obvious that the choice of the ethical parameters may also affect welfare rankings of countries. As an illustrative example, in Figure 3 we consider comparison of welfare levels of USA and Norway in year 2000 as a function of ε and ρ. The choice of these two countries is due to the fact that, as shown in Figure 1, they are characterized by the highest levels of per capita income and the corresponding generalized Lorenz curves intersect. In fact, it is known that if the generalized Lorenz curves of two distributions cross, then there exist two Lorenz-consistent indexes that rank inversely these two distributions in terms of relative welfare. We wish to check the welfare-reversing parameter values in the Atkinson-Gini family to assess the parameter sensitivity of such re-rankings. As it can be noticed, welfare levels in Norway are higher than that of USA for almost all the alternative measure considered. Only for values of ε less than 0.4 and $\rho = 1$ the economic well-being of the USA is higher, while increasing both the ethical parameters welfare is considerably higher in Norway. The intuitive reason of this re-ranking is that, despite the USA has the highest mean per capita GDP, its income distribution is much more unequal than Norway, and only for those parameter values that put less weight on the relative shares of the more deprived economic well-being results to be higher. Thus, social welfare is higher in the USA only for those welfare measures that almost completely disregard inequality assessment; in all the other cases well-being is significantly higher in Norway. This result supports the evidences obtained by generalized Lorenz dominance, which indicate that only individuals in the top 5th percentile are well-off in the USA than in Norway.

Insert Figure 3 here

Results from sensitivity analysis suggest the relevance of accounting for different types of inequality, going beyond standard inequality measures, but at the same time they suggest that specific attention has to be devoted on the way they penalize mean incomes: an excessive emphasis on inequality can be too welfare wasting and flatten well-being comparisons across countries and over time. For this reason, in the rest of the paper we consider a hybrid Atkinson-Gini welfare function that moderately accommodate well-being for inequality in both income levels and rankings by choosing $\varepsilon = 0.5$ and $\rho = 2$. This measure also allows a direct comparison of welfare levels with those obtained by means of commonly used standard Atkinson and Gini indexes.

Returning to Table 1, on the right side of the table we report the changing in countries rankings in terms of economic well-being levels, while on the left side the welfare measures previously described are shown for each selected country and reference year[15].

Before commenting the results, we have to specified that Atkinson and Gini indexes differ each other in that they consider different aspects of inequality: Atkinson coefficients focus on the levels of income, while the Gini measures takes into account both the levels and ranking of incomes (Ebert and Welsch, 2004). Furthermore all of the inequality indicators that we have considered, satisfy the *principle of transfers* and the *principle of proportionality of transfers*. This means that the inequality measure shows a decrease in inequality if an amount of income is transferred from a richer person to a poorer person and, moreover, that this measure reports no change if everyone's income is changed by the same percentage (Dalton, 1920).

The estimated welfare levels indicate that the inequality expressed by the Gini-based indexes is significantly higher than that from the Atkinson family. As in Ebert and Welsch (2004) this suggests that the ranking of incomes plays an important role in the evaluation of inequality, over and above the level of incomes .

Analyzing rankings by levels of per capita GDP and considering the overall sample period (1970-2000) we can see that the rank changes are not so evident. The majority of countries keep their position stable exception of France (that moves from position 5 to 6), Germany that falls in the chart (from 2 to 5) and Norway that increases its level of individual income reaching the top of the rankings (from 6 to 2).

Focusing the attention on the distributional-weighted welfare measures we can see that the rank changes across the benchmark years are much more frequent than GDP changes. In this case only two countries remain stable on their position: Italy that fluctuates between 8th and 9th places and Mexico that instead is always in last place.

Through a closer inspection and aside from the different benchmark years and countries, the analysis of welfare rankings shows that the largest shifts are downwards. Some evidence of this statement are: Canada (1970) that from the 3rd position, according to GDP ranking falls for all the other welfare measures; France (1970) ranked 5th by GDP and 8th in ranking for the other measures. On the other hand sizable upward shifts concern Finland (1980 and 1990) and France (2000).

[15] More precisely, in the first column we report per capita GDP, in columns 2 and 3 the Atkinson indexes; in column 4 standard Gini coefficient and in column 5 the hybrid index of welfare.

Turning to the comparison over time, we can observe that the number of countries with three or more rank changes for all the five measures is higher in the first decade than in any other period. It is interesting to notice that the largest rank changes appear for the standard Gini-based measures and that they have become more frequent in richer countries. Taking into account rank changes for Gini index, inequality increases in the UK, Germany and Australia, while it decreased in Canada, Finland and Norway and it remained largely unchanged in France, Italy, Mexico and USA, over the same period. For the other decades, rank shifts are less evident than the previous period; significant rank changes (three or more rank changes) appear less frequently in both the 1980-1990 and 1990-2000 periods. However, the only changes showed affect the inequality adjusted measures and once again mainly the standard Gini measure.

Insert Figure 4 here

In order to better explain changes in well-being measures, in Figure 4 we have represented levels and trends in per capita GDP and three aggregate welfare measures for each benchmark year from 1970 to 2000. The measures considered are the conventional Atkinson ($\varepsilon = 0.5$ and $\rho = 1$), standard Gini ($\varepsilon = 0$ and $\rho = 2$) and the hybrid Atkinson-Gini welfare indexes ($\varepsilon = 0.5$ and $\rho = 2$).

Thanks to this figure the comparison of aggregate welfare between countries is easier and clearer. When examining per capita income levels, we see that for all the selected countries there is a constant increase over time, since 1970 with a slowdown between 1985 and 1995 for some countries; this is particularly clear for Finland, Mexico and Canada and the same fluctuations are reflected in the trend of the other welfare measures.

For all countries, with the exception of France, we see a substantial divergence between per capita income levels and the other measures of well-being. The increase in distances proves that for all the analyzed countries there is a growth of inequality due to increasing social distances. There is only a slight catch up on GDP for all three indexes in France, but in general differences between per capita incomes and economic well-being are higher in 2000 than in 1970. This result is alarming especially for Mexico, which is not only characterized by the lowest per capita incomes (five times smaller than all the other countries), but also shows the greatest divergence between welfare measures.

However, some countries with high levels of GDP, as Italy, United Kingdom and USA, are characterized by large and widening differences in inequality-adjusted social welfare levels. Overall then it would seem that for these countries the increase in GDP do not completely convert into higher levels of aggregate well-being.

The same evidences are shown on Table 2 where overall welfare losses and their brake-down in the components due to rank dispersion and inequality in income levels are presented. These results support the previous remarks. In particular, the percentage welfare loss in Mexico is the highest and, moreover, for all the benchmark years, except 1980, this country reports a progressive worsening in inequality. We can observe an analogous situation for Australia, Italy, Norway, United Kingdom and USA, although with significantly lower welfare losses levels. The percentage welfare loss has increased for the greater part of the countries considered since 1970, while only Canada, Finland and France show a positive trend in well-being, but the increase of welfare is not always reflected in both the income and rank dispersion components.

Insert Table 2 here

4.3 Intertemporal analysis of economic well-being: income growth and inequality

In this Section we analyze to what extent the inclusion of distributional considerations in welfare measurement affects the impression of changes in economic well-being in the selected countries. The theoretical framework presented in Section 2 can be profitably used not only to compare welfare levels across countries, but also to assess the impact of changes in inequality on economic growth.

Following Ahluwalia and Chenery (1974), Klasen (1994) and Gruen and Klasen (2001, 2007), in order to improve on the growth rate of per capita GDP as an indicator of changes in economic well-being, alternative composite indexes of growth and income distribution are introduced and compared. From equation (21) it is possible to account for distributional issues by defining welfare growth rates in terms of equally distributed equivalent levels of income; formally, the average welfare growth rate can be defined as:

$$\overline{R}^{t,t+k}_{W_{(\rho,\varepsilon)}} = \frac{1}{k-1}\frac{W^{t+k}_{(\rho,\varepsilon)} - W^{t}_{(\rho,\varepsilon)}}{W^{t}_{(\rho,\varepsilon)}} = \frac{1}{k-1}\frac{\mu^{t+k}(1-I^{t+k}_{(\rho,\varepsilon)}) - \mu^{t}(1-I^{t}_{(\rho,\varepsilon)})}{\mu^{t}(1-I^{t}_{(\rho,\varepsilon)})} \qquad (22)$$

Expression (22) highlights how distributional-accounting growth rates are themselves functions of the inequality penalties considered and changes in well-being may significantly vary with the values of the ethical parameters ε and ρ. In particular, by assuming $\varepsilon = 0$ and $\rho = 1$ (i.e. $I_{(\rho,\varepsilon)} = 0$) we obtain standard per capita GDP growth, while in all the other cases ($\varepsilon \neq 0$ and/or $\rho \neq 1$) growth rates of distribution-sensitive welfare measures are obtained.

The calculations of standard income-based average annual growth rates and inequality adjusted growth rates[16], for the whole sample period (1970-2000) and for three sub-periods, are presented in Table 3. The distribution-weighted growth rate are obtained from the welfare measures already considered in the international comparison discussed in the previous Section, and capture the dispersion of incomes and ranks. The three measures considered are to be preferred to standard GDP growth rate since the combination of income growth and changes in the income distribution provides a better representation of changes in well-being. Moreover, comparisons between such measures and standard growth rate enable to infer changes in income distribution and the beneficiaries of economic growth. In fact, situations in which the average growth rate of per capita GDP is higher (lower) than those of distribution-weighted welfare measures indicates that inequality has increased (decreased) over the period considered. Analyzing the growth rates for the period 1970-2000, it is possible to notice that welfare growth rates are higher than income growth rates only for Canada, Finland and France, indicating that in these three countries the increase in mean income levels has been accompanied by diminishing level and rank inequality. In these cases, the growth process has increased the economic well-being for those individuals in the lowest part of the income distribution and it can be then considered to be "pro-poor" (Ravallion and Chen, 2003)[17]. On the other hand, for all the remaining countries the inclusion of inequality considerations leads to lower rates of growth. Such decreases in welfare losses are particularly significant for Mexico, UK and USA, where inequality decreases the growth of economic well-being by almost one percentage point.

Insert Table 3 here

[16] We have considered average annual rates instead of cumulate rates to obtain a standardized measure of growth. The observation periods diverge between countries (as an example Australia is observed between 1968 and 2000, while the period of analysis for the USA goes from 1972 to 2000) and therefore is not correct to compare cumulate growth rate.

[17] These results are confirmed by analyzing the "growth incidence curves" (Ravallion and Chen, 2003), which gives rates of growth by quantiles of the distribution of income, for each country in the entire period. These graphs are not presented here, but are available from the authors.

The analysis of growth rates of well-being can be further deepened by considering changes in sub-periods: longer-term analysis may in fact hide heterogeneity in welfare dynamics (Atkinson and Brandolini, 2001). Sub-period analysis allows to point out several interesting evidences. Firstly, it is interesting to note that almost all the countries, with the exception of Canada, UK and USA, are characterized by the highest average GDP growth rates between 1970 and 1980, compared to the other sub-periods. In the 1970s to these high GDP growth rates correspond even higher increases in inequality adjusted welfare changes in six countries, which show a general decreasing trend in income inequality. Only Australia and USA experienced increasing welfare losses. On the other hand, we can notice an evident growth slowdown in the other two decades especially for the European countries in the 1990s, with the exception of France, which has been accompanied by even lower rates of growth in economic well-being. This phenomenon is particularly evident for Finland and Italy, where the average annual growth of the Atkinson-Gini welfare measure is lower than that of per capita GDP by one percentage point (passing from 1.37% to 0.40% in Finland and from 1.51% to 0.45% in Italy). In these two countries, the 1990-2000 period has been then characterized not only by a sharp slowdown with respect to the previous decade (with per capita GDP growth reducing from 2.66 to 1.37 and from 2.28 to 1.51 in Finland and Italy, respectively), but also by rising welfare losses, which suggest that richer individuals have received greater benefits from the growth process ("pro-rich" growth) and that there has been a widening in social distances.

In order to better illustrate the growth dynamics in the three decades and the effect of including different inequality penalties on welfare growth, the welfare changes of four reference countries have been graphically represent in Figure 5. In particular we focus the attention on Italy and Mexico, which are ranked in the last positions of welfare rankings, and on Norway and USA, which are characterized by the highest levels of economic well-being.

Insert Figure 5 here

Analyzing the estimated welfare growth rates, we note that during the 1970s in Italy and Mexico, annual income growth was accompanied by falling inequality which ensures that increases in well-being were above the income growth rate. In the other periods the situation changes significantly; in particular, as discussed above, in the nineties per capita income in

Italy grows at a slower rate and moreover well-being increases at an even slower rate, indicating a significant increase in inequality during this period (which is particularly evident when the Atkinson-Gini measure is considered). Particularly interesting is the situation in Mexico during the 1980s; in this period the country experienced the lowest annual growth rate of per capita incomes (0.7%), but this growth in mean income is completely offset when distributional considerations are taken into account. Inequality growth is in fact so high that economic well-being, when measured with Gini and Atkinson-Gini welfare indexes, is characterized by negative growth rates. Completely different is the situation of Norway, which is characterized by high annual income growth rates and by unchanged inequality. Changes in the alternative welfare measures considered basically coincide with GDP growth rates; only in the 1990s an increase in inequality that lowers welfare levels can be pointed out. Finally, the USA in all the three decades shows moderate to high income growth, which translates into significantly lower welfare increases, especially in the 1980s, once the rising inequality is accounted for.

Table 4 shows changes in the estimated well-being loss implied by the three welfare measure considered. The information reported in this Table is the complement to that of Table 3 and allows to isolate the inequality component of the rate of growth of welfare, measuring to what extent distribution-weighted and income-weighted growth rates differ. The analysis of the table allows to capture the income distribution dynamics across countries. Moreover, as previously highlighted, significant heterogeneities among sub-periods can be picked out, with a continuous worsening of welfare levels that is particularly evident in the 1990s, when all the countries with the exception of Australia and France experienced significant reductions of economic well-being. The data reported in this table are then used in the following Figure 6 to decompose the causes of changes in inequality and separate the effects of inequality due to income dispersion from that due to rank dispersion, by plotting changes in Atkinson ($\varepsilon = 0.5$ and $\rho = 1$) and Gini ($\varepsilon = 0$ and $\rho = 2$) inequality indexes in the two axes.

From our elaborations we can highlight three main groups of countries. The first group (Group A) is relating to virtuous countries, which shows a fall both in income levels dispersion and in rank dispersion over the whole selected period. Group B is characterized by moderate increases in inequality in income levels and by a considerable growth of social distance. In the last group (Group C) there are those countries with the worst inequality dynamics, displaying a significant growth in both rank and income dispersion.

Insert Table 4 here

Insert Figure 6 here

Finally, Figures 7 and 8 provide a summary of the relationship between income-based growth and changes in inequality of incomes, and further highlight how the framework proposed in this paper can be very effective in illustrating the efficiency and equity implications of the growth process. The welfare loss measure considered in the Figures is the hybrid Atkinson-Gini measure, accounting for different types of inequality.

Insert Figure 7 here

Insert Figure 8 here

Analyzing Figure 7, no clear relationship between income growth and changes in inequality can be picked out. The three countries with decreasing inequality in both income levels and social distances (France, Canada and Finland) line up on the same mean growth rate of the other industrialized countries, but their resulting growth in welfare levels is much higher due to rising distribution equity. Only three countries out of ten are then characterized by "pro-poor" growth over the entire period of analysis. Regarding the remaining countries, Norway has the highest per capita GDP growth rate, and its increasing inequality does not reduce noticeably welfare. Among the industrialized countries, UK experienced the highest income inequality growth, which is mainly due to the sharply rising inequality in the eighties (panel b of Figure 8), confirming the findings of Jenkins (1997).

The analysis disaggregated by sub-periods reveals several interesting evidences. It is confirmed that the relationship between income and inequality growth rates does not show any clear pattern. However, heterogeneous dynamics can be detected among the sub-periods. In particular, while the 1970s are characterized by rising incomes and decreasing inequality in almost all the countries, the situation significantly changes in the other two decades, when only Finland and Canada in 1980 and Australia and France in the 1990s reveal a modest decrease in income inequality, which indicates that the growth process has favoured individuals in the lowest part of the distribution thus increasing aggregate economic well-being.

The analysis carried out in this Section clearly highlights that combining income growth with levels and changes in inequality lead to very large differences in the evaluation of the dynamics of economic well-being. From a policy perspective, the approach considered in the present study suggests that interventions aimed at increasing the incomes of the poor, realizing a more even distribution of incomes, may yield higher growth in aggregate economic welfare.

5 Concluding Remarks

In this paper, we have investigated how inequality-adjusted welfare measures would change the impression of aggregate well-being in both cross-country and intertemporal dimensions.

The generalized approach to inequality measurement proposed by Ebert (1988) and Araar and Duclos (2003) has been applied to incorporate distributional components in the evaluation of economic well-being. This framework, which merges the Atkinson and single-parameter Gini families of inequality and welfare indexes, have allowed to obtain alternative welfare measures that penalize mean income for inequality in both levels and ranks of incomes. The dimension of aggregate welfare derived from these inequality-adjusted measures significantly differs from the one obtained with real per capita incomes.

Using plausible adjustments for inequality that are consistent with the literature on both inequality aversion and relative deprivation, the corresponding measures of economic well-being obtained, compared to per capita incomes, significantly change the picture of aggregate welfare across country and over time. This is reflected by the differences in the results obtained in the empirical application, based on comparable data for ten OECD countries, using standard Atkinson and Gini-based measures and hybrid Atkinson-Gini welfare measures.

As it clearly emerges from our results, inequality matters for welfare comparisons. The ranking of countries for the selected reference years is significantly affected by adjustments for income inequality, measured not only in terms of income levels, but also in terms of social distances, suggesting that relative income may be much more important for individual and aggregate welfare than absolute income.

Moreover, with respect to the evidences obtained in the intertemporal analysis, the methodology presented in the paper has allowed to account for distributional issues by

defining welfare changes over time in terms of equally distributed equivalent levels of income for each year. The results obtained highlighted that combining income growth with levels and changes in inequality lead to very large differences in the evaluation of economic well-being growth. The move from a simply income-weighted growth rate to distribution-weighted measures, which evaluate the observed growth in the distribution-sensitive welfare measures, is proved to be very effective. Such measures may lead to a re-evaluation of economic policy priorities in favour of interventions aimed at increasing the incomes of the poor, which not only a provide a more even distribution of incomes but also yield higher growth in aggregate economic well-being.

Despite this analysis does not offer a clear-cut solution to the issues connected to the measurement of economic welfare, it provides significant insides on the relevance of including both size and distribution considerations in the assessment of economic well-being and growth, suggesting that improvements in a better understanding of well-being are not only feasible but also relevant for an economic policy.

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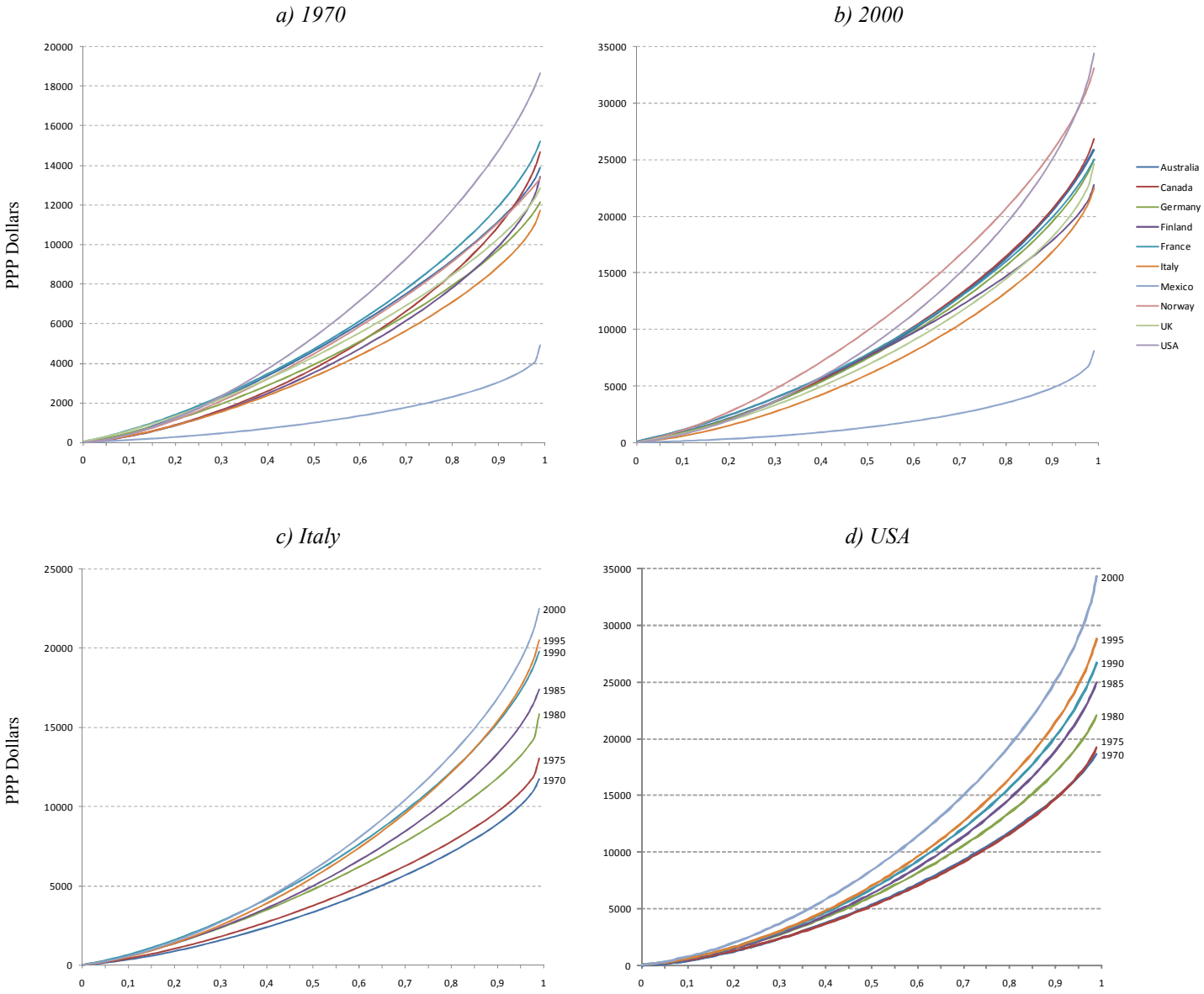

Figure 1 – Generalized Lorenz curves: cross-country and intertemporal comparisons

Table 1 – Per capita GDP and inequality-adjusted welfare measures

Year	Country	Welfare measure: (1) GDP (per capita)	(2) Equally Distributed Equivalent Income: $\varepsilon = 0.5;\ \rho = 1$	(3) Equally Distributed Equivalent Income: $\varepsilon = 1;\ \rho = 1$	(4) Equally Distributed Equivalent Income: $\varepsilon = 0;\ \rho = 2$	(5) Equally Distributed Equivalent Income: $\varepsilon = 0.5;\ \rho = 2$	Ranked by: (1)	(2)	(3)	(4)	(5)
1970	**Australia**	13,861	13,004 (93.82)	12,061(87.02)	10,238(73.86)	9,672(69.77)	4	4	3	3	3
	Canada	14,686	13,016 (88.63)	11,446(77.94)	9,211(62.72)	8,412(57.28)	3	3	6	6	7
	Finland	12,136	11,450 (94.34)	10,799(88.98)	8,904(73.36)	8,558(70.52)	8	8	7	7	6
	France	13,429	11,910 (88.69)	10,537(78.46)	8,501(63.30)	7,823(58.25)	5	7	8	8	8
	Germany	15,218	14,196 (93.29)	13,269(87.19)	10,802(70.98)	10,351(68.02)	2	2	2	2	2
	Italy	11,732	10,639 (90.69)	9,648(82.24)	7,814(66.60)	7,318(62.37)	9	9	9	9	9
	Mexico	4,930	3,927 (79.67)	3,322(67.38)	2,551(51.74)	2,348(47.63)	10	10	10	10	10
	Norway	13,352	12,560 (94.07)	11,489(86.05)	10,031(75.12)	9,331(69.89)	6	5	5	4	4
	UK	12,849	12,182 (94.81)	11,568(90.03)	9,590(74.64)	9,284(72.26)	7	6	4	5	5
	USA	18,647	16,985 (91.09)	15,129(81.13)	12,653(67.86)	11,549(61.93)	1	1	1	1	1
1980	**Australia**	17,975	16,676 (92.78)	15,420(85.79)	12,560(69.88)	11,874(66.06)	4	4	5	6	6
	Canada	19,000	17,414 (91.65)	15,935(83.87)	12,870(67.74)	12,112(63.74)	3	3	3	3	5
	Finland	16,142	15,589 (96.57)	15,018(93.04)	12,831(79.49)	12,459(77.19)	7	7	6	4	3
	France	17,514	16,224 (92.63)	14,982(85.55)	12,171(69.50)	11,501(65.67)	5	6	7	7	7
	Germany	17,457	16,448 (94.22)	15,521(88.91)	12,719(72.86)	12,266(70.26)	6	5	4	5	4
	Italy	15,828	14,334 (90.56)	13,232(83.60)	10,775(68.08)	10,315(65.17)	8	9	9	9	9
	Mexico	6,127	5,115 (83.48)	4,359(71.15)	3,383(55.21)	3,083(50.32)	10	10	10	10	10
	Norway	19,708	18,528 (94.02)	17,110(86.82)	14,642(74.29)	13,696(69.50)	2	2	2	1	1
	UK	15,395	14,625 (95.00)	13,896(90.26)	11,519(74.82)	11,137(72.34)	9	8	8	8	8
	USA	22,042	19,922 (90.38)	17,803(80.77)	14,494(65.76)	13,325(60.45)	1	1	1	2	2
1990	**Australia**	20,806	18,966 (91.16)	17,261(82.96)	13,899(66.80)	13,034(62.65)	6	7	7	7	7
	Canada	20,896	19,298 (92.36)	17,796(85.17)	14,438(69.09)	13,656(65.36)	4	5	5	5	5
	Finland	20,000	19,360 (96.80)	18,741(93.71)	15,980(79.90)	15,635(78.17)	7	4	3	3	2
	France	20,873	19,140 (91.70)	17,484(83.76)	14,240(68.22)	13,359(64.00)	5	6	6	6	6
	Germany	21,307	19,807 (92.96)	18,452(86.60)	14,979(70.30)	14,325(67.23)	3	3	4	4	4
	Italy	19,802	18,221 (92.02)	16,777(84.72)	13,549(68.42)	12,833(64.81)	9	8	8	8	8
	Mexico	6,658	5,165 (77.57)	4,177(62.74)	3,224(48.42)	2,856(42.90)	10	10	10	10	10
	Norway	23,958	22,546 (94.11)	21,082(88.00)	17,479(72.96)	16,558(69.11)	2	2	1	1	1
	UK	19,849	18,067 (91.02)	16,482(83.03)	13,206(66.53)	12,452(62.73)	8	9	9	9	9
	USA	26,688	23,668 (88.68)	20,737(77.70)	16,725(62.67)	15,178(56.87)	1	1	2	2	3
2000	**Australia**	25,835	23,925 (92.61)	22,092(85.51)	17,900(69.29)	16,913(65.47)	4	4	4	5	5
	Canada	26,821	24,546 (91.52)	22,443(83.68)	18,141(67.64)	17,074(63.66)	3	3	3	3	4
	Finland	22,741	21,386 (94.04)	20,258(89.08)	16,732(73.58)	16,254(71.48)	8	8	7	7	7
	France	25,045	23,499 (93.83)	22,074(88.14)	17,974(71.77)	17,278(68.99)	6	5	5	4	3
	Germany	25,061	23,176 (92.48)	21,428(85.50)	17,368(69.30)	16,481(65.76)	5	6	6	6	6
	Italy	22,487	20,127 (89.50)	17,950(79.82)	14,449(64.25)	13,354(59.39)	9	9	9	9	9
	Mexico	8,082	6,125 (75.78)	4,818(59.61)	3,738(46.25)	3,244(40.14)	10	10	10	10	10
	Norway	33,092	30,566 (92.37)	28,210(85.25)	22,939(69.32)	21,724(65.65)	2	1	1	1	1
	UK	24,666	22,176 (89.90)	20,170(81.77)	16,112(65.32)	15,255(61.85)	7	7	8	8	8
	USA	34,365	30,012 (87.33)	26,078(75.89)	20,840(60.64)	18,926(55.07)	1	2	2	2	2

Notes: sorted in descending order, from highest to lowest welfare levels.
In parentheses we report the ratio (in %) of the respective adjusted income to GDP per capita.

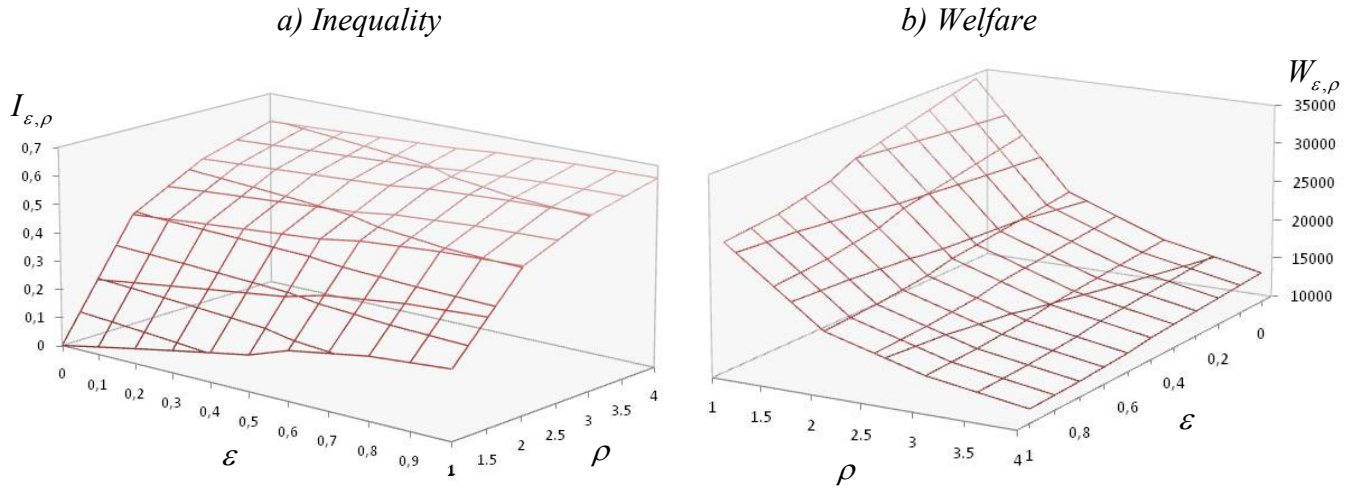

Figure 2 – Sensitivity of inequality and welfare measures to the choice of the ε and ρ parameters (*USA, year 2000*)

$$\Delta W_{\varepsilon,\rho} = W^{Norway}_{\varepsilon,\rho} - W^{USA}_{\varepsilon,\rho}$$

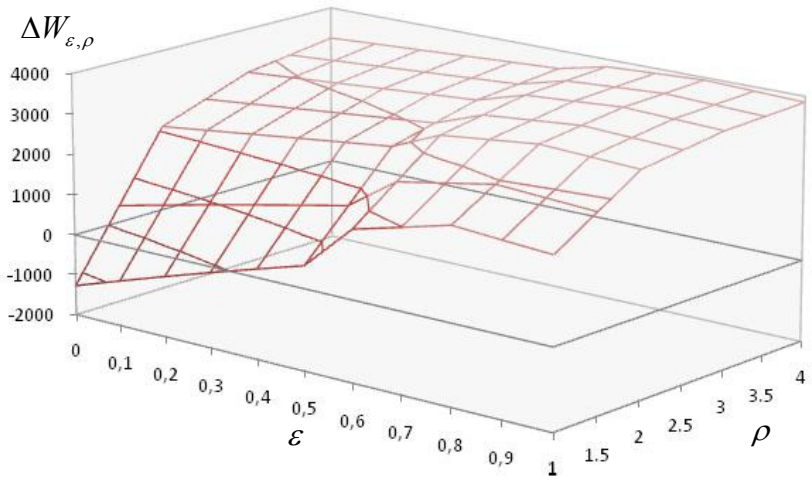

Figure 3 – Sensitivity of social welfare comparisons: *Norway vs Usa (year 2000)*

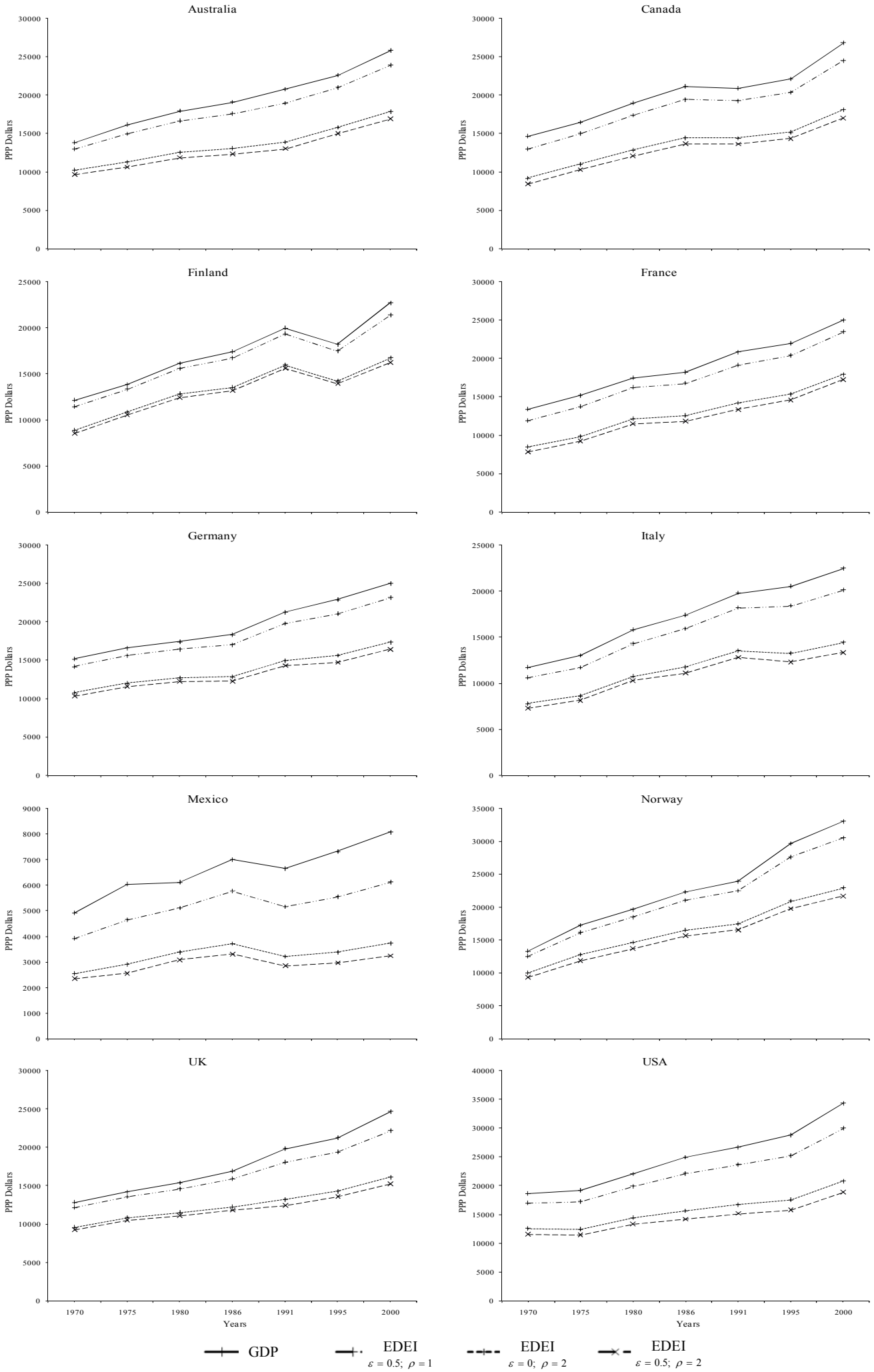

Figure 4 – Time patterns of alternative per capita measures of well-being

Table 2 – Welfare loss due to inequality (in percentage)

Year	Country	Welfare loss			Ranked by		
		(1) $\varepsilon = 0.5;\ \rho = 1$	(2) $\varepsilon = 0;\ \rho = 2$	(3) $\varepsilon = 0.5;\ \rho = 2$	(1)	(2)	(3)
1970	**Australia**	6.18	26.14	30.23	7	8	7
	Canada	11.37	37.28	42.72	2	2	2
	Finland	5.66	26.64	29.48	9	7	9
	France	11.31	36.70	41.75	3	3	3
	Germany	6.71	29.02	31.98	6	6	6
	Italy	9.31	33.40	37.63	4	4	5
	Mexico	20.33	48.26	52.37	1	1	1
	Norway	5.93	24.88	30.11	8	10	8
	UK	5.19	25.36	27.74	10	9	10
	USA	8.91	32.14	38.07	5	5	4
1980	**Australia**	7.22	30.12	33.94	6	6	6
	Canada	8.35	32.26	36.26	4	3	3
	Finland	3.43	20.51	22.81	10	10	10
	France	7.37	30.50	34.33	5	5	5
	Germany	5.78	27.14	29.74	8	7	8
	Italy	9.44	31.92	34.83	3	4	4
	Mexico	16.52	44.79	49.68	1	1	1
	Norway	5.98	25.71	30.50	7	8	7
	UK	5.00	25.18	27.66	9	9	9
	USA	9.62	34.24	39.55	2	2	2
1990	**Australia**	8.84	33.20	37.35	4	4	3
	Canada	7.64	30.91	34.64	7	7	7
	Finland	3.20	20.10	21.83	10	10	10
	France	8.30	31.78	36.00	5	5	5
	Germany	7.04	29.70	32.77	8	8	8
	Italy	7.98	31.58	35.19	6	6	6
	Mexico	22.43	51.58	57.10	1	1	1
	Norway	5.89	27.04	30.89	9	9	9
	UK	8.98	33.47	37.27	3	3	4
	USA	11.32	37.33	43.13	2	2	2
2000	**Australia**	7.39	30.71	34.53	8	6	6
	Canada	8.48	32.36	36.34	5	5	5
	Finland	5.96	26.42	28.52	10	10	10
	France	6.17	28.23	31.01	9	9	9
	Germany	7.52	30.70	34.24	7	7	8
	Italy	10.50	35.75	40.61	3	3	3
	Mexico	24.22	53.75	59.86	1	1	1
	Norway	7.63	30.68	34.35	6	8	7
	UK	10.10	34.68	38.15	4	4	4
	USA	12.67	39.36	44.93	2	2	2

Notes: ranked in descending order, from the highest welfare loss (highest inequality) to the lowest (lowest inequality).

Table 3 – Per capita welfare measures: annual average growth rates (in percentage)

Country	1970-2000				1970-1980				1980-1990				1990-2000			
	GDP	$\varepsilon = 0.5$ $\rho = 1$	$\varepsilon = 0$ $\rho = 2$	$\varepsilon = 0.5$ $\rho = 2$	GDP	$\varepsilon = 0.5$ $\rho = 1$	$\varepsilon = 0$ $\rho = 2$	$\varepsilon = 0.5$ $\rho = 2$	GDP	$\varepsilon = 0.5$ $\rho = 1$	$\varepsilon = 0$ $\rho = 2$	$\varepsilon = 0.5$ $\rho = 2$	GDP	$\varepsilon = 0.5$ $\rho = 1$	$\varepsilon = 0$ $\rho = 2$	$\varepsilon = 0.5$ $\rho = 2$
Australia	2.70	2.62	2.34	2.34	2.28	2.17	1.74	1.75	1.97	1.72	1.33	1.22	2.20	2.38	2.62	2.71
Canada	2.85	3.05	3.34	3.55	2.94	3.38	3.97	4.40	1.00	1.08	1.22	1.28	3.15	3.02	2.85	2.78
Finland	3.01	2.99	3.03	3.10	3.30	3.61	4.41	4.56	2.66	2.69	2.73	2.83	1.37	1.05	0.47	0.40
France	2.88	3.24	3.71	4.03	2.76	3.29	3.93	4.27	2.40	2.25	2.12	2.02	1.82	2.07	2.38	2.67
Germany	2.40	2.34	2.25	2.19	1.84	1.98	2.22	2.31	2.45	2.27	1.97	1.87	1.76	1.70	1.60	1.51
Italy	3.06	2.97	2.83	2.75	3.49	3.47	3.79	4.10	2.28	2.47	2.34	2.22	1.51	1.16	0.74	0.45
Mexico	2.00	1.75	1.46	1.19	2.70	3.36	3.63	3.48	0.72	0.08	-0.39	-0.61	1.94	1.69	1.45	1.23
Norway	4.93	4.78	4.29	4.43	3.97	3.96	3.83	3.90	2.70	2.71	2.42	2.61	3.81	3.56	3.12	3.12
UK	3.07	2.73	2.27	2.14	1.98	2.01	2.01	2.00	2.89	2.35	1.46	1.18	2.43	2.27	2.20	2.25
USA	3.01	2.74	2.31	2.28	2.60	2.47	2.08	2.20	1.76	1.57	1.28	1.16	3.20	2.98	2.73	2.74

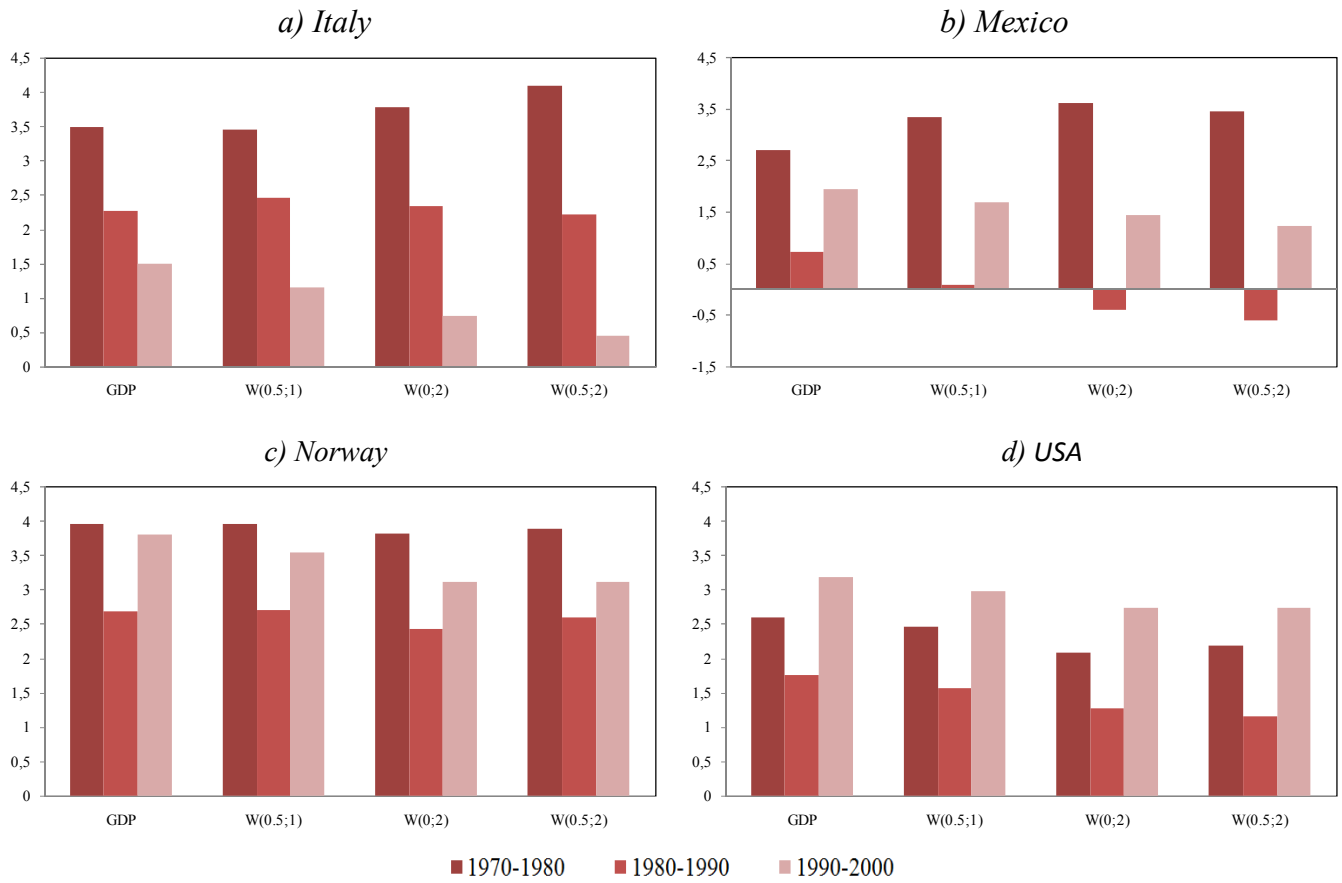

Figure 5 - Per capita welfare measures: annual average growth rates (selected countries)

Table 4 – Loss in social welfare: annual mean percentage variations

	1970-2000			1970-1980			1980-1990			1990-2000		
Country	$\varepsilon = 0.5$ $\rho = 1$	$\varepsilon = 0$ $\rho = 2$	$\varepsilon = 0.5$ $\rho = 2$	$\varepsilon = 0.5$ $\rho = 1$	$\varepsilon = 0$ $\rho = 2$	$\varepsilon = 0.5$ $\rho = 2$	$\varepsilon = 0.5$ $\rho = 1$	$\varepsilon = 0$ $\rho = 2$	$\varepsilon = 0.5$ $\rho = 2$	$\varepsilon = 0.5$ $\rho = 1$	$\varepsilon = 0$ $\rho = 2$	$\varepsilon = 0.5$ $\rho = 2$
Australia	0.61	0.55	0.45	1.29	1.17	0.94	2.80	1.27	1.26	-1.49	-0.68	-0.69
Canada	-0.88	-0.45	-0.52	-2.66	-1.35	-1.51	-0.84	-0.42	-0.44	1.22	0.52	0.54
Finland	0.18	-0.03	-0.11	-3.94	-2.30	-2.26	-0.74	-0.22	-0.48	8.64	3.14	3.07
France	-1.51	-0.77	-0.86	-3.17	-1.53	-1.61	1.59	0.52	0.61	-2.33	-1.02	-1.26
Germany	0.45	0.21	0.26	-1.74	-0.81	-0.88	2.43	1.05	1.13	0.68	0.34	0.45
Italy	0.42	0.23	0.26	0.13	-0.44	-0.74	-1.40	-0.10	0.09	3.50	1.47	1.71
Mexico	0.60	0.36	0.45	-2.09	-0.80	-0.57	2.98	1.26	1.24	0.73	0.38	0.44
Norway	0.95	0.78	0.47	0.07	0.28	0.11	-0.19	0.65	0.16	2.95	1.35	1.12
UK	3.15	1.23	1.25	-0.37	-0.07	-0.03	7.95	3.29	3.47	1.24	0.36	0.24
USA	1.50	0.80	0.64	1.13	0.93	0.55	1.47	0.75	0.76	1.32	0.60	0.46

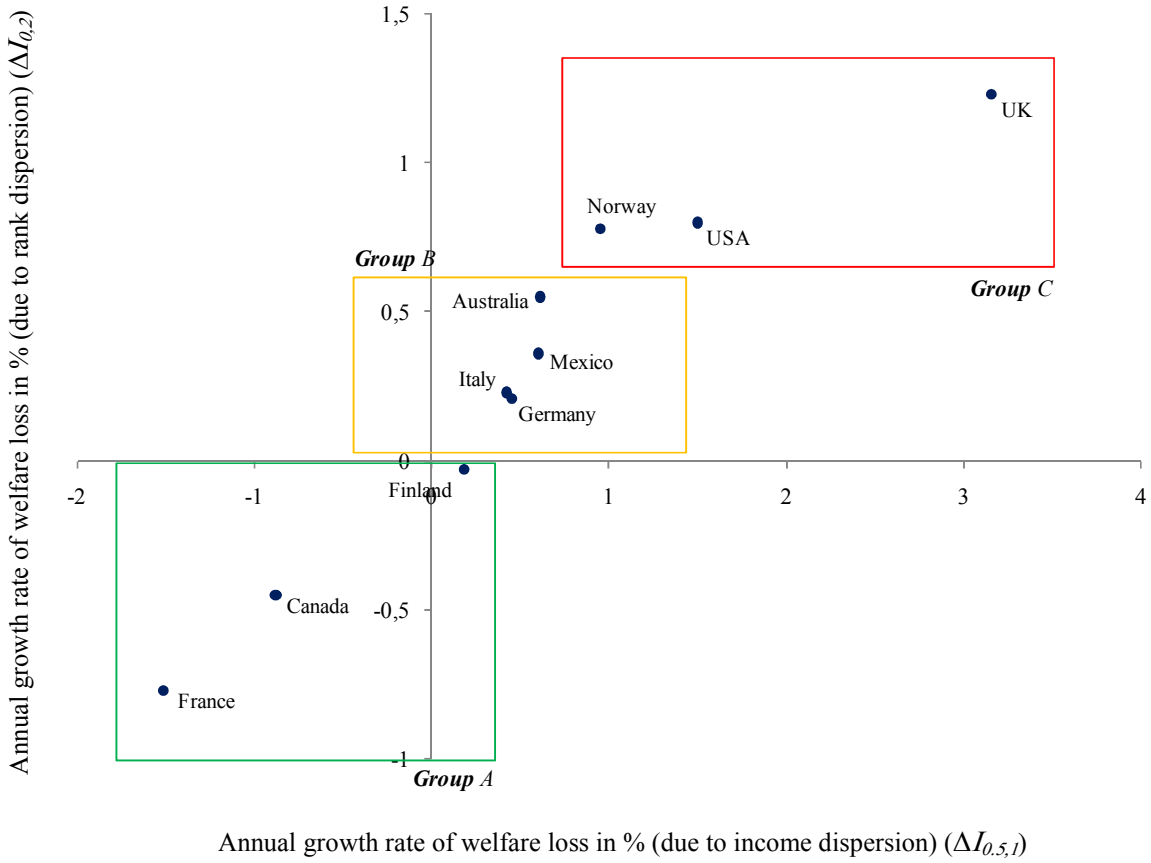

Figure 6 – Sorting of countries by mean annual growth rate of welfare loss (1970-2000)

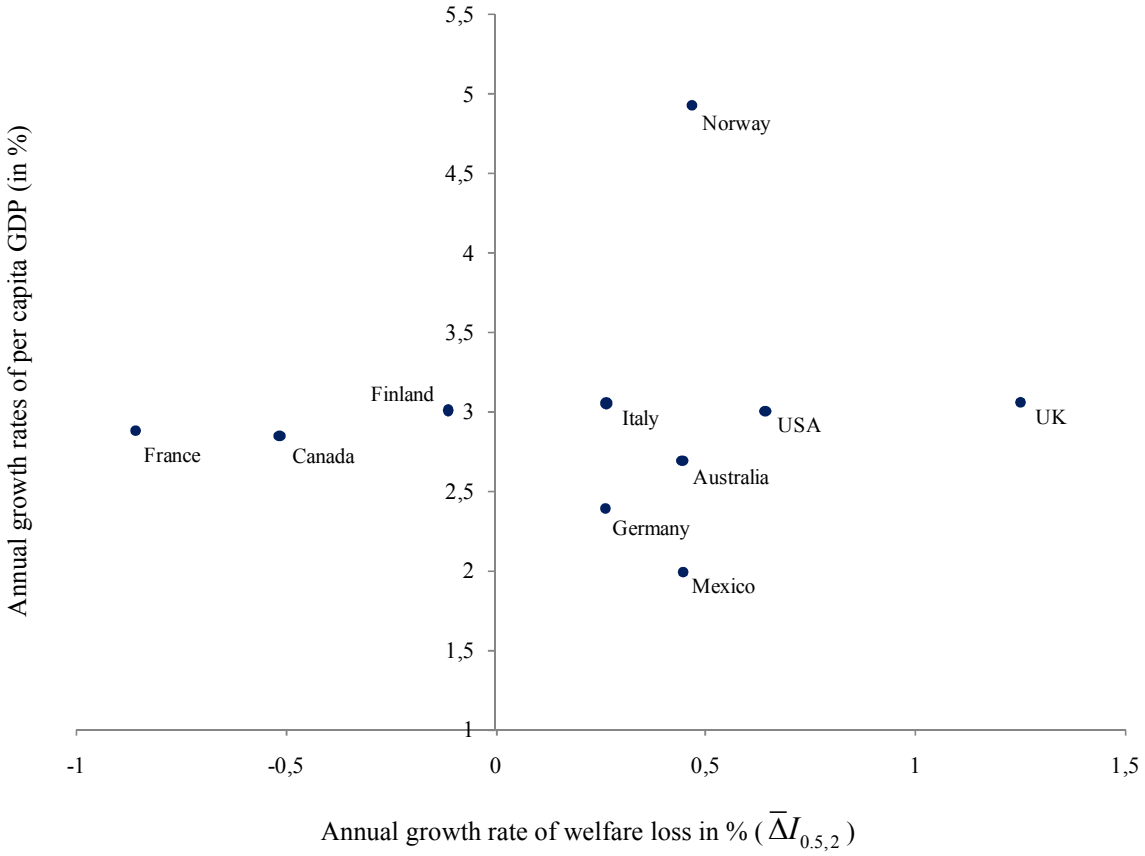

Figure 7 – Sorting of countries by annual growth rates of GDP and welfare loss ($\overline{\Delta I}_{0.5,2}$) (1970-2000)

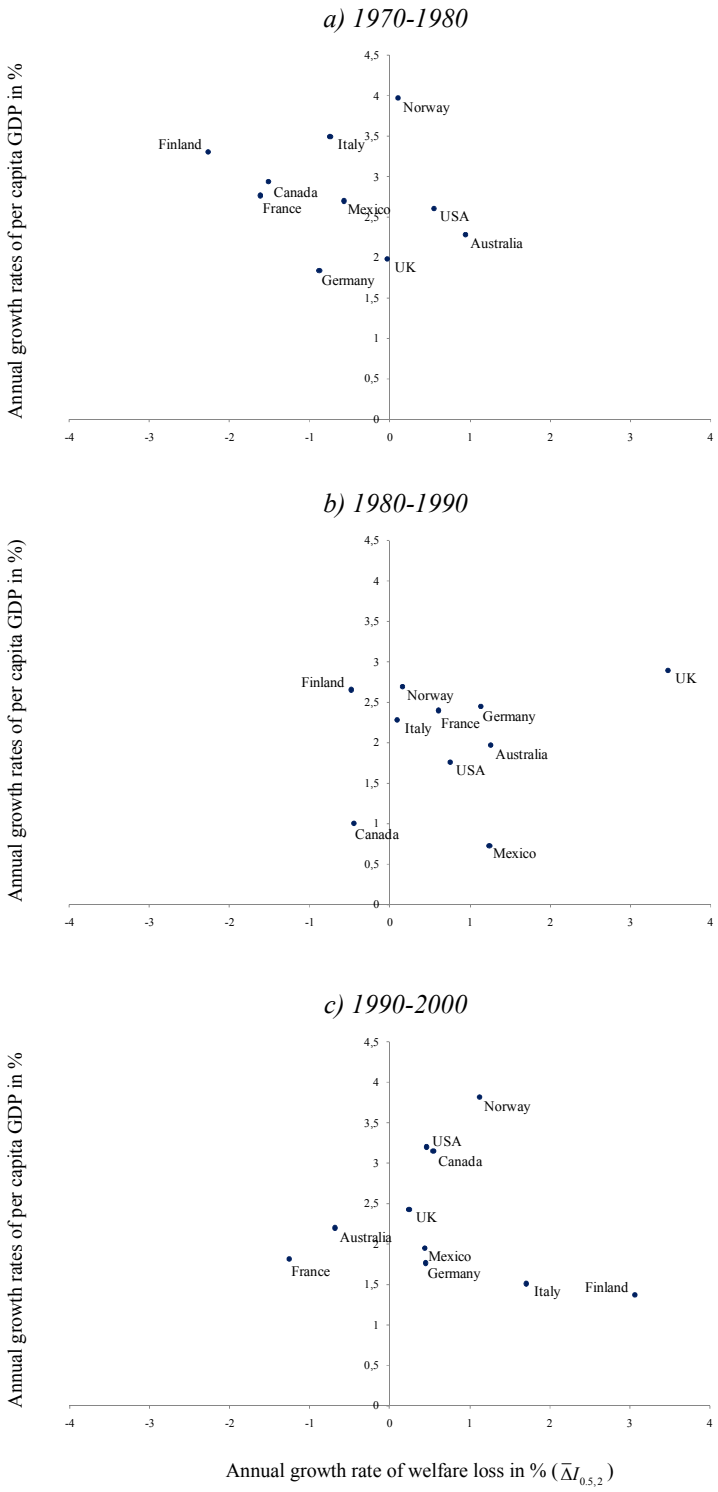

Figure 8 – Sorting of countries by annual GDP growth rates and mean annual changes in welfare loss for different sub-periods

APPENDIX

Table A1 – Sample composition: availability of income data and Gini indexes

	1970			1975			1980			1985			1990			1995			2000		
Country	**Year**	**Gini Index**		**Year**	**Gini Index**		**Year**	**Gini Index**		**Year**	**Gini Index**		**Year**	**Gini Index**		**Year**	**Gini Index**		**Year**	**Gini Index**	
Australia	1968	26.1	(31.8)	1976[a]	30.3	(30.3)	1981	30.1	(31.0)	1985	31.6	(32.5)	1989	33.2	(33.2)	1995[a*]	30.0	(30.0)	2000[a*]	30.7	(30.7)
Canada	1971	37.3	(37.3)	1975	33.0	(33.1)	1981	32.3	(32.3)	1987	31.5	(31.5)	1991	30.9	(30.9)	1994	31.3	(31.3)	2000	32.4	(32.4)
Finland	1971	26.6	(26.7)	1976	21.4	(21.4)	1981	20.5	(20.5)	1985	22.4	(22.4)	1990	20.1	(20.1)	1995	21.6	(21.7)	2000	26.4	(26.4)
France	1970	36.7	(42.5)	1975	35.1	(35.2)	1981	30.5	(31.4)	1984[b*]	31.0	(37.6)	1989	31.8	(32.7)	1995	30.1	(30.2)	2000	28.2	(28.2)
Germany	1973	29.0	(29.9)	1978	27.8	(28.7)	1981	27.1	(28.0)	1985	30.0	(30.0)	1990	29.7	(29.7)	1995	31.8	(31.8)	2000	30.7	(30.7)
Italy	1970	33.4	(39.0)	1975	33.6	(39.2)	1980	31.9	(37.5)	1986	32.4	(32.5)	1991	31.6	(31.6)	1995	35.4	(35.4)	2000	35.7	(35.8)
Mexico	1968	48.3	(53.6)	1975	51.9	(57.4)	1977	44.8	(50.4)	1984	46.9	(46.9)	1989	51.6	(51.3)	1994	53.8	(53.6)	2000	53.7	(53.5)
Norway	1970	24.9	(30.7)	1976	26.0	(31.7)	1982	25.7	(32.5)	1985	26.0	(31.8)	1990	27.0	(32.8)	1996	29.6	(35.4)	2000	30.7	(36.5)
UK	1970	25.4	(25.4)	1975	23.7	(23.7)	1980	25.2	(25.2)	1985	27.6	(27.7)	1990	33.5	(33.5)	1995	32.8	(32.9)	2000	34.7	(34.6)
USA	1972	32.1	(38.8)	1974	35.0	(35.9)	1979	34.2	(34.3)	1986	37.2	(37.2)	1991	37.3	(37.4)	1994	39.0	(39.0)	2000	39.4	(39.4)

Notes: data are taken from WIID (2006) if not otherwise indicated. Gini indexes are computed from income data by population percentiles interpolated from decile income distribution where available. For comparison purposes, we present the Gini indexes reported by WIID in round brackets.

a) Data are taken from Australian Bureau of Statistics (ABS)

b) Data are taken Luxembourg Income Study (LIS)

* Quintile income distribution

Table A2 – Data: Cumulative Shares of Income by Population Decile (%)

a) 1970

	Population decile									
Country	**First**	**Second**	**Third**	**Fourth**	**Fifth**	**Sixth**	**Seventh**	**Eight**	**Ninth**	**Tenth**
Australia	2.9	5.5	7.1	8.1	8.9	9.8	10.7	12.0	14.1	20.9
Canada	1.8	3.8	5.2	6.4	7.5	8.8	10.4	12.7	16.4	26.9
Finland	3.7	5.4	6.5	7.5	8.5	9.6	10.7	12.2	14.4	21.4
France	2.1	3.9	5.1	6.4	8.0	9.2	9.6	12.5	15.5	27.6
Germany	3.5	5.2	6.2	7.1	8.2	9.2	10.5	12.2	14.8	23.1
Italy	2.6	4.2	5.8	6.9	8.1	9.2	10.2	12.1	15.1	25.7
Mexico	1.9	3.2	4.0	4.9	5.7	6.8	8.2	10.8	15.3	39.3
Norway	3.0	4.8	5.9	7.1	8.1	9.4	10.8	12.4	14.4	24.1
UK	4.0	5.7	6.8	7.7	8.5	9.4	10.6	11.9	14.0	21.3
USA	2.2	4.1	5.5	7.1	8.5	10.0	11.3	12.9	15.2	23.1

b) 2000

	Population decile									
Country	**First**	**Second**	**Third**	**Fourth**	**Fifth**	**Sixth**	**Seventh**	**Eight**	**Ninth**	**Tenth**
Australia*	7.7	12.6	17.6	23.7	38.4	-	-	-	-	-
Canada	2.7	4.6	5.8	6.9	8.0	9.1	10.6	12.4	15.1	24.8
Finland	4.3	5.7	6.6	7.5	8.3	9.3	10.3	11.5	13.4	23.2
France	4.0	5.0	6.0	7.0	8.0	9.0	11.0	12.0	15.0	22.0
Germany	3.0	5.0	6.0	7.0	8.0	9.2	10.7	12.4	15.1	23.7
Italy	2.2	4.1	5.3	6.5	7.7	9.1	10.4	12.4	15.3	26.9
Mexico	1.2	2.2	3.1	4.1	5.2	6.6	8.4	10.9	16.0	42.3
Norway	2.3	3.8	5.0	6.3	7.5	9.1	10.9	12.9	15.3	26.9
UK	2.8	4.6	5.6	6.5	7.6	8.7	10.0	11.8	14.5	27.9
USA	1.8	3.5	4.8	6.0	7.3	8.7	10.3	12.5	16.1	29.0

Notes: data are taken from WIID (2006) and then corrected by means of the regression based approach discussed in Section 3.
* Quintile income data

Table A3 – Generalized Lorenz dominance: cross-country comparisons in 2000

	Australia	**Canada**	**Finland**	**France**	**Germany**	**Italy**	**Mexico**	**Norway**	**UK**	**USA**
Australia		x	x	x	x	x	+	-	x	x
Canada	x		x	x	x	x	+	-	x	x
Finland	x	x		x	x	x	+	x	x	x
France	x	x	x		x	x	+	x	x	x
Germany	x	x	x	x		x	+	-	x	x
Italy	x	x	x	x	x		+	-	-	-
Mexico	-	-	-	-	-	-		-	-	-
Norway	+	+	x	x	+	+	+		+	x
UK	x	x	x	x	x	+	+	-		x
USA	x	x	x	x	x	+	+	x	x	

Notes: + stands for dominates; - stands for is dominated by; x indicates crossing generalized Lorenz curves.
90 pair-wise comparisons: 36 unambiguous dominances (36%) and 58 ambiguities (64%).