Session Number: 5
Session Title: Measuring and Interpreting Trends in Global Inequality and Poverty
Paper Number: 2
Session Organizer: Stephan Klasen and D.S. Prasada Rao
Discussant: To be announced

Paper Prepared for the 28th General Conference of
The International Association for Research in Income and Wealth
Cork, Ireland, August 22 – 28, 2004

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WELFARE AND POVERTY IN EUROPEAN COUNTRIES: AN INFERENCE-BASED STOCHASTIC DOMINANCE APPROACH

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ABSTRACT

The measurement of welfare, inequality and poverty and the comparisons between countries or time periods is an issue of great controversy. One of the main reasons for this is that implicit or explicit value judgements have to be made, and it is not easy to determine which of these value judgements are the more appropriate ones. On the other hand, in the last two decades a renewed interest in economic inequality and poverty has grown, motivated both by the increase in inequality in some countries and by the appearance of new techniques to measure them. In this paper we apply inference-based stochastic dominance methods to study welfare and poverty in European Union countries during the period 1993-1999, applying purchasing power parities from the OECD. There are two main advantages of the methods and data used in this work: on the one hand, the stochastic method uses explicit and widely, though not universally, accepted assumptions, and if this small number of assumptions is accepted, the welfare and poverty ranking that the method provides is unambiguous. On the other hand, the use of the European Community Household Panel permits the study of trends in welfare and poverty in different countries, during the period indicated above, using harmonised data. In addition, the use of inference tests permits a more precise ranking.

Keywords: Social welfare, poverty, income distribution, stochastic dominance, European Union.

1. INTRODUCTION

Inequality, poverty and welfare are related and controversial concepts. One of the main reasons for this controversy is that some kinds of value judgements have to be introduced to be able to measure them. Obviously, these value judgements are subjective and two different individuals will seldom agree on their preferences.

However, despite these problems in measuring the level and trends of poverty and welfare, the comparison among different countries and time periods is crucial to social scientists and policy makers in order to study the effect of policies on the welfare of societies (García, 2003). This interest is particularly important in the European countries. While there is a convergence process in economic and political aspects it is interesting to analyse if there is also any convergence in terms of welfare and inequality, or if the economic and political process has no bearing on social rapprochement. As we can see in table 1, inequality disparities, measured by the Gini coefficient, among European countries are remarkable.

(TABLE 1 HERE)

In this paper we try to measure welfare and poverty levels in European Union countries in the 90's using the dominance technique. The main advantage of this tool is that it is based on a few widely, though not universally, accepted value judgements which if accepted, can achieve an unambiguous ranking, in the sense that we avoid the multiplicity index number problem (Bishop and Formby, 1994). An additional advantage of dominance theory is that a powerful relationship exists between income distribution dominance and poverty (Foster and Shorrocks, 1988). Also, inference tests can be developed in order to overcome sampling errors (Beach and Davidson, 1983; Beach et al., 1994).

The paper has been structured in the following way. In the second section we briefly summarise the dominance method and the inference test that was used. Section three presents the data and details the methodological decisions. Section four analyses the empirical results. The paper ends with a list of principal conclusions.

2. STOCHASTIC DOMINANCE AND INFERENCE METHODS FOR EVALUATING WELFARE AND POVERTY

In this section we summarise the basic techniques of stochastic dominance approach that are used to compare welfare. We begin by discussing first-order dominance (rank dominance) and second-order dominance (generalised Lorenz dominance) with special reference to the links of dominance approach to poverty measures. Finally, we review the inference procedures used in order to compare two functions (quantile functions or generalised Lorenz curves) computed from a sample of micro data on incomes that are subject to sampling errors.

Although second order dominance was developed earlier than rank dominance, we begin the next point with first-order dominance since it is the first step towards the development of stochastic dominance theory.

2.1. First-order dominance (Rank dominance)

Let us define an income vector $x = \{x(1), x(2), ..., x(n)\}$ as the incomes of a population with *n* individuals[1]. The strong Pareto principle implies that an income vector *x* dominates an income vector *y*, denoted $x >_P y$, if, and only if, $x(i) \geq y(i)$ for all i and $x(i) > y(i)$ for at least one *i*. If we also assume anonymity, the statistical cumulative distribution functions for income contain enough information to rank social welfare.

Let *F* denote the cumulative income distribution function. The inverse of this function (or quantile function) is defined as $X(p) := \inf\{x : F(x) \geq p\}$.

[1] In order to facilitate comparisons among populations of different sizes, we adopt the population principle (Sen, 1976).

Then, $X >_R Y$ *iff* $X(p) \geq Y(p)$ for every $p \in [0,1]$, with at least one strict inequality. In this context, Saposnik (1981, 1983) proves the following theorem:

Theorem 1: $X >_R Y$ *iff* $w(X) > w(Y), \forall w \in W_p$

Where W_p denotes the class of anonymous and increasing welfare functions, that is, the class of functions according to the assumptions of the Pareto principle and anonymity.

This theorem implies that, if we accept the anonymous Pareto principle, we can rank different social states using quantile function as we have seen. However, as soon as there is any crossing between the two quantile functions comparison is not possible and we cannot order both distributions using the rank dominance criterion. To overcome this problem there are two possible alternatives. On the one hand, we can use the inference tools developed in the 80's and 90's, since many of these apparent crossings are not real but caused by sampling errors. On the other hand, we can introduce another assumption based on inequality aversion. We will examine these two approaches after studying the relationship between rank dominance and poverty.

2.2. *Rank dominance and poverty*

Foster and Shorrocks (1988) provide a link between first-degree stochastic dominance and poverty measures. Let us define a poverty index as: $H(X,z) = q(x;z)/n(x)$ where $q(x;z)$ represents the population at or below the poverty line *z*. This poverty measure is the well-known head-count poverty measure. Then, Foster and Shorrocks (1988) prove a fundamental corollary to theorem 1:

$$X >_R Y \ \ iff \ \ X \geq_{H(z)} Y, \forall z$$

This corollary links first order dominance to the head-count poverty concept. If we fix any arbitrary poverty line *z* and distribution *X* rank dominates distribution *Y* at and below that poverty line, then the head-count poverty in *X* cannot exceed that in *Y*. So, if we truncate the quantile function at any poverty line, *z*, and we test for rank dominance below income *z*, we can reach conclusions on poverty based on the head-count poverty measure, although there are crossings between the functions above the arbitrary point *z*.

2.3. *Second-order dominance (Generalised Lorenz dominance)*

Among the interesting works written in the early 70's related to inequality, Atkinson's (1970) stands out. He demonstrates that: "when comparing distributions with the same mean condition is equivalent to the requirement that the Lorenz curves do not intersect. (…) then, we can judge between them without needing to agree on the form of *U(y)* (except that it be increasing and concave)…"(Atkinson, 1970, p. 247). So Atkinson presents the assumptions we need to accept, in the form of individual utility functions, in order to be able to rank welfare with second order dominance: utility functions have to increase with income and it is necessary for them to be concave[2]. The implications of these assumptions are clear: there is a preference for efficiency (more income is preferred) and for equity[3] (the less inequality the better)[4].

Under these assumptions, in Atkinson's context (same mean), distribution *X* second order dominates another distribution *Y* if $L_i^X \geq L_i^Y$ (where L_i^X represents the Lorenz curve of the distribution *X* at every point *i*) with at least one inequality prevailing. So, in this particular case, welfare is greater in *X* than in *Y*. The key point is that there is some kind of inequality aversion, so if the income is the same, more equality is preferred[5].

As we have seen, this result holds with equal means. But the means of two distributions will seldom be equal as Sen (1973) pointed out. In that case Lorenz

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[2] Dasgupta, Sen and Starret (1973) showed that S-chur concavity is enough.

[3] The assumption of preference for equality is specially important in this context and it should be clear that it is related to concavity. As Atkinson points out, concavity is related to the preference for equality; in other words, with the Pigou-Dalton principle of transfers: "That the concavity of *U(y)* is sufficient to guarantee that the principle of transfers holds is hardly surprising…" (Atkinson, 1970, p. 249).

[4] Of course, in order to aggregate individual welfare, other conditions are needed: additive, separable and symmetric welfare functions (well behaved) and individuals are anonymous.

[5] Although this value judgement is not necessarily universally accepted, the progressivity of most tax schedules in developed countries is a good proof of the preference for equality.

dominance has only equality implications: a distribution X is said to be more equal than a distribution Y if $L_i^X \geq L_i^Y$ with at least one inequality prevailing[6].

However, following Shorrocks (1983), we can overcome the problem of unequal means. Shorrocks developed the concept of generalised Lorenz curves. Roughly speaking, the generalised Lorenz curve is the Lorenz curve scaled by distribution mean.

Following Gatswirth (1971), we can define the Lorenz curve as:

$$L_X(p) := \mu^{-1} \int_0^p X(u)du \qquad (1)$$

The generalised Lorenz curve will then be (Shorrocks, 1983):

$$GL_X(p) := \int_0^p X(u)du = \mu_X L_X(p), \quad \forall p \in [0,1]$$

Let W_S be a S-concave and increasing welfare function[7]. Then we have the next theorem, demostrated by Shorrocks (1983):

Theorem 2: $w(X) \geq w(Y), \forall w \in W_S$ *iff* $GL_X(p) \geq GL_Y(p)$ *for all p with at least one inequality prevailing.*

From the discussion above, the relationship between equality and welfare in this context should be clear. Inequality plays a fundamental role in generalised Lorenz dominance, as in Atkinson's approach. The "inequality aversion" used as an assumption (Dalton-Pigou transfers principle) implies that the more inequality that exits the less welfare that particular society has. It should also be clear that in second order dominance, if we have equal means, inequality and welfare rankings will be equivalent. So, if the means are equal, inequality and welfare provide the same ranking. However, if they are not equal, we can still rank welfare associated to different income distributions.

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[6] It is interesting to note that the inequality ranking given by the Lorenz Curves is widely accepted and is unambiguous, avoiding the Multiplicity Index Problem (see Bishop and Formby, 1994).

[7] As we have seen, Dasgupta, Sen and Starret (1973) showed that Schur-concavity is enough to take into account the Pigou-Dalton principle.

As we have seen, the tool that stochastic dominance provides is quite powerful. Once we accept a small number of assumptions (preference for efficiency and equity)[8], we can rank the welfare associated with income distributions.

2.4. Second-order dominance and poverty

In the same way as in the case of first order dominance, Foster and Shorrocks (1988) provide a corollary that links second order dominance to poverty. However, in this particular case, it is linked to income-gap poverty concept. Let us define the income-gap, that is, the weighted sum of the income shortfalls of the poor, that is:

$$P(x;z) = \left[\frac{1}{n(x)}\right]\sum_{i=1}^{r}\frac{z-x_i}{z}$$

Where r is the order statistic corresponding to the poverty line, z, and x_i is the ith individual's income. The income-gap criterion implies that income distribution X dominates income distribution Y, denoted by $X >_{P(z)} Y$, if, and only if, $(1/n)\sum x_i > (1/n)\sum y_i$ for all i up to r and for any given z. Then:

$$GL_X(p) \geq GL_Y(p) \;\; iff \quad X \geq_{P(z)} Y, \forall z$$

This corollary implies that if we truncate the distribution at any arbitrary poverty line z and X generalised Lorenz dominates Y at and below that poverty line, then the income-gap poverty in X cannot exceed comparable poverty in Y using that poverty line, and this is the case for every poverty line z.

[8] Although these assumptions are widely accepted, we cannot say that they are universally accepted. Think, for example, of Rawl´s approach.

2. 5. Inference tests

As we have seen, the dominance approach has strong foundations related to the Old Welfare School and provides an interesting tool to study inequality and welfare. However, this descriptive approach does have some problems. On the one hand, there are a lot of crossings when comparing the quantile functions (or the generalized Lorenz curves), and, as we know, in this case we are not able to rank welfare. On the other hand, different sampling errors can lie under the descriptive results. In this context, some works such as those carried out by Beach and Davidson (1983) or Beach and Kaliski (1986) provide an implement to improve the stochastic dominance method using inference-based tests. Let us study this approach more carefully[9].

Let *J* be the space of all univariate probabilities such that $0 \leq J \leq 1$ and $Y \subseteq R^{+}$, where R^{+} is the set of positive real numbers, and *Y* is a vector of positive incomes[10]. Let $F(y)$ represent the proportion of the population with income less than or equal to *y*, where $y \in Y$ and $F \in J$. $F(y)$ is the cumulative distribution.

In this context, Beach and Davidson (1983) derive the joint variance-covariance structure of Lorenz ordinates. This procedure presents a very important advantage: since the distribution is based on a distribution-free method it permits the deduction of the variance-covariance matrix (Π) without knowing the underlying distribution. Inference tests can then be developed in the following way.

Let us divide the population into quantile groups (e.g. deciles) with corresponding *K+1* proportions. We then have a set of *K* abscise $p_1 < p_2 < ... < p_k$, a set of *K* population income quantiles $\xi_{p1} < \xi_{p2} < ... < \xi_{pK}$ and a set of *K* population Lorenz curve ordinates, $L_1 < L_2 < ... < L_K$.

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[9] We start with the generalised Lorenz dominance for the sake of clarity.
[10] Y can also be seen as a vector of expenditures.

The conditional means and variances of incomes less than or equal to ξ_{pi} are respectively $\gamma_i \equiv E(Y/Y \leq \xi_{pi})$ and $\lambda_i^2 \equiv E\left[(Y-\gamma_i)^2 / Y \leq \xi_{pi}\right]$. Then the population mean and variance are: $\gamma_{K+1} \equiv \mu$ and $\lambda_{K+1}^2 \equiv \sigma^2$. Furthermore suppose F is strictly increasing and continuous at ξ_{pi} [11].

We can define the vector of generalised Lorenz ordinates multiplying the vector of Lorenz ordinates (Shorrocks, 1983) by μ as:

$$G = (p_1\gamma_1, p_2\gamma_2, ..., p_K\gamma_K, \mu)'.$$

Now, the objective is to establish formulas for the asymptotic distributions of generalised Lorenz ordinates. We assume independent micro data samples from strictly monotonic and twice differentiable distribution with finite mean and variance. We select a random sample N from a population whose distribution function (F) is unknown. Let the observations be ordered from the smallest ($Y_{(1)}$) to largest ($Y_{(N)}$), so that $Y_{(1)} \leq Y_{(2)} \leq ... \leq Y_{(N)}$. $Y_{(J)}$ is the j^{th} observation with weight ω_j. Let the sample quantile $\hat{\xi}_{pi}$ be defined as the r-th order statistic $Y_{(r_i)}$ such that $\hat{\xi}_{pi} = Y_{(r_i)}$, with the r_i^{th} weighted order statistic, where $r_i = \left\{ p_i \sum_{j=1}^{N} \omega_j \right\}$ denotes the greatest integer less than or equal to $p_i \sum_{j=1}^{N} \omega_j$ [12]. If F is strictly monotonic and differentiable for any finite set $\{p_i / i = 1,2,...,k\}$, Wilks (1962) proves that the $\hat{\xi}_{pi}$'s are asymptotically multivariate normal including $\hat{\gamma}_i$ and $GL(p_i)$. From all we have seen, the generalised Lorenz ordinates can be computed as:

$$\hat{G}_i = p_i\hat{\gamma}_i = \frac{\sum_{i=1}^{r_i} \omega_j Y_{(j)}}{\sum_{i=1}^{N} \omega_j}$$

[11] Thus only one ξ_{pi} corresponds to each p_i.

[12] Thus, we can say that $100p_i$ percent of the weighted sample of observations is less than or equal to ξ_{pi}.

Since by definition the weighted cumulative sample means and variances for each i are $\hat{\gamma}_i = \dfrac{\sum_{j=1}^{r_i} \omega_j Y_{(j)}}{r_i}$ and $\hat{\lambda}_i^2 = \dfrac{\left[\sum_{j=1}^{r_i} \omega_j \left(Y_{(j)} - \hat{\gamma}_i\right)^2\right]}{r_i}$, respectively, and the sample unconditional mean $\hat{\mu}$ is $\dfrac{\sum_{j=1}^{N} \omega_j Y_{(J)}}{\sum_{j=1}^{N} \omega_j}$.

Beach and Davidson (1983) prove that the vector of sample generalised Lorenz ordinates, $\hat{G} = \left(\hat{G}_1, \hat{G}_2, ..., \mu\right)'$, is asymptotically normal in that $\sqrt{N}(\hat{G} - G)$ has a limiting K+1 variable normal distribution. This K+1 variable normal distribution has zero mean and covariance matrix $\Pi = \lfloor \varpi_{ij} \rfloor$, where for $i \leq j = 1,2,..,K+1$ are:

$$\varpi_{ij} = p_i\left[\lambda_i^2 + \left(1 - p_j\right)\left(\xi_{pi} - \gamma_i\right)\left(\xi_{pj} - \gamma_j\right) + \left(\xi_{pi} - \gamma_i\right)\left(\gamma_j - \gamma_i\right)\right]$$

When i=j:

$$\varpi_{ij} = p_i\left[\lambda_i^2 + \left(1 - p_j\right)\left(\xi_{pi} - \gamma_i\right)^2\right]$$

The asymptotic standard errors for sample generalised Lorenz ordinates will be given by $\left(N^{-1}\hat{\varpi}_{ij}\right)^{1/2}$ where N is the unweighted sample observations number[13].

Now that the variance-covariance matrix of generalised Lorenz ordinates is defined, we need to develop an statistical test to compare the different hypotheses. Following Bishop, Formby and Thistle (1989) we use a pairwise statistical inference test to compare two generalised Lorenz ordinates for each i=1,2,…,$K+1$, where the null and alternative hypotheses are:

$$H_{0,i} : GL_i^X = GL_i^Y \quad \text{and} \quad H_{A,i} : GL_i^X \neq GL_i^Y \qquad (1)$$

where GL_i^X and GL_i^Y are the generalised Lorenz ordinates for each i for income vectors X and Y.

[13] For the whole population the consistent estimate for the mean will be $\hat{\mu}$ and for the variance $N^{-1}\hat{\sigma}^2$.

The statistical test for equality of the i^{th} elements of the vectors GL^X and GL^Y will be:

$$T_{GLi} = \frac{\hat{G}L_i^X - \hat{G}L_i^Y}{\left[\left(\frac{\hat{\varpi}_{ii}^X}{N_X}\right) + \left(\frac{\hat{\varpi}_{ii}^Y}{N_Y}\right)\right]^{1/2}} \quad \text{for } i=1,2,\ldots,K. \qquad (2)$$

This statistical test is asymptotically normal under the null hypothesis.

It is important to recall that the alternative hypothesis can be considered as two side alternatives:

$H_{Ai}^{+} : GL_i^X > GL_i^Y$ and $H_{Ai}^{-} : GL_i^X < GL_i^Y$

The critical values for this test are determined by the Student Maximum Modulus distribution[14], which accounts for the correlation among the variables. If the null hypothesis is not rejected, we cannot rank. However, if we reject the overall null hypothesis, there are three possible outcomes:

- weak generalised Lorenz dominance: if for some quantiles $GL_i^X > GL_i^Y$ and for other quantiles $GL_i^X = GL_i^Y$.
- strong generalised Lorenz dominance: if for all i $GL_i^X > GL_i^Y$.
- the Lorenz generalised curves cross if for some quantiles $GL_i^X > GL_i^Y$ and for other quantiles $GL_i^X < GL_i^Y$. In this case, we cannot compare the welfare associated to the distributions *X* and *Y* using the second-order dominance approach.

Once we have seen how to perform statistical tests in second-order dominance it is relatively easy to extend the basic results of Beach and Davidson (1983) to the study of rank dominance, since the methodology is similar. Beach, Chow Formby and Slotsve (1994) provide asymptotic variance and covariance structure of rank dominance based on the distribution-free approach.

[14] Obtained from Stoline and Ury (1979).

As before, we take a random sample of size N from a population. Let the observations be ordered from smallest ($Y_{(1)}$) to largest ($Y_{(N)}$) so that $Y_{(1)} \le Y_{(2)} \le ... \le Y_{(N)}$. $Y_{(J)}$ is the j^{th} observation with weight ω_j. We divide the population in the same K proportions corresponding to the quantile groups so that $0 < p_1 < p_2 < ... < p_{k-1} < 1$ and so we have a set of income quantile such that $\xi_{p1} < \xi_{p2} < ... < \xi_{pK-1}$.

If we define the quantile means for each quantile group with income between $\xi_{p(i+1)}$ and ξ_{pi} as:

$$\mu_i = E\left(Y / \xi_{pi} < Y < \xi_{p(i+1)}\right) \text{ for } i=1,2,...,K.$$

the weighted quantile means for each sample groups are given by:

$$\hat{\mu}_i = \frac{\left(\sum_{j=t_i}^{r_i} w_j Y_j\right)}{\sum_{j=t_i}^{r_i} w_j},$$

where $t_i = r_{i-1} + 1$.

According to Beach, Chow Formby and Slotsve (1994) the vector of sample quantile means can be written in terms of $\hat{G}$ as:

$$\begin{pmatrix} \hat{\mu}_1 \\ \hat{\mu}_2 \\ \vdots \\ \hat{\mu}_k \end{pmatrix} = \begin{pmatrix} \hat{G}_1 / p_1 \\ \left(2\hat{G}_2 / p_2\right) - 1(\hat{G}_1 / p_1) \\ \vdots \\ \left(k\hat{G}_k / p_k\right) - \left[(k-1)(\hat{G}_{k-1} / p_{k-1})\right] \end{pmatrix}$$

This vector of sample quantile means is also asymptotically normal[15].

Finally, Beach, Chow Formby and Slotsve (1994) illustrated the procedure for a specific choice of quantile such as decile (K=10). In this case, the asymptotic variances can be computed as:

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[15] Since $\hat{\mu}$ is a linear transformation of $\hat{G}$ (Rao, 1973).

$Var(\hat{\mu}_i) = (100\varpi_{11})N^{-1}$, *i=1*

$Var(\hat{\mu}_i) = \left[100(\varpi_{ii} + \varpi_{i-1,i-1} - 2\varpi_{(i-1)i})\right]N^{-1}$,   *i=2,...,10.*

Given these variances, we can test the *k* subhypotheses similar to (1) and (2), using the statistic:

$$T_{GLi} = \frac{\hat{\mu}_i^X - \hat{\mu}_i^Y}{\left[\left(\frac{Var(\hat{\mu}_i^X)}{N_X}\right) + \left(\frac{Var(\hat{\mu}_i^Y)}{N_Y}\right)\right]^{1/2}} \quad \text{for } i=1,2,\ldots,K.$$

3. EMPIRICAL ANALYSIS

3.1. Data

To analyse income distributions across European Union countries the data used are obtained from the *European Community Household Panel* (ECHP). This survey has been developed by EUROSTAT and contains data on individuals and households for European countries. The information on incomes is homogenous across countries because the methodology and the data format are common to all the countries analysed, thus making the comparisons possible. At present, we have data from seven waves, between 1994 and 2000.

The ECHP provides, for every household, information regarding the personal characteristics of all members older than 16 as well as on household structure and sources of household income. The reference period for income is the year prior to the interview.

Using comparative static analysis, we shall study income distributions of European countries from three waves of the ECHP (1994, 1997 and 2000). The reason for selecting these particular years is to have three reference points to compare economic well-being across European countries and to detect changes in the different rankings of countries during the period 1993-1999.

The interviews corresponding to the three waves under consideration were performed in the years 1994, 1997 and 2001, so the corresponding incomes refer to the years 1993, 1996 y 2000 respectively. Sample sizes and time periods to which data apply are shown in table 2.

(TABLE 2 HERE)

With regard to the years 1997 and 2000 we have data corresponding to all fifteen European countries. In the first wave considered (1994), data from Austria, Finland and Sweden are not available. Austria and Finland joined the ECHP project in 1995 and 1996 respectively. Data for Sweden are available from 1997, derived from the Swedish Living Conditions Survey and transformed into ECHP format.

In 1997, the original surveys of the ECHP were stopped in Germany, the United Kingdom and Luxembourg. In these countries there exist national panels, which have been used to supply data comparable with those of the ECHP for all the waves. Consequently, for the year 1994, two sets of data are available for Germany and the United Kingdom. In the case of Luxembourg we only have data from the ECHP for the year 1994. In our analysis we follow EUROSTAT's recommendations and hence we have used, in order to make longitudinal comparisons, standardised data from national surveys for Germany and the United Kingdom, and ECHP data for Luxembourg in 1994.

The income concept used is household disposable income, which includes income after transfers and the deduction of income tax and social security contributions. Incomes have been adjusted to account for differences in purchasing power of monetary units across countries by using purchasing power parities corresponding to each country and year, supplied by the OECD.

Since the welfare of a household depends on its income, its size and composition, we shall take these factors into account by adjusting income, using equivalence scales. In this paper, we use the traditional OECD scale, which assigns the value of 1 to the first adult in the household. Each additional adult receives a weight of 0.7 and each child under 16 gets a weight of 0.5. The equivalent income is assigned to each member, employing the hypothesis that all persons belonging to the same household enjoy the same level of welfare, therefore, the unit of analysis is the individual person. The data are weighted by the ECHP individual weights.

3.2. Results

Tables A.1, A.2 and A.3 of the appendix contain the sample decile conditional means (μ_i) and the standard errors used to compute the statistical tests for rank dominance inference. In order to apply second order dominance, we also present the sample decile generalised Lorenz ordinates (GL_i) and the standard errors in Tables A.4, A.5 and A.6, which are calculated using Beach and Kaliski's (1986) procedure for weighted data.

The computed test for stochastic dominance permits the comparison of quantile functions and generalised Lorenz curves. The results of comparisons between countries are shown in tables A.7, A.8 and A.9, in the cases of first and second-degree stochastic dominance. The first entry in these tables refers to the result in rank dominance comparison and the second entry indicates the result of applying generalised Lorenz dominance tests to each of the pairwise comparisons. In these summary tables of the results the entry "+" indicates that a country in a row dominates a country in a column. On the contrary, the entry "–" implies that a country in a row is dominated by a country in a column. An entry of "X" means that the quantile functions or generalised Lorenz curves intersect and therefore the considered countries cannot be ordered. The entry "w" means weak dominance, the entry "s" means strong dominance at 1% significance level, and "s5" and "s10" indicate strong dominance at 5 and 10% significance levels respectively. We represent welfare rankings in figures A.1, A.2 and A.3 using Hess diagrams that summarise the information contained in tables A.7, A.8 and A.9.

In Tables A.10, A.11 and A.12, we present results of rank dominance tests (head-count poverty) as well as generalised Lorenz dominance tests (income-gap poverty) for constructing poverty orderings. We assume that the poverty group is contained in the bottom three deciles so we use the truncated income distribution above the third decile. It is possible to specify alternative poverty lines. The notation is the same as that used in tables A.7, A.8 and A.9, with the exception of a “=”, which indicates that the null hypothesis of no significant difference between two truncated functions (quantile functions or generalised Lorenz functions) cannot be rejected. The poverty rankings are given in figures A.4, A.5 and A.6 where discontinuous lines in Hess diagram indicate equivalent poverty between countries.

Applying rank dominance tests to each of the pairwise comparisons for the years 1993, 1996 and 1999, we can conclude a high and increasing power to order income distribution welfare. Results are shown in table 3. The rank dominance criterion is conclusive in 78.79, 82.86 and 83.81 per cent of possible comparisons. The marginal effect of second order dominance increases the percentage of orders to 89.39, 93.33 and 95.24 for the years 1993, 1996 and 1999 respectively.

(TABLE 3 HERE)

These results are more conclusive in the case of poverty orderings, shown in table 4. Truncated rank dominance (head-count poverty) can order 93.94, 95.24 and 97.14 per cent of the possible comparisons and the marginal effect of truncated second order dominance (income-gap poverty) increases the rank power from the percentage mentioned to very high levels close to 100. In 1999 only one comparison cannot be ordered by the income-gap poverty criterion.

(TABLE 4 HERE)

Using dominance statistical tests, we are able to rank a high percentage of comparisons such as those obtained by Bishop, Formby and Smith (1994) or Bishop, Formby and Thistle (1991). Obviously, on the one hand, the inference-based stochastic dominance methodology provides a partial order more complete than one based on ordinary dominance methodology. On the other hand, poverty dominance provides a more complete partial ordering than one based on second degree dominance and, finally, second degree dominance provides a partial order more complete than one based on rank dominance.

Several interesting results emerge from the analysis of comparisons between countries extracted from tables A.7-A.9 and Hess diagrams (figures A.1-A.3). First, we can conclude that the general pattern of dominance orderings is constant over time and not very important differences can be observed when comparing different years. In all tests of dominance (rank, generalised Lorenz and poverty), Luxembourg dominates all European countries and Portugal is dominated by all countries. Only in 1993, is Greece non-comparable to Ireland when applying rank dominance tests. However, in the other comparisons, Greece dominates Portugal and all countries dominate both. Denmark is dominated only by Luxembourg in all the years studied.

Different groups of European Union countries can be detected if we concentrate our attention on tests of rank dominance. A first group composed by Belgium, the United Kingdom, the Netherlands, Germany, France, Denmark and Austria[16], is only dominated by Luxembourg, but dominates a second group composed of Ireland, Italy, Spain, Greece and Portugal. Between these two sets of countries we find Sweden and Finland, in 1996 and 1999, which are non-comparable to various countries belonging to both previously mentioned groups. The United Kingdom is also a country that presents many crossings.

The application of generalised Lorenz dominance tests provides more complete rankings. The results are also better since the number of comparable pairwises increases from 1993 to 1999. The marginal effect of second order dominance is conclusive in detecting an increase in relative economic well-being in Sweden or Finland when we introduce the Dalton-Pigou transfers principle. However, other countries are characterised by lower welfare comparative degrees when applying second order dominance with regard to rank dominance results (such as the United Kingdom).

[16] In 1996 and 1999.

Some groups of countries can be observed in 1996 and 1999 according to second order dominance criterion. A first group with high levels of welfare is composed by Luxembourg, Denmark, Belgium, Germany and Austria. A second group of intermediate degree of welfare includes the Netherlands, the United Kingdom, Finland, Sweden and France; many of these countries are non-comparable to each other. Finally, we get a complete welfare ranking for five countries: (in this order) Ireland, Italy, Spain, Greece and Portugal.

If we further restrict the analysis to truncated dominance, in order to rank poverty, we observe complete and stable poverty orderings. In 1999, we only find one case (Belgium vs. the Netherlands) where relative poverty cannot be evaluated using second order truncated dominance.

The general pattern of poverty orderings within the countries can be summarised as follows: Luxembourg dominates Denmark and both dominate all other countries. Greece only dominates Portugal and the other countries dominate both. We have detected four cases of poverty equivalence in terms of head-count ratio and income-gap poverty ratio: Belgium vs. Germany, the Netherlands vs. Sweden and France vs. the United Kingdom in 1996, and Belgium vs. the Netherlands in 1999.

Some countries have changed during the analysed period. Using head-count poverty and income-gap poverty criterion, in 1993 the United Kingdom achieved a poverty level non-comparable to Ireland, and just below we can rank Spain and Italy, which have non-comparable poverty levels. In 1996 and 1999, the United Kingdom dominates Ireland, and Italy dominates Spain.

We can find other differences in poverty rankings over time affecting the group of countries comprising Austria, Belgium, the Netherlands, Germany, Sweden and France. However, comparing dominance statistical tests reveal crossings and equivalent poverty or "weak" dominance statements. Since these statements about economic well-being are more ambiguous, the detected differences are less conclusive and therefore it is easier that changes take place in rankings over time.

4. CONCLUSIONS

In this work we have studied the levels and trends of welfare and poverty in European Union countries in the 90's using dominance techniques and some inference tests to take into account sampling errors. From this study several interesting conclusions may be drawn related both to the technique and the empirical observation.

On the one hand, the dominance methodology combined with inference tests is a powerful tool to make comparisons on welfare and poverty. First, as we have said, because it incorporates explicit and widely accepted value judgements. Second, because it shows a high ability to rank European Union countries unambiguously in terms of welfare and poverty during the period 1993-1999. Using rank dominance we are able to rank more than 78% of comparisons, while using second order dominance at least almost 90% of comparisons are ordered. Restricting the analysis to poverty, we can rank more than 94% of all pairwise comparisons. These percentages increase over time.

On the other hand, some interesting general patterns appear when analysing the results. There is a relative stability in the orderings, with different sets of countries clearly differentiated, which can be interpreted as a lack of convergence in social terms. Luxembourg dominates all countries and all countries dominate Portugal, in all considered years. Among these two cases, generally northern and central European countries dominate Mediterranean ones. The introduction of inequality aversion through the Pigou-Dalton principle and the poverty-gap criterion worsens the position of countries like the United Kingdom and improves others such as Sweden.

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TABLE 1

Gini Coefficients for European Union countries in 1997

Austria	0.25
Belgium	0.34
Denmark	0.21
Finland	0.23
France	0.30
Germany	0.29
Greece	0.35
Ireland	0.33
Italy	0.32
Netherlands	0.28
Portugal	0.38
Spain	0.35
Sweden	0.23
United Kingdom	0.34
EU15T	0.31

Source: Eurostat, ECHP.

TABLE 2

Number of households and number of individuals in the ECHP
(1993, 1996, 1999)

	Years	Number of households	Number of individuals
Austria	*1996*	3142	8733
	1999	2644	7169
Belgium	*1993*	3490	9149
	1996	3039	7916
	1999	2572	6560
Denmark	*1993*	3482	7693
	1996	2745	6204
	1999	2281	5222
Finland	*1996*	4108	10890
	1999	3104	7552
France	*1993*	7344	18916
	1996	6176	15758
	1999	5345	13368
Germany	*1993*	6207	16284
	1996	6163	15942
	1999	5693	14340
Greece	*1993*	5523	16231
	1996	4604	13491
	1999	3918	11383
Ireland	*1993*	4048	14585
	1996	2945	9952
	1999	1951	6276
Italy	*1993*	7115	21394
	1996	6713	20074
	1999	6052	17602
Luxembourg	*1993*	1011	2087
	1996	2654	7107
	1999	2373	6195
Netherlands	*1993*	5187	13029
	1996	5049	12584
	1999	5008	12446
Portugal	*1993*	4881	14706
	1996	4802	14428
	1999	4633	13841
Spain	*1993*	7206	23025
	1996	5794	18167
	1999	5132	15048
Sweden	*1996*	5891	13453
	1999	5734	12918
United Kingdom	*1993*	5126	12844
	1996	4965	12397
	1999	4890	12186

TABLE 3

First order dominance and second order dominance

Summary of results

Waves		First order dominance		Second order dominance	
		Number	Percent	Number	Percent
1993	Dominance	52	78.79	59	89.39
	Intersections	14	21.21	7	10.61
	Total	66	100.00	66	100.00
1996	Dominance	87	82.86	98	93.33
	Intersections	18	17.14	7	6.67
	Total	105	100.00	105	100.00
1999	Dominance	88	83.81	100	95.24
	Intersections	17	16.19	5	4.76
	Total	105	100.00	105	100.00

TABLE 4

First order dominance and second order dominance poverty

Summary of results

Waves		First order dominance		Second order dominance	
		Number	Percent	Number	Percent
1993	Dominance	62	93.94	64	96.97
	Intersections or equivalences	4	6.06	2	3.03
	Total	66	100.00	66	100.00
1996	Dominance	100	95.24	102	97.14
	Intersections or equivalences	5	4.76	3	2.86
	Total	105	100.00	105	100.00
1999	Dominance	102	97.14	104	99.05
	Intersections or equivalences	3	2.86	1	0.95
	Total	105	100.00	105	100.00

APPENDIX

TABLE A.1

Conditional means and standard errors (1993)

Decile	Belgium	Denmark	France	Germany	Greece	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain	United Kingdom
1	3593.661	5037.337	2832.067	2882.991	1111.214	2676.871	1539.189	5208.795	3742.840	1029.255	1697.364	2187.772
	(70.531)	(57.743)	(46.513)	(65.363)	(19.372)	(20.986)	(32.396)	(200.759)	(54.210)	(23.719)	(25.287)	(46.254)
2	6033.464	6823.911	5108.630	6055.711	2320.457	3556.016	3510.206	8723.008	5714.496	2222.881	3176.112	4568.449
	(53.535)	(46.811)	(31.200)	(43.176)	(26.869)	(19.227)	(28.450)	(117.392)	(31.899)	(23.849)	(20.697)	(49.819)
3	7318.863	7913.567	6209.700	7347.778	3194.796	4282.023	4589.880	10581.710	6676.702	2985.850	4018.299	5965.212
	(48.473)	(46.136)	(32.467)	(34.389)	(24.715)	(23.222)	(27.599)	(161.064)	(27.179)	(23.161)	(22.766)	(46.926)
4	8492.296	8812.770	7329.804	8432.789	3975.231	4960.802	5500.649	12462.170	7430.830	3691.605	4816.914	7112.145
	(58.330)	(41.414)	(39.079)	(40.238)	(26.396)	(26.367)	(27.790)	(162.450)	(31.599)	(27.015)	(22.435)	(40.784)
5	9749.142	9593.720	8448.314	9489.760	4733.739	4344.425	6495.179	14489.297	8286.045	4319.315	5574.470	8187.140
	(66.238)	(43.313)	(38.887)	(40.661)	(30.317)	(35.266)	(34.190)	(165.869)	(42.745)	(23.882)	(26.035)	(51.132)
6	11023.555	10491.513	9638.893	10715.909	5508.968	8065.896	7553.446	16356.065	9380.973	5022.722	6418.684	9478.861
	(62.167)	(54.633)	(46.036)	(54.176)	(30.631)	(45.705)	(37.779)	(195.444)	(48.003)	(32.381)	(28.809)	(59.522)
7	12418.498	11485.417	10974.285	12240.611	6512.667	8020.170	8819.541	18959.423	10668.166	5882.816	7511.434	11003.976
	(74.887)	(53.680)	(50.701)	(53.411)	(42.464)	(51.997)	(42.949)	(265.863)	(63.030)	(39.250)	(39.005)	(66.504)
8	14203.042	12713.832	12761.985	14101.928	7793.886	9516.754	10322.219	22783.510	12625.192	7229.366	9069.250	12942.870
	(90.474)	(68.514)	(66.064)	(75.972)	(46.890)	(58.145)	(46.387)	(362.693)	(82.587)	(55.752)	(50.763)	(88.960)
9	16948.654	14654.875	15572.566	16974.297	9582.791	11766.968	12371.723	27827.339	15169.889	9418.424	11441.797	15908.924
	(139.791)	(97.852)	(89.215)	(97.366)	(58.967)	(84.930)	(63.893)	(386.860)	(90.198)	(84.197)	(68.553)	(110.236)
10	29045.307	22781.297	31341.572	26470.149	16760.443	19828.022	20033.949	44630.957	22674.594	17177.428	18845.456	24155.594
	(777.616)	(490.689)	(749.917)	(295.879)	(281.610)	(462.537)	(209.399)	(1442.820)	(270.779)	(227.980)	(182.490)	(257.268)

TABLE A.2

Conditional means and standard errors (1996)

Decile	Austria	Belgium	Denmark	Finland	France	Germany	Greece	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain	Sweden	United Kingdom
1	4573.605	4558.661	6227.972	4698.510	3680.092	4520.467	1629.132	3301.953	2043.020	7707.339	4372.675	1562.880	1642.728	4292.768	3708.656
	(64.031)	(73.910)	(73.082)	(49.134)	(47.349)	(53.722)	(25.782)	(26.355)	(36.447)	(85.734)	(53.813)	(27.265)	(30.050)	(53.664)	(48.851)
2	6790.827	6934.094	8335.551	6375.416	5839.221	7098.335	2948.923	4479.932	4129.128	10790.928	6444.714	2787.945	3333.553	6407.859	5852.911
	(47.564)	(56.935)	(60.736)	(29.114)	(36.919)	(40.236)	(31.021)	(33.807)	(31.877)	(90.378)	(35.077)	(21.539)	(29.134)	(35.664)	(43.513)
3	7956.367	8301.581	9487.512	7162.465	7063.210	8357.015	3901.478	5377.784	5268.151	12706.292	7494.747	3543.957	4305.924	7410.547	7180.441
	(51.466)	(54.981)	(46.694)	(28.205)	(37.493)	(36.883)	(29.958)	(36.381)	(29.112)	(82.108)	(34.334)	(25.741)	(25.859)	(31.455)	(47.240)
4	9180.492	9454.880	10544.606	7864.770	8172.306	9508.771	4715.281	6224.186	6261.449	14410.837	8394.256	4279.566	5184.540	8188.669	8434.876
	(58.477)	(65.412)	(65.485)	(32.810)	(41.706)	(41.861)	(33.864)	(39.559)	(32.461)	(93.402)	(39.932)	(26.642)	(30.820)	(31.934)	(51.020)
5	10294.047	10657.825	11519.547	8654.017	9328.561	10630.622	5599.709	7217.341	7351.797	16007.173	9437.451	5012.749	6044.081	8985.607	9717.209
	(53.989)	(64.987)	(52.686)	(35.224)	(44.447)	(43.722)	(35.976)	(52.615)	(40.919)	(96.620)	(47.267)	(30.558)	(31.040)	(33.621)	(56.306)
6	11495.015	12000.259	12484.310	9500.444	10582.871	11742.049	6535.728	8458.882	8572.488	18143.453	10563.101	5788.111	6984.929	9872.919	11212.645
	(67.971)	(75.325)	(73.204)	(43.118)	(51.472)	(45.009)	(42.842)	(64.507)	(42.798)	(133.710)	(48.726)	(32.593)	(36.780)	(44.349)	(65.758)
7	12835.396	13460.716	13712.753	10534.158	12039.024	12983.602	7664.753	9861.114	9867.118	20426.861	11933.868	6681.948	8209.714	10965.242	12849.745
	(76.114)	(79.716)	(69.024)	(51.958)	(58.352)	(50.655)	(52.614)	(70.685)	(43.357)	(127.281)	(69.203)	(40.352)	(49.982)	(47.855)	(75.720)
8	14708.165	15138.109	15077.694	11822.763	13820.868	14740.209	9191.454	11524.412	11312.439	23223.951	13880.075	8030.864	9900.671	12301.021	14967.298
	(95.170)	(93.671)	(87.136)	(57.444)	(67.067)	(69.355)	(60.195)	(80.103)	(48.110)	(166.102)	(82.208)	(59.060)	(59.990)	(57.940)	(92.509)
9	17250.336	17889.829	17094.455	13760.567	16584.199	17501.528	11374.837	14159.129	13532.371	27696.570	16531.624	10687.630	12683.179	14251.740	18189.728
	(117.262)	(134.615)	(109.303)	(83.021)	(98.174)	(96.013)	(83.990)	(117.782)	(71.745)	(234.674)	(98.686)	(104.889)	(91.465)	(68.513)	(123.009)
10	25619.510	29798.418	24100.694	19950.178	26467.907	27167.370	19170.924	25545.569	20535.200	42412.855	25614.106	18819.568	20524.860	19528.960	28801.592
	(385.712)	(618.502)	(366.752)	(234.282)	(375.549)	(321.393)	(316.773)	(1045.135)	(188.472)	(695.096)	(404.774)	(228.667)	(213.418)	(230.695)	(376.574)

TABLE A.3
Conditional means and standard errors (1999)

Decile	Austria	Belgium	Denmark	Finland	France	Germany	Greece	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain	Sweden	United Kingdom
1	5538.176	4968.199	6483.851	4806.524	4463.670	5485.866	2175.920	3485.280	2776.820	8570.200	4919.129	1955.016	2631.508	4045.521	3694.244
	(78.400)	(87.198)	(98.450)	(52.669)	(48.253)	(62.950)	(34.336)	(52.187)	(43.477)	(93.371)	(64.896)	(28.743)	(40.006)	(63.325)	(60.783)
2	7919.360	7423.088	9255.357	6608.130	6520.749	8228.988	3729.789	5225.527	5147.801	11978.135	7455.910	3225.720	4474.283	6652.207	6339.041
	(54.378)	(63.758)	(80.769)	(51.320)	(41.787)	(44.632)	(37.068)	(56.304)	(38.577)	(115.830)	(42.656)	(26.787)	(33.371)	(44.496)	(53.313)
3	9182.427	8845.628	10687.583	7747.237	7950.914	9559.762	4811.932	6292.650	6458.195	14264.618	8650.273	4125.291	5629.740	7877.332	7867.805
	(63.659)	(66.176)	(71.089)	(43.853)	(49.128)	(48.235)	(36.769)	(47.735)	(35.108)	(98.357)	(42.361)	(33.734)	(34.931)	(39.150)	(52.588)
4	10390.665	10042.546	11910.679	8476.985	9282.504	10762.820	5796.261	7418.978	7607.785	16003.988	9768.096	5038.629	6541.336	8784.583	9327.718
	(60.675)	(58.201)	(72.904)	(37.878)	(51.107)	(35.361)	(43.415)	(81.106)	(43.065)	(103.696)	(45.091)	(33.312)	(34.249)	(33.071)	(63.483)
5	11682.460	11206.443	13035.749	9294.730	10556.034	11728.921	6757.543	8790.776	8840.894	17919.895	10896.346	5858.920	7514.865	9593.927	10780.972
	(83.835)	(86.173)	(76.529)	(53.018)	(52.763)	(44.392)	(42.861)	(73.111)	(43.801)	(129.987)	(49.708)	(32.792)	(42.020)	(37.654)	(61.069)
6	13092.382	12569.996	14093.886	10335.403	11890.090	12997.474	7798.790	10118.292	10164.968	20358.864	12151.802	6762.365	8639.611	10531.863	12299.074
	(78.422)	(75.329)	(69.906)	(57.243)	(59.295)	(61.082)	(51.250)	(91.349)	(52.249)	(154.736)	(60.862)	(44.797)	(45.093)	(45.311)	(73.368)
7	14503.102	14009.313	15512.665	11522.445	13433.063	14679.751	9200.806	11549.008	11525.511	23081.227	13711.726	7882.760	9972.105	11736.060	14137.669
	(87.349)	(90.475)	(105.518)	(75.518)	(66.120)	(65.280)	(71.107)	(83.128)	(50.031)	(173.199)	(75.660)	(47.536)	(57.016)	(56.899)	(83.648)
8	16526.706	16087.709	17355.463	13045.924	15577.011	16623.806	10938.006	13322.897	13178.531	26388.130	15900.770	9357.636	11794.333	13178.820	16350.128
	(107.408)	(129.812)	(115.998)	(73.555)	(97.426)	(81.695)	(72.492)	(108.114)	(57.146)	(212.229)	(92.548)	(66.508)	(74.897)	(57.567)	(102.610)
9	18998.353	19070.892	19480.439	15120.444	18605.611	19673.763	13282.752	15604.527	15513.450	31823.334	19064.915	12042.833	14941.306	15257.433	20178.800
	(130.463)	(157.814)	(139.854	(103.031)	(104.202)	(112.501)	(99.956)	(138.913)	(76.252)	(286.733)	(121.143)	(110.713)	(117.526)	(83.788)	(151.906)
10	29036.934	35250.115	28277.600	22336.344	28827.266	30264.966	21136.451	25286.301	23867.539	48725.105	27814.461	21675.143	23899.157	22579.952	34263.448
	(462.589)	(2725.841)	(633.572)	(399.065)	(489.148)	(402.027)	(335.437)	(500.732)	(284.243)	(977.800)	(314.301)	(276.574)	(306.250)	(342.197)	(817.315)

TABLE A.4
Generalized Lorenz ordinates and standard errors (1993)

Decile	Belgium	Denmark	France	Germany	Greece	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain	United Kingdom
1	359.005	503.426	283.114	288.285	111.110	267.615	153.904	519.243	374.158	102.899	169.682	218.722
	(7.053)	(5.774)	(4.651)	(6.536)	(1.937)	(2.099)	(3.240)	(20.076)	(5.421)	(2.372)	(2.529)	(4.625)
2	962.351	1185.817	793.977	893.856	343.156	623.217	504.925	1391.544	945.607	325.187	487.293	675.567
	(11.211)	(9.310)	(7.096)	(10.052)	(4.282)	(3.546)	(5.616)	(28.735)	(7.757)	(4.363)	(4.194)	(8.901)
3	1694.237	1977.174	1414.947	1628.633	662.635	1051.419	963.913	2449.715	1613.278	623.772	889.123	1272.088
	(14.873)	(12.843)	(9.531)	(12.599)	(6.325)	(5.415)	(7.786)	(40.689)	(9.726)	(6.224)	(5.970)	(12.659)
4	2543.467	2858.451	2147.928	2471.912	1060.158	1547.499	1513.977	3695.932	2356.361	992.933	1370.814	1983.303
	(19.280)	(15.968)	(12.492)	(15.505)	(8.450)	(7.536)	(9.907)	(53.022)	(11.985)	(8.360)	(7.706)	(15.805)
5	3518.381	3817.823	2992.759	3420.888	1533.532	1981.942	2163.495	5144.862	3184.965	1424.864	1928.261	2802.017
	(24.288)	(19.144)	(15.424)	(18.397)	(10.821)	(10.346)	(12.504)	(65.700)	(15.083)	(10.184)	(9.684)	(19.640)
6	4620.737	4866.974	3956.648	4492.479	2084.429	2788.531	2918.840	6780.468	4123.063	1927.137	2570.130	3749.903
	(28.893)	(23.101)	(18.846)	(22.246)	(13.140)	(14.027)	(15.326)	(80.160)	(18.637)	(12.610)	(11.835)	(24.067)
7	5862.586	6015.516	5054.077	5716.540	2735.696	3590.548	3800.794	8676.411	5189.879	2515.418	3321.273	4850.300
	(34.278)	(26.884)	(22.507)	(26.020)	(16.299)	(18.160)	(18.474)	(99.811)	(23.283)	(15.481)	(14.728)	(28.929)
8	7282.891	7286.899	6330.275	7126.733	3515.084	4542.224	4833.016	10954.762	6452.398	3238.355	4228.198	6144.587
	(40.531)	(31.534)	(27.139)	(31.245)	(19.666)	(22.556)	(21.728)	(126.412)	(29.360)	(19.566)	(18.435)	(35.223)
9	8977.756	8752.387	7887.532	8824.163	4473.363	5718.920	6070.188	13737.496	7969.387	4180.197	5372.378	7735.480
	(49.675)	(37.881)	(33.126)	(37.632)	(23.625)	(28.543)	(25.869)	(152.858)	(35.552)	(25.546)	(23.227)	(42.617)
10	11882.287	11030.516	11021.689	11471.178	6149.408	7701.723	8073.583	18200.591	10236.847	5897.940	7256.923	10151.039
	(101.555)	(69.564)	(89.006)	(55.262)	(41.679)	(59.268)	(38.406)	(240.474)	(51.429)	(40.722)	(34.550)	(57.488)

TABLE A.5
Generalized Lorenz ordinates and standard errors (1996)

Decile	Austria	Belgium	Denmark	Finland	France	Germany	Greece	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain	Sweden	United Kingdom
1	457.068	455.534	622.446	468.655	367.948	451.720	162.840	329.207	204.231	770.200	437.110	156.173	164.165	429.042	370.791
	(6.403)	(7.391)	(7.308)	(4.913)	(4.735)	(5.372)	(2.578)	(2.635)	(3.645)	(8.573)	(5.381)	(2.726)	(3.005)	(5.366)	(4.885)
2	1136.151	1148.943	1456.001	1106.196	951.870	1161.553	457.732	777.200	617.144	1849.293	1081.581	434.967	497.520	1069.828	956.082
	(10.150)	(11.811)	(12.031)	(7.052)	(7.600)	(8.596)	(5.184)	(5.391)	(6.278)	(16.027)	(8.025)	(4.448)	(5.437)	(8.090)	(8.350)
3	1931.788	1979.101	2404.752	1822.443	1658.191	1997.255	847.880	1314.978	1143.959	3119.922	1831.056	789.363	928.113	1810.882	1674.126
	(14.081)	(16.036)	(15.564)	(9.092)	(10.474)	(11.393)	(7.634)	(8.372)	(8.553)	(22.558)	(10.567)	(6.484)	(7.476)	(10.406)	(12.066)
4	2849.837	2924.589	3459.212	2608.920	2475.421	2948.132	1319.408	1937.397	1770.104	4561.006	2670.482	1217.320	1446.567	2629.749	2517.614
	(18.605)	(20.986)	(20.530)	(11.472)	(13.658)	(14.536)	(10.324)	(11.561)	(11.040)	(29.851)	(13.509)	(8.578)	(9.868)	(12.701)	(16.061)
5	3879.242	3990.372	4611.167	3474.322	3408.278	4011.194	1879.379	2659.131	2505.284	6161.723	3614.227	1718.595	2050.975	3528.310	3489.335
	(22.691)	(25.864)	(24.452)	(14.065)	(17.029)	(17.774)	(13.145)	(15.802)	(14.165)	(37.211)	(17.043)	(10.946)	(12.230)	(15.102)	(20.410)
6	5028.743	5190.398	5859.598	4424.366	4466.565	5185.399	2532.951	3505.019	3362.532	7976.068	4670.537	2297.406	2749.468	4515.602	4610.599
	(27.745)	(31.475)	(29.753)	(17.232)	(20.882)	(21.022)	(16.431)	(20.975)	(17.396)	(47.453)	(20.665)	(13.417)	(14.978)	(18.255)	(25.444)
7	6312.283	6536.469	7230.874	5477.782	5670.467	6483.759	3299.427	4491.131	4349.244	10018.754	5863.924	2965.601	3570.439	5612.126	5895.574
	(33.226)	(37.242)	(34.675)	(21.013)	(25.153)	(24.566)	(20.367)	(26.482)	(20.562)	(56.900)	(25.754)	(16.385)	(18.681)	(21.637)	(31.073)
8	7783.099	8050.280	8738.643	6660.058	7052.554	7957.780	4218.572	5643.572	5480.488	12341.149	7251.931	3768.687	4560.506	6842.228	7392.304
	(39.921)	(43.659)	(40.589)	(25.054)	(29.867)	(29.323)	(24.743)	(32.400)	(23.878)	(68.746)	(31.704)	(20.679)	(23.047)	(25.610)	(37.691)
9	9508.133	9839.263	10448.088	8036.115	8710.974	9707.933	5356.056	7059.485	6833.725	15110.806	8905.094	4837.450	5828.824	8267.402	9211.277
	(47.616)	(52.470)	(47.529)	(30.600)	(36.419)	(35.686)	(30.469)	(40.610)	(28.515)	(84.644)	(38.402)	(28.308)	(29.499)	(30.063)	(46.016)
10	12070.084	12819.105	12858.158	10031.133	11357.764	12424.670	7273.148	9614.042	8887.245	19352.092	11466.504	6719.407	7881.310	10220.298	12091.436
	(69.977)	(92.792)	(68.690)	(44.453)	(59.504)	(55.389)	(50.181)	(118.262)	(39.171)	(126.871)	(63.180)	(43.406)	(42.523)	(42.416)	(68.814)

TABLE A.6
Generalized Lorenz ordinates and standard errors (1999)

Decile	Austria	Belgium	Denmark	Finland	France	Germany	Greece	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain	Sweden	United Kingdom
1	552.545	496.084	646.959	480.622	446.081	548.451	217.455	348.524	277.438	856.533	491.529	195.360	263.065	404.111	369.410
	(7.840)	(8.720)	(9.845)	(5.267)	(4.825)	(6.295)	(3.434)	(5.219)	(4.348)	(9.337)	(6.490)	(2.874)	(4.001)	(6.332)	(6.078)
2	1344.481	1238.393	1572.495	1141.435	1098.156	1371.350	590.434	871.077	792.218	2054.346	1237.120	517.932	710.493	1069.332	1003.314
	(11.990)	(13.605)	(16.308)	(9.284)	(8.098)	(9.742)	(6.532)	(9.831)	(7.544)	(19.197)	(9.730)	(4.970)	(6.647)	(9.880)	(10.402)
3	2262.723	2122.956	2641.253	1916.159	1893.248	2327.326	1071.627	1500.342	1438.038	3480.808	2102.147	930.461	1273.467	1857.065	1790.094
	(16.792)	(18.674)	(21.759)	(12.690)	(12.015)	(13.335)	(9.523)	(13.583)	(10.299)	(27.189)	(12.840)	(7.673)	(9.394)	(12.821)	(14.520)
4	3301.790	3127.210	3832.321	2763.857	2821.498	3403.609	1651.253	2242.240	2198.816	5081.207	3078.957	1434.324	1927.601	2735.523	2722.866
	(21.397)	(23.068)	(27.230)	(15.489)	(16.060)	(15.950)	(12.987)	(20.078)	(13.608)	(35.232)	(16.166)	(10.343)	(12.001)	(15.211)	(19.465)
5	4470.036	4247.854	5135.896	3693.330	3877.101	4576.501	2327.007	3121.317	3082.906	6873.196	4168.592	2020.216	2679.087	3694.916	3800.963
	(27.785)	(29.488)	(32.840)	(19.395)	(20.143)	(19.125)	(16.327)	(25.968)	(16.952)	(45.212)	(19.831)	(12.898)	(15.184)	(17.846)	(24.148)
6	5779.274	5504.854	6545.285	4726.870	5066.110	5876.248	3106.886	4133.147	4099.403	8909.083	5383.772	2696.453	3543.048	4748.102	5030.871
	(33.679)	(35.046)	(37.790)	(23.649)	(24.610)	(23.517)	(20.227)	(33.104)	(20.876)	(57.124)	(24.294)	(16.309)	(18.568)	(20.989)	(29.656)
7	7229.584	6905.785	8096.551	5879.115	6409.417	7344.223	4026.967	5288.047	5251.954	11217.205	6754.944	3484.728	4540.259	5921.708	6444.638
	(39.976)	(41.533)	(45.180)	(29.176)	(29.456)	(28.246)	(25.593)	(39.314)	(24.470)	(70.153)	(29.796)	(19.853)	(22.788)	(24.933)	(35.797)
8	8882.255	8514.556	9832.097	7183.707	7967.118	9006.604	5120.768	6620.337	6569.807	13856.018	8345.021	4420.492	5719.692	7239.590	8079.650
	(47.577)	(50.684)	(53.142)	(34.384)	(36.413)	(33.982)	(30.864)	(47.014)	(28.401)	(85.402)	(36.443)	(24.662)	(28.202)	(28.816)	(43.004)
9	10782.090	10421.645	11780.141	8695.752	9827.679	10973.980	6449.043	8180.790	8121.152	17038.352	10251.513	5624.775	7213.823	8765.333	10097.531
	(55.948)	(61.202)	(61.796)	(41.220)	(43.393)	(41.502)	(37.602)	(55.949)	(33.255)	(105.127)	(44.704)	(32.514)	(36.481)	(34.157)	(53.338)
10	13685.783	13946.657	14607.901	10929.386	12710.406	14000.476	8562.688	10709.420	10507.906	21910.862	13032.959	7792.290	9603.738	11023.328	13523.875
	(84.206)	(285.991)	(98.992)	(65.125)	(73.126)	(66.127)	(57.433)	(86.625)	(49.743)	(164.236)	(62.628)	(51.155)	(54.910)	(54.263)	(107.277)

TABLE A.7
Rank and second order dominance (1993)

	Belg.	Denm.	Fran.	Germ.	Gree.	Irel.	Ital.	Lux.	Neth.	Port.	Spa.	U. K.
Belgium	*											
Denmark	X X	*										
France	$-_w -_s$	X $-_s$	*									
Germany	$-_w -_w$	X X	X $+_w$	*								
Greece	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	*							
Ireland	$-_s -_s$	$-_s -_s$	$-_{s5} -_{s5}$	$-_{s5} -_{s5}$	X $+_s$	*						
Italy	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$+_s +_s$	X X	*					
Luxembourg	$+_w +_s$	$+_w +_w$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	*				
Netherlands	$-_w -_w$	X $-_s$	X X	X X	$+_s +_s$	$+_s +_s$	$+_s +_s$	$-_s -_s$	*			
Portugal	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_w -_{s10}$	$-_w -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	*		
Spain	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$+_s +_s$	X $-_s$	X X	$-_s -_s$	$-_s -_s$	$+_s +_s$	*	
United Kingdom	$-_s -_s$	X $-_s$	$-_w -_{s5}$	$-_s -_s$	$+_s +_s$	X X	$+_s +_s$	$-_s -_s$	X $-_s$	$+_s +_s$	$+_s +_s$	*

Notes:
Rank dominance results are shown by the first position in each element. Second order dominance results are shown by the second position in each element.
"+" indicates that the statistical test reveals the country in the row rank dominates the country in the column.
"–" indicates that the statistical test reveals the country in the row is rank dominated by the country in the column.
"X" indicates that the two distributions cross.
"w" indicates that the stochastic dominance is "weak"
"s" indicates that the stochastic dominance is "strong" at the 1% level.
"s5" indicates that the stochastic dominance is "strong" at the 5% level. "s10" indicates that the stochastic dominance is "strong" at the 10% level.

TABLE A.8

Rank and second order dominance (1996)

	Aust.	Belg.	Denm.	Finl.	Fran.	Germ.	Gree.	Irel.	Ital.	Lux.	Neth.	Port.	Spa.	Sw.	U. K.
Austria	*														
Belgium	$+_w +_w$	*													
Denmark	$X\ +_s$	$X\ +_w$	*												
Finland	$-_w -_w$	$-_w -_w$	$-_s -_s$	*											
France	$-_w -_s$	$-_s -_s$	$-_s -_s$	X X	*										
Germany	$+_w +_w$	$-_w -_w$	$X\ -_s$	$+_w +_w$	$+_w +_s$	*									
Greece	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_w -_s$	$-_s -_s$	$-_s -_s$	*								
Ireland	$-_w -_s$	$-_s -_s$	$-_w -_s$	$X\ -_s$	$-_s -_s$	$-_s -_s$	$+_s +_s$	*							
Italy	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_w -_s$	$-_s -_s$	$-_s -_s$	$+_s +_s$	$-_w -_s$	*						
Luxembourg	$+_s +_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	*					
Netherlands	$-_w -_w$	$-_w -_w$	$X\ -_s$	X X	$+_w +_w$	$-_w -_w$	$+_s +_s$	$+_w +_s$	$+_s +_s$	$-_s -_s$	*				
Portugal	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_w -_w$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	*			
Spain	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_w -_s$	$-_s -_s$	$-_s -_s$	$+_w +_w$	$-_s -_s$	$-_w -_s$	$-_s -_s$	$-_s -_s$	$+_w +_w$	*		
Sweden	$-_s -_s$	$-_{s5} -_{s5}$	$-_s -_s$	X X	X X	$-_{s5} -_{s5}$	$+_w +_s$	$X\ +_s$	$X\ +_s$	$-_s -_s$	$-_w -_w$	$+_w +_s$	$X\ +_s$	*	
United Kingdom	$X\ -_w$	$-_w -_s$	$X\ -_s$	X X	$+_w +_w$	$X\ -_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$-_s -_s$	X X	$+_s +_s$	$+_s +_s$	X X	*

Notes:

Rank dominance results are shown by the first position in each element. Second order dominance results are shown by the second position in each element.

"+" indicates that the statistical test reveals the country in the row rank dominates the country in the column.

"–" indicates that the statistical test reveals the country in the row is rank dominated by the country in the column.

"X" indicates that the two distributions cross.

"w" indicates that the stochastic dominance is "weak"

"s" indicates that the stochastic dominance is "strong" at the 1% level.

"s5" indicates that the stochastic dominance is "strong" at the 5% level. "s10" indicates that the stochastic dominance is "strong" at the 10% level.

TABLE A.9

Rank and second order dominance (1999)

	Aust.	Belg.	Denm.	Finl.	Fran.	Germ.	Gree.	Irel.	Ital.	Lux.	Neth.	Port.	Spa.	Sw.	U. K.
Austria	*														
Belgium	$-_w -_w$	*													
Denmark	$+_w +_s$	$+_w +_w$	*												
Finland	$-_s -_s$	$-_w -_w$	$-_w -_w$	*											
France	$-_w -_s$	$-_w -_s$	$-_w -_s$	X X	*										
Germany	$+_w +_w$	$+_w +_w$	X $-_s$	$+_s +_s$	$+_w +_s$	*									
Greece	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	*								
Ireland	$-_s -_s$	$-_s -_s$	$-_s -_s$	X $-_w$	$-_s -_s$	$-_s -_s$	$+_s +_s$	*							
Italy	$-_s -_s$	$-_s -_s$	$-_s -_s$	X $-_s$	$-_s -_s$	$-_s -_s$	$+_s +_s$	X $-_w$	*						
Luxembourg	$+_s +_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	*					
Netherlands	$-_w -_s$	$-_w -_w$	$-_w -_s$	$+_w +_w$	$+_w +_s$	$-_s -_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$-_s -_s$	*				
Portugal	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_w -_s$	$-_s -_s$	$-_s -_s$	$-_w -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	*			
Spain	$-_s -_s$	$-_s -_s$	$-_s -_s$	X $-_w$	$-_s -_s$	$-_s -_s$	$+_s +_s$	$-_s -_s$	$-_w -_w$	$-_s -_s$	$-_s -_s$	$+_s +_s$	*		
Sweden	$-_s -_s$	$-_s -_s$	$-_s -_s$	X $-_w$	$-_w -_w$	$-_s -_s$	$+_s +_s$	X $+_{s5}$	X $+_s$	$-_s -_s$	$-_s -_s$	$+_w +_s$	$+_w +_s$	*	
United Kingdom	X $-_w$	X $-_w$	X $-_s$	X X	X X	X $-_s$	$+_s +_s$	$+_{s10} +_{s10}$	$+_s +_s$	$-_s -_s$	X X	$+_s +_s$	$+_s +_s$	X X	*

Notes:

Rank dominance results are shown by the first position in each element. Second order dominance results are shown by the second position in each element.

"+" indicates that the statistical test reveals the country in the row rank dominates the country in the column.

"–" indicates that the statistical test reveals the country in the row is rank dominated by the country in the column.

"X" indicates that the two distributions cross.

"w" indicates that the stochastic dominance is "weak".

"s" indicates that the stochastic dominance is "strong" at the 1% level.

"s5" indicates that the stochastic dominance is "strong" at the 5% level. "s10" indicates that the stochastic dominance is "strong" at the 10% level.

TABLE A.10

Rank and second order poverty dominance (1993)

	Belg.	Denm.	Fran.	Germ.	Gree.	Irel.	Ital.	Lux.	Neth.	Port.	Spa.	U. K.
Belgium	*											
Denmark	$+_s +_s$	*										
France	$-_s -_s$	$-_s -_s$	*									
Germany	$-_w -_s$	$-_s -_s$	$+_w +_w$	*								
Greece	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	*							
Ireland	$-_s -_s$	$-_s -_s$	$-_{s5} -_{s5}$	$-_{s5} -_{s5}$	$+_s +_s$	*						
Italy	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$+_s +_s$	X $-_s$	*					
Luxembourg	$+_s +_s$	$+_w +_w$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	*				
Netherlands	$-_w -_w$	$-_s -_s$	$+_s +_s$	X $+_w$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$-_s -_s$	*			
Portugal	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_{s10}$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	*		
Spain	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$+_s +_s$	$-_s -_s$	X X	$-_s -_s$	$-_s -_s$	$+_s +_s$	*	
United Kingdom	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$+_s +_s$	X X	$+_s +_s$	$-_s -_s$	$-_s -_s$	$+_s +_s$	$+_s +_s$	*

Notes:
Rank dominance results are shown by the first position in each element. Second order dominance results are shown by the second position in each element.
"+" indicates that the statistical test reveals the country in the row rank dominates the country in the column.
"–" indicates that the statistical test reveals the country in the row is rank dominated by the country in the column.
"X" indicates that the two distributions cross.
"w" indicates that the stochastic dominance is "weak".
"s" indicates that the stochastic dominance is "strong" at the 1% level.
"s5" indicates that the stochastic dominance is "strong" at the 5% level. "s10" indicates that the stochastic dominance is "strong" at the 10% level.
"=" indicates that the truncated distributions are equivalent.

TABLE A.11

Rank and second order poverty dominance (1996)

	Aust.	Belg.	Denm.	Finl.	Fran.	Germ.	Gree.	Irel.	Ital.	Lux.	Neth.	Port.	Spa.	Sw.	U. K.
Austria	*														
Belgium	$+_w +_w$	*													
Denmark	$+_s +_s$	$+_s +_s$	*												
Finland	$-_w -_w$	$-_w -_w$	$-_s -_s$	*											
France	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_w -_s$	*										
Germany	$+_w +_w$	= =	$-_s -_s$	$+_w +_w$	$+_s +_s$	*									
Greece	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	*								
Ireland	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$+_s +_s$	*							
Italy	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$+_s +_s$	$-_w -_s$	*						
Luxembourg	$+_s +_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	*					
Netherlands	$-_w -_w$	$-_w -_w$	$-_s -_s$	X $-_w$	$+_s +_s$	$-_w -_w$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$-_s -_s$	*				
Portugal	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_w -_w$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	*			
Spain	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$+_w +_w$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$+_w +_w$	*		
Sweden	$-_s -_s$	$-_{s5} -_{s5}$	$-_s -_s$	X $-_w$	$+_s +_s$	$-_{s5} -_{s5}$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$-_s -_s$	= =	$+_s +_s$	$+_s +_s$	*	
United Kingdom	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_w -_s$	= =	$-_s -_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$-_s -_s$	$-_s -_s$	$+_s +_s$	$+_s +_s$	$-_s -_s$	*

Notes:

Rank dominance results are shown by the first position in each element. Second order dominance results are shown by the second position in each element.

"+" indicates that the statistical test reveals the country in the row rank dominates the country in the column.

"–" indicates that the statistical test reveals the country in the row is rank dominated by the country in the column.

"X" indicates that the two distributions cross.

"w" indicates that the stochastic dominance is "weak".

"s" indicates that the stochastic dominance is "strong" at the 1% level.

"s5" indicates that the stochastic dominance is "strong" at the 5% level.

"=" indicates that the truncated distributions are equivalent.

TABLE A.12

Rank and second order poverty dominance (1999)

	Aust.	Belg.	Denm.	Finl.	Fran.	Germ.	Gree.	Irel.	Ital.	Lux.	Neth.	Port.	Spa.	Sw.	U. K.
Austria	*														
Belgium	$-_s -_s$	*													
Denmark	$+_s +_s$	$+_s +_s$	*												
Finland	$-_s -_s$	$-_w -_w$	$-_s -_s$	*											
France	$-_s -_s$	$-_s -_s$	$-_s -_s$	X $-_w$	*										
Germany	$+_w +_w$	$+_s +_s$	$-_s -_s$	$+_s +_s$	$+_s +_s$	*									
Greece	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	*								
Ireland	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$+_s +_s$	*							
Italy	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$+_s +_s$	X $-_s$	*						
Luxembourg	$+_s +_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	*					
Netherlands	$-_s -_s$	= =	$-_s -_s$	$+_w +_w$	$+_s +_s$	$-_s -_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$-_s -_s$	*				
Portugal	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	*			
Spain	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_s -_s$	$+_s +_s$	$-_s -_s$	$-_w -_w$	$-_s -_s$	$-_s -_s$	$+_s +_s$	*		
Sweden	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_w -_{s5}$	$-_w -_w$	$-_s -_s$	$+_s +_s$	$+_s +_s$	$+_s +_s$	$-_s -_s$	$-_s -_s$	$+_s +_s$	$+_s +_s$	*	
United Kingdom	$-_s -_s$	$-_s -_s$	$-_s -_s$	$-_w -_s$	$-_w -_s$	$-_s -_s$	$+_s +_s$	$+_{s10} +_{s10}$	$+_s +_s$	$-_s -_s$	$-_s -_s$	$+_s +_s$	$+_s +_s$	$-_w -_s$	*

Notes:
Rank dominance results are shown by the first position in each element. Second order dominance results are shown by the second position in each element.
"+" indicates that the statistical test reveals the country in the row rank dominates the country in the column.
"–" indicates that the statistical test reveals the country in the row is rank dominated by the country in the column.
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"=" indicates that the truncated distributions are equivalent.

FIGURE A.1
Statistical comparisons of first and second order dominance (1993)

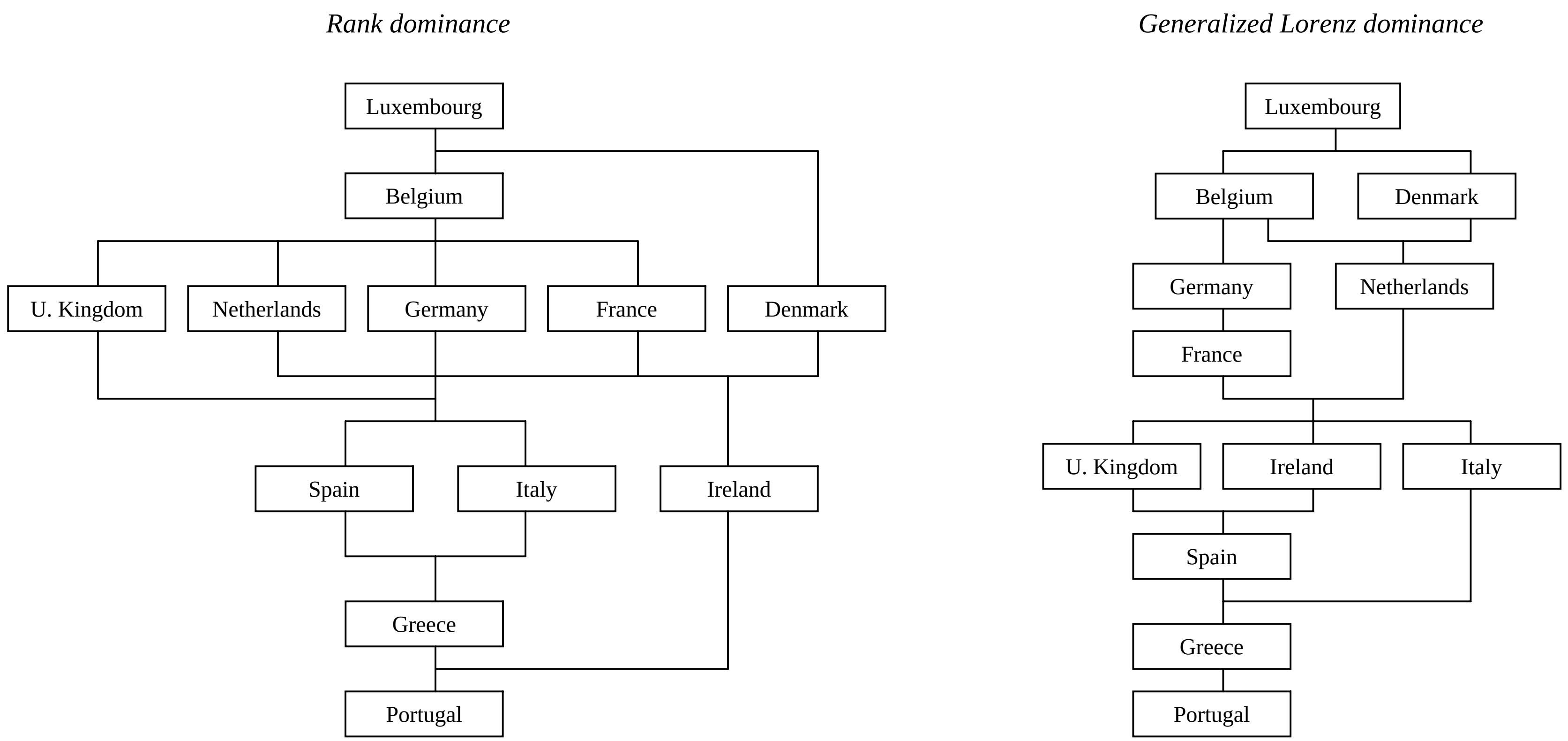
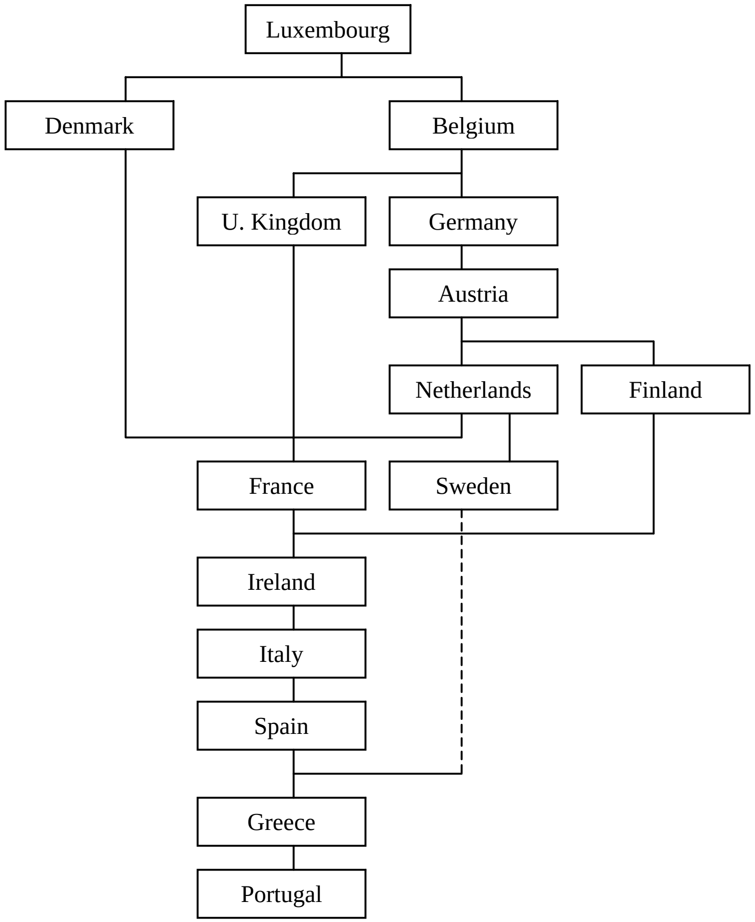


FIGURE A.2

Statistical comparisons of first and second order dominance (1996)

Rank dominance



Generalized Lorenz dominance

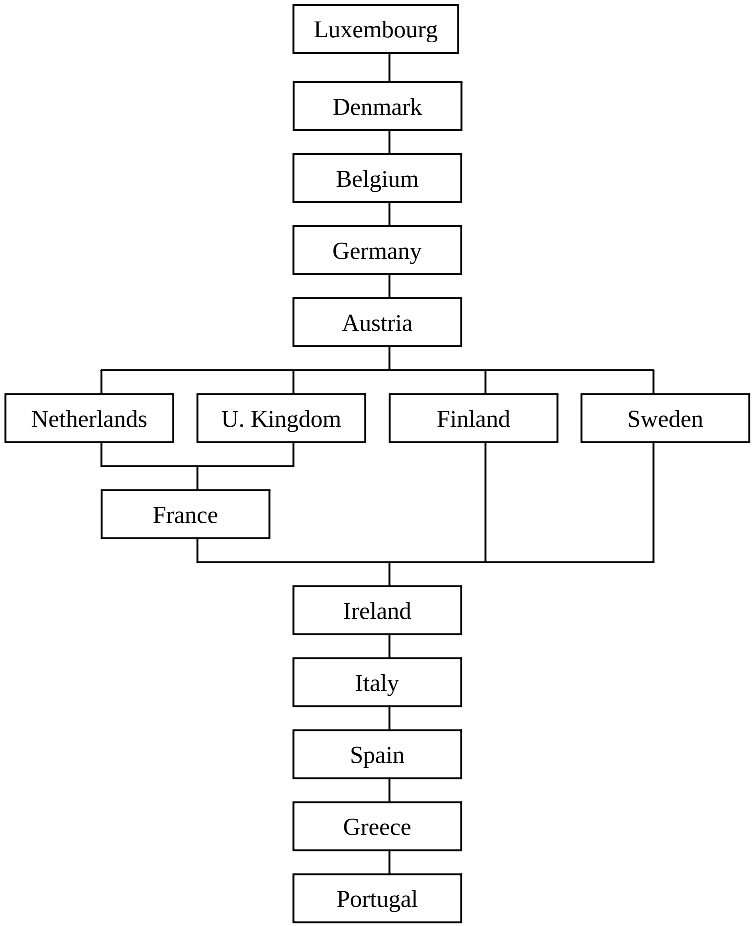


FIGURE A.3

Statistical comparisons of first and second order dominance (1999)

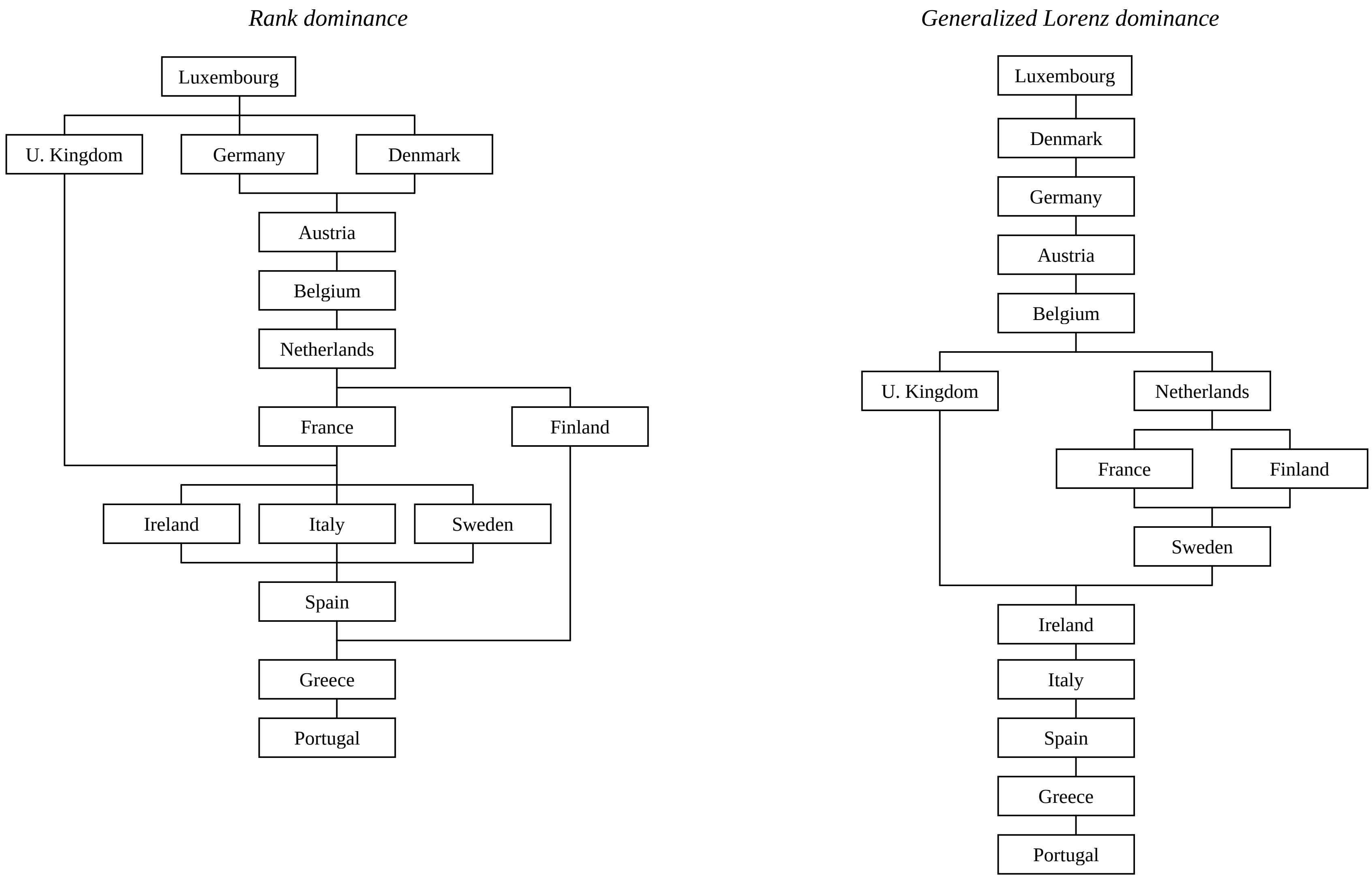
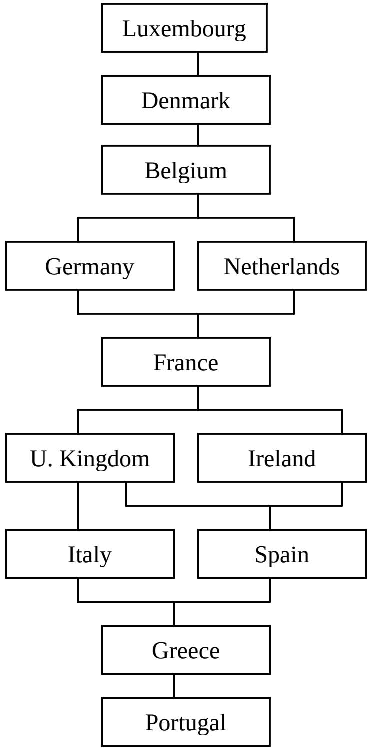


FIGURE A.4

Statistical comparisons of rank dominance poverty and second order dominance poverty (1993)

Head-count poverty



Income-gap poverty

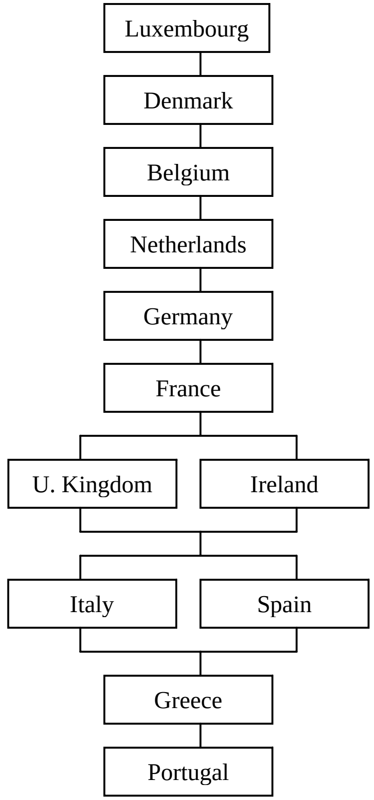


FIGURE A.5

Statistical comparisons of rank dominance poverty and second order dominance poverty (1996)

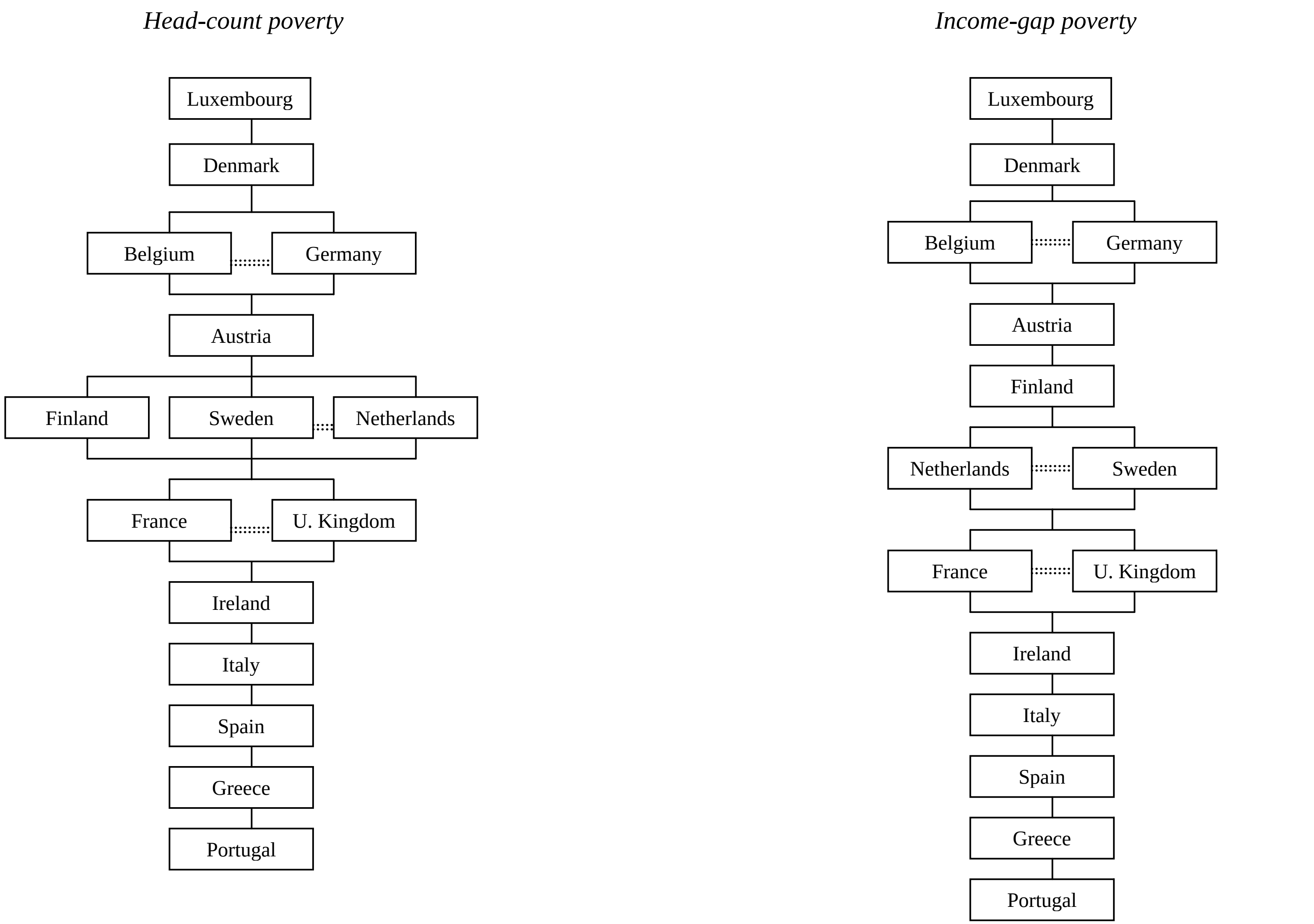
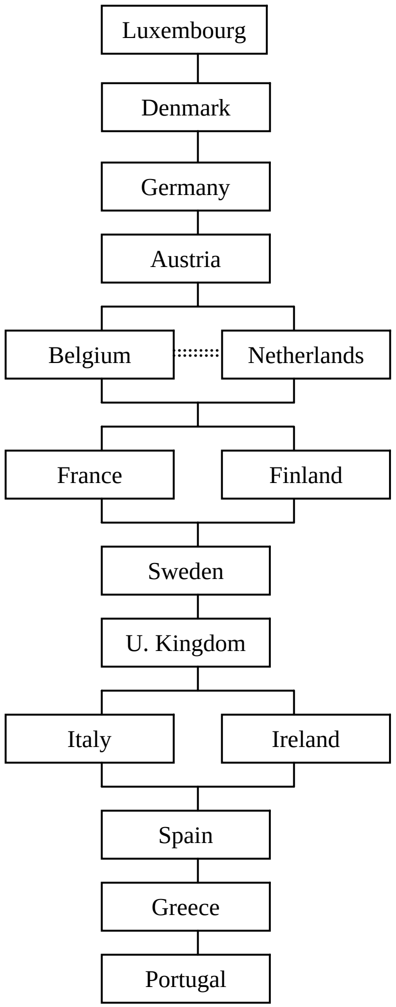


FIGURE A.6

Statistical comparisons of rank dominance poverty and second order dominance poverty (1999)

Head-count poverty



Income-gap poverty