Review of Income and Wealth
Series 47, Number 3, September 2001

MEASURING INCOME INEQUALITY IN EUROLAND

BY MIRIAM BEBLO

Centre for European Economic Research (ZEW), Mannheim

AND

THOMAS KNAUS

Freie Universität Berlin

In this paper we propose an aggregate measure of income inequality for the founding countries of the European Monetary Union. Applying the methodology of the Theil index we are able to derive a measure for Euroland as a whole by using complementary data from the European Community Household Panel and the Luxembourg Income Study. The property of additive decomposability allows us to determine each country's contribution as well as that of each demographic group to overall income inequality. In addition the impact of government transfers on this inequality measure is assessed.

1. INTRODUCTION

With the start of the European Monetary Union on January 1, 1999, all participating states now share a single currency. They have achieved an important milestone in becoming a single economic unit which we shall refer to as Euroland.[1] However, this one event should not distract from the fact that there still remain considerable economic, cultural as well as important social differences between the participating nations.

With the present paper we hope to shed some additional light on this issue by estimating an aggregate measure of income inequality within Euroland. We are interested in the income distribution in Euroland as one indicator of the current state of a European social union. Real income distribution comparisons are of interest to policy makers because many people, not only as members of the current monetary but especially as potential members of a social union, see themselves increasingly as residents of a single Euroland. Therefore research on the current state of social cohesion within this area is needed to provide a base point for developing and evaluating policy options down the line.

Note: This study has been (co-)funded by a grant from the European Commission, TMR Programme, Access to Large Scale Facilities and hosted by IRISS-C/I at CEPS/INSTEAD. We gratefully acknowledge comments from Irwin Collier, Waltraud Schelkle, Tim Smeeding as well as two anonymous referees and we thank the research team at CEPS/INSTEAD for their patient support. We also thank session participants at the ESPE 2000 conference and at the Vereinstagung 2000 for fruitful discussions.

[1]The eleven founding members of Euroland include, in alphabetical order, Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain. Of the fifteen member states of the European Union (EU) only Denmark, Greece, Sweden and the U.K. were not part of the European Monetary Union (EMU) in 1999.

The scientific literature on this subject can be classified into three fields of research. The first field focuses on empirical inequality measurement in general. In recent years much progress has been made as a result of new databases such as the Luxembourg Income Study. Examples for surveys of this literature are Atkinson, Rainwater, and Smeeding (1995) and Gottschalk and Smeeding (1997, 2000). The second major field is concerned with real income comparisons.[2] Work in this field includes Atkinson (1995), Gottschalk and Smeeding (1997, 2000) and Rainwater and Smeeding (1995). Gottschalk and Smeeding (1997, 2000) present estimates of absolute income inequality in different industrialized countries, however focusing on a different set of countries. In Rainwater and Smeeding (1995) the real income of children in different industrialized countries is compared. The article closest in spirit to the present paper is Atkinson (1995). He also constructs a measure of Europe-wide income distribution but using a quite different method. Atkinson did not employ micro-data but instead "tried the experiment of estimating the overall distribution from national 'meso-tables,' in that the population is divided into 40 groups of equal size (20 groups in the case of Finland, Netherlands, Portugal and Spain), ranked according to their equivalent disposable income, where it is assumed that incomes are equal within each group" (Atkinson, 1995, p. 13). His work also differs from ours with respect to the definition of Europe and with respect to the level of disaggregation since we draw on the original micro-data. The third and last line of work we refer to deals with the theory of inequality index numbers. This literature is concerned with a specific property of inequality measures, namely additive decomposability, as advanced among others by Berry, Bourguignon, and Morrison (1983a, 1983b), Bourguignon (1979), Cowell (1980), Shorrocks (1980), and Theil (1967, 1979a, 1979b).

Our study adds to this earlier research by explicitly focusing on inequality in the founding countries of Euroland together and in the methodology to be applied. We will compare real household equivalent incomes across countries and it is our principal objective to aggregate the inequality measures into a single inequality measure for Euroland as a whole. We believe that such measures will be an essential part of future discussion about a European social union. The major difference of our study is the special focus we employ on a hypothetical Euroland around the mid-1990s. Using data from Wave 2 (1995) of the European Community Household Panel (ECHP) together with data from the Luxembourg Income Study (LIS) in the mid-1990s, inequality in every single country will be measured as will be overall inequality of household equivalent income in Euroland. Of course at that point in history one could only speak of the group of countries that would ultimately form a future Euroland. Documenting the heterogeneity of the social structures of the individual states at a time when a prospective monetary union just came into view is nevertheless most interesting, especially with regard to the current discussion about potential future or recent entry of the non-participating countries (the remaining EU countries Denmark, Greece,

[2]Theil (1989) distinguishes two basic categories for making cross-country comparisons. International income inequality ignores the within country inequality and compares only the countries' per capita income. "We obtain world inequality from international inequality by adding the average within-country inequality" (Theil, 1989). Our approach can be assigned to the latter field of obtaining world (in our case Euroland) income inequality.

Sweden and the United Kingdom as well as Eastern European countries joining the EU). We believe that our attempt to aggregate national inequality measures for all founding countries of the European Monetary Union constitutes a genuine contribution since it exploits methodology used to analyze inequality in regions of flexible size like Euroland that will admit new members in the foreseeable future. To our knowledge this could very well be the first approach to quantify aggregate inequality in Euroland at a time when information about social structures in Euroland is still rather limited.

We use a summary measure of the generalized entropy family of inequality indices, the Theil inequality index, due to its distinct advantage of being an additively decomposable measure. This property allows us to derive an inequality index for Euroland as a whole, even if complete information on all participating countries is not available. Applying the methodology of the Theil index we are still able to compute a measure for Euroland income inequality when we combine data of the ECHP, that do not include Finland, with LIS-data that do not include Portugal.

Additive decomposability further allows us to determine each country's and household's contribution to overall income inequality in Euroland. By using an additively decomposable measure, we can compare the country effect and the household structure effect within each country with the Euroland average and assess the relative contribution of both effects.

Finally we analyze the redistributive impact of transfer policies in the different Euroland countries for different inequality measures upon (aggregate) Euroland inequality. By comparing the distributions of net total incomes (including governmental and social insurance transfers) with pre-transfer (but post-tax) incomes we are able to assess the effectiveness of government transfers in the Euro countries.

The paper proceeds as follows: we begin with a discussion of real income comparisons across countries along with an introduction to the data sets used. Next the methodology of measuring income inequality with an additively decomposable measure is described. We then present the results for overall inequality in Euroland and a decomposition of this index with respect to the Euro countries. This is followed by a decomposition by countries as well as demographic groups to investigate their respective contributions to measured inequality in Euroland. In addition the effect of social transfer payments on the distribution of income will be analyzed. The paper concludes with a summary of the main findings.

2. Concepts and Data

Since a comparison of income distributions across countries raises a host of problems and important issues, we want to be sure that we know what it is precisely that we measure. Second, choices must be made to achieve comparability among people living in households of different sizes and in different countries.

Our analysis is limited to the distribution of disposable money income. That is, rather than basing measured inequality on consumption or expenditure data, we take total annual household income after taxes and transfer payments as our chosen indicator for differences in the access to economic resources or achievable

economic well-being. Since we are particularly interested in comparing real income levels across all countries that constitute Euroland from the very beginning we first have to transform all incomes into comparable monetary values in an appropriate manner. All income amounts have been reported in national currency units and are converted to a comparable base using the multilateral purchasing power parities provided by Eurostat for the reference year.[3]

We measure income as household equivalent income, i.e. adjusted for family size. The unit of analysis is the individual to whom we assign an equivalent household income according to the modified OECD scale.[4] Insofar as household structures differ across countries, the choice of the equivalence scale may indeed affect the result of the income comparison. This problem is taken care of by sensitivity analyses using different scales. We multiply the household equivalent income by the number of individuals in each household, thereby assuming that within each family an equal share of income is allocated to each member. Thus we do not take into account the possibility of unequal sharing within the household. While clearly a very strict assumption, this is a standard assumption in income distribution research as typically little or no information is available about income distribution *within* families.[5]

Since time spent in gainful employment is in most cases not the sole productive activity of a household, it would be necessary to also account for the yields of household production, as for instance the value of a cooked meal or a well-educated child and not just market income. However in the present study household production is ignored due to data constraints. For this reason the results need to be interpreted cautiously as inequality might be overestimated when there are households in which home-produced goods make up a major share of a family's total real consumption. In a comparison of inequality measures across countries the respective relevance of household production should be kept in mind when interpreting differing indices.

A very rich and only recently issued data set to investigate the distribution of income across European countries is provided by the European Community Household Panel (ECHP). To meet the demand for greater in-depth knowledge and better compatibility of data on social and economic conditions in the European Union, the ECHP was launched as a closely coordinated component of a system of household surveys aimed at generating comparable social statistics at the EU level. The ECHP is a standardized survey conducted in Member States of the European Union under the auspices of the Statistical Office of the European Communities.[6] It involves annual interviewing of a representative panel of

[3]In sensitivity analyses different conversion rates have been used to transform national currencies into ECU (in particular, ECU exchange rates from 1994 and EURO exchange rates from 1999), but these turn out not to have a substantial effect on the final measure.

[4]With the modified OECD scale a weight of 1 is assigned to the first household member of age 16 and above. Every additional adult (person over 15) receives the weight 0.5 and each child under 16 receives the weight 0.3.

[5]It should be noted that by focusing on disposable money income we ignore two factors that also affect family well-being and may vary widely across countries (Gottschalk and Smeeding, 2000). The first is any sort of in-kind income including private and publicly provided goods. The second concerns indirect taxation.

[6]For a detailed description of the ECHP methodology and questionnaires, see Eurostat (1996a, 1996b).

households and individuals in each country, covering a wide range of topics on living conditions. The ECHP includes comparable information across Member States regarding income, work and employment, poverty and exclusion, housing, health and many other social indicators. The key feature of the ECHP is harmonization of its methodology, specifically through the creation of a centralized questionnaire that serves as the point of departure for all national surveys. Although this common questionnaire ensures a common conceptual framework and comparability of the national surveys, it does not necessarily imply the use of identical questions among countries. On the contrary, because of differing legal and institutional frameworks, the same information, e.g. on income and social transfers, is sometimes provided by very different questions (Eurostat, 1998).

To assess the quality of the ECHP, data comparisons with other EU and national sources have been made (Eurostat, 1998). Income distribution in the ECHP, the most important feature for our analysis, has been compared with the national consumption and expenditure surveys showing that the overall mean income level is higher in the ECHP. But the differences are only marginal and they are most pronounced in those countries where the consumption-expenditure survey is known to be of limited quality with respect to income data (Eurostat, 1998).

To study income inequality in Euroland we need income data on all eleven founding members of the European Monetary Union. In Wave 2 of the ECHP, gathered in 1995, information for Finland is lacking, because it first joined the ECHP in 1996. For this reason we draw on additional data from the Luxembourg Income Study (LIS)[7] for the same year. The LIS is a collection of micro data sets obtained from a range of income surveys in various countries. Information on income and household characteristics has been made comparable to improve consistency across countries. Thus the major difference between the ECHP and the LIS is that while the LIS data provide information that has been drawn from national surveys and made comparable *ex post*, the ECHP has been started with a common conceptual framework and standardized content from the very beginning.

With both data sets, the 1995 wave of the ECHP for ten of the Euro countries and the 1995 LIS data on Finland, we have assembled all the ingredients required to estimate an inequality measure for Euroland as a whole.

3. Methodology

We now turn our attention to the central methodological problem of this paper. After transforming all nominal incomes into real incomes we must choose an appropriate summary measure to make our comparisons.

In the present paper we limit our attention to an index from the generalized entropy family of inequality indices.[8] The specific summary measure used here is commonly called the Theil inequality index $T(1)$. We choose the $T(1)$ index

[7]Further information at http://www.lisweb.ceps.lu, status July 9, 2001. See particularly de Tombeur and O'Connor (1995).

[8]For an overview of the numerous summary measures for inequality available in the literature see, for example, Jenkins (1991) or Slottje (1989).

because of the underlying analogy between the concepts of disorder (or entropy) and inequality.[9] This index takes the form

$$T(1) = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{y_i}{\mu}\right)\ln\left(\frac{y_i}{\mu}\right) \tag{1}$$

where N is the size of the population, y_i is individual income, and μ is the mean income of the population. According to Bourguignon (1979), Cowell (1980) or Shorrocks (1980) the $T(1)$ measure can be decomposed such that

$$T(1) = \sum_{k=1}^{K} s_k \cdot T(1)_k + \sum_{k=1}^{K} s_k \ln\left(\frac{\mu_k}{\mu}\right) \qquad \text{where } s_k = \frac{\sum_{j=1}^{N_k} y_j}{\sum_{i=1}^{N} y_i} = \frac{N_k \cdot \mu_k}{N \cdot \mu}. \tag{2}$$

The first term describes inequality within each of the K population subgroups. In our case subgroups correspond to different countries and different household types within Euroland. The second term measures inequality between these subgroups, using s_k as the share of total income of subgroup k. The income share s_k can be interpreted as the economic weight in the total population. From (2) it follows that apart from the value of inequality within subgroups $T(1)_k$, inequality depends on mean income levels μ_k and population sizes N_k. Hence, once we have the countries' inequality indices, all we need to determine overall inequality are these aggregate macroeconomic numbers.

The generalized entropy family in general and the Theil index $T(1)$ in particular satisfy the axioms of symmetry (anonymity), population replication (population homogeneity, replication invariance), mean independence (invariance to relative changes, scale invariance, homogeneity), the Dalton–Pigou principle of transfers (strong principle of transfers) and additive decomposability. The last property implies that an overall inequality measure can be additively decomposed into its subgroups' distinct inequality measures as has been shown in equation (2) above.[10]

Additive decomposability is the condition we impose when choosing our inequality measure.[11] Of course, there are objections in that it requires a certain degree of independence between subgroups. It is not entirely intuitive why

[9]At first glance, the Theil measure that takes the average of reciprocal income shares weighted by income shares, appears somehow ad hoc. The rationale for this specific functional form requires an excursion to information theory which is concerned with valuing the knowledge that an outcome, one of many possible, has occurred. Finally the analogy between the concepts of disorder (entropy) in information theory and of inequality provides the rationale for using such an index in the context of inequality measurement. For details see the seminal contribution by Theil (1967) or a shorter exposition in Jenkins (1991).

[10]Two remarks about other often used axioms are in order here. First, $T(1)$ is not normalized between 0 and 1 so it does not satisfy the axiom of normalization. Dividing $T(1)$ by $\ln(N)$ achieves normalization. Second, $T(1)$ is bottom-sensitive because observations are weighted by the size of their incomes, i.e. the axiom of transfer sensitivity is satisfied at the bottom end of the distribution. A 100 ECU transfer from someone with 100,000 ECU to someone with 90,000 ECU would alter $T(1)$ by as much as one from someone with 10,000 ECU to someone with 9,000 ECU. The change in $T(1)$ depends on the relative incomes of the households involved in the transfer.

[11]The priority of additive decomposability is the reason for using the non-normalized $T(1)$ measure, i.e. in our case maximum possible inequality in a group depends on population size. The intuition behind this is that income inequality in a society with a million people where one person receives all income is higher than in a society with only a thousand inhabitants where one person holds the total income.

inequality in one group should be independent of inequality in another group. But in this particular case the different groups represent different countries. Here it seems sensible to allow inequality in Germany to be independent of inequality, say, in Portugal. Whether the assumption of independence still holds with the introduction of a common currency and monetary policy in 1999 is subject to further discussion. The property displayed in equation (2) suggests a natural cardinalization of decomposable measures. In our context, it is an appropriate decomposition for revealing the pattern of inequality in Euroland.

Instead of calculating the $T(1)$ index an alternative choice would be the $T(0)$ index—also called the mean logarithmic deviation which has the property of being even more bottom sensitive than the $T(1)$. We choose the $T(1)$ index because our main purpose is to draw a picture of the income distribution in Euroland and not evaluate the effectiveness of distribution policies. The crucial advantage of the $T(1)$ measure for the analysis presented here lies in its use of economic weights or income shares instead of using sole population shares (as in the $T(0)$ measure). While population shares are part of income shares as can be seen from equation (2) the latter also include relative mean incomes. We consider economic weights or income shares more appropriate since they better reflect countries' economic standings in terms of political power within the European Monetary Union than pure population sizes.

Indices other than those belonging to the Theil family do not satisfy what Cowell (2000) labels the "accountant's approach" to decomposition, meaning that the weighted within-group inequality terms together with the between-group inequality term sum to unity, an essential property in our context. This accounting property illustrates that the overall inequality is not just the simple sum of individual inequalities, in which case it would be sufficient to look at the differences of individual inequality measures to evaluate the degree of heterogeneity between countries. However, when viewing all countries together as a single entity, overall inequality is the sum of weighted inequality indices and appropriately measured between-group inequality. In view of the economic and social process of integration that is reflected in a single European market and a single European Currency area we think it worthwhile to consider inequality within Euroland as a whole. For this reason we look at real rather than nominal inequality as usually done in the scientific literature.

One major reason why we actually need additive decomposability to be satisfied is that at the time of foundation Euroland consisted of eleven countries. In the 1995 wave of the ECHP, however, Finland was not yet included in the data set. As a consequence we first have to calculate a proxy measure for overall Euroland inequality including only ten countries, i.e. with Finland missing. The value of this "Euro10"-Theil index then has to be adjusted by Finland's contribution to total inequality by exploiting additional information provided by the LIS. It is at this point where the properties of the Theil index $T(1)$ come into play: the Theil index can be calculated with aggregate data, in particular the population share, the mean income and the Theil (inequality) index of every population subgroup as shown in (1) and (2). Hence, if we dispose of $T(1)$ indices of all participating nations as well as their respective population shares and mean incomes, we can simply "sum" everything according to equation (2).

Looking closer at the changes that result when integrating a new country into an existing entity, we can discriminate four effects:

$$T(1)^{K+1} - T(1)^{K} = \underbrace{s_{K+1}^{K+1} \cdot T(1)_{K+1}}_{I \geq 0} + \underbrace{s_{K+1}^{K+1} \cdot \ln \frac{\mu_{K+1}}{\mu^{K+1}}}_{II <> 0?} + \underbrace{\sum_{k=1}^{K} \left[(s_k^{K+1} - s_k^{K}) \cdot T(1)_k \right]}_{III \leq 0} + \underbrace{\left[\sum_{k=1}^{K} s_k^{K+1} \cdot \ln \left(\frac{\mu_k}{\mu^{K+1}} \right) - \sum_{k=1}^{K} s_k^{K} \cdot \ln \left(\frac{\mu_k}{\mu^{K}} \right) \right]}_{IV <> 0?} \tag{3}$$

where subscript k represents subgroup k as before and superscript K represents the total number of all K subgroups.

One direct (positive) effect from adding another country with inequality $T(1)_{K+1}$ is quite obvious when inspecting (2). Technically speaking we are now summing over $(K+1)$ groups instead of K groups. As long as the added country has at least some degree of inequality, i.e. $(T(1)_{K+1} > 0)$, the sum of individual Theil indices will always be greater in the new bigger entity. This direct inequality effect is captured by the first term in equation (3) above. The sign of term II depends on the relative size of the new country's mean income level μ_{K+1} with respect to that of the existing entity ($\mu_{K+1} \neq \mu^{K}$). If the entrant's mean income is larger, there will be a positive mean income effect, otherwise we will observe a negative impact on aggregate inequality.

Effects III and IV are both re-weighting effects. The third term is unambiguously negative. When adding another country, overall population and overall mean income will be altered. This again will affect the weights assigned to the existing (old) countries. Since every country k is weighted by its economic share s_k, its contribution to overall inequality will always be smaller in the new bigger entity. As a result the re-weighting inequality effect III and the direct inequality effect I work in opposite directions. The sign of the last term IV is ambiguous again. It depends on the relation between the new overall mean income and the old overall mean income which we can call the re-weighting mean income effect. If the entrant's income level leads to a rise in overall mean income, the re-weighting mean income effect will be negative. It will be positive if a relatively poor country enters. As a result, the sign of the combined effect of the four partial effects remains also unclear, i.e. it is not determined ex-ante.

In our example of Euroland we can now assess empirically what the net effect will be when adding the data from Finland to the inequality measure based on the ECHP data set. Calculating the Euro10-Theil according to equation (2) generates an inequality index of 0.1849. Integrating Finland's income and population data with reference to equation (3) then yields an overall Euro-Theil of 0.1831. To draw a comparison, note that the US-Theil index calculated with LIS-data from 1994 amounts to 0.2289.

On the right hand side of equation (4) we can discriminate the following four effects:

$$0.1831 - 0.1849 = 0.0018 + 0.0016 - 0.0033 - 0.0019. \tag{4}$$

The resulting net effect of including Finland is thus $0.1831 - 0.1849 = -0.0018$, i.e. there is less than 1 percent difference between the two indices.[12] The direct inequality effect (first term), the between-group or mean income effect (second term) and the re-weighting inequality effect (third term) more or less level each other out. So the major part of the overall change can be attributed to between-group re-weighting caused by a higher overall mean income after integrating Finland into our empirical Euroland (fourth term).

This analysis gives us an impression of the mechanics behind the Theil $T(1)$ inequality measure that relies on differences not only in incomes but also in population sizes. The property of additive decomposability has been exploited to construct a measure for inequality in founding Euroland as a whole. We find this measure not to differ very much from the Euro10-Theil calculated for only those ten countries included in Wave 2 of the ECHP. This finding allows us to focus our further analyses on those ten countries using the Euro10 results as a proxy for the structure of the income distribution within all of Euroland.

4. The Structure of Income Inequality in Euroland

Having constructed and evaluated a measure of overall inequality in Euroland we are now interested in determining the various sources of this income inequality. How much does each nation contribute to the overall inequality index of 0.18 and which share of the income distribution can be traced back to demographic groups? First we will present the decomposition of the inequality measure by countries. Then we turn to the decomposition by countries *and* household types to answer the question which of these characteristics is the driving force for the observed income inequality in Euroland.

4.1. *Decomposition by Countries*

Let us start with a closer inspection of the nations' population shares within the Euroland income distribution. At first glance, the most striking feature is the great discrepancies in population sizes across Euro countries as can be seen in Table 1.

We have Germany, France and Italy with an average population share of 20 percent and more on the one hand. On the other hand, there are six very small countries that constitute only 5 percent and less (Luxembourg with a share of a sixth of a percentage point) of the Euroland population. Spain is in the middle ranks with 14 percent of all residents. Population shares within the income deciles differ very much from these average country means. However, there is no clear relationship between income distribution and absolute country size. Instead, as one might expect, geography matters a lot. Whereas the central or continental Euro countries are over-proportionally represented in the higher income deciles,

[12]We use a 1 percent rule of thumb as a rough substitute for more rigorous statistical inference that must await future work. The small differences in the $T(1)$ measures may not come as a surprise since Finland is a very small country with a population share of less than 2 percent of the Euroland population. The same holds true for the income share. Furthermore Finland is consistently found to be one of the less unequal countries in international comparisons, as for example in Atkinson, Rainwater, and Smeeding (1995).

TABLE 1

INCOME DISTRIBUTION IN EUROLAND (DECILES)

Income Decile	Population share in %										
	G	NL	BE	LU	F	IRL	I	ES	P	A	Euroland
1	20.1	3.2	2.4	0.04	8.6	1.2	26.2	26.1	10.6	1.7	100
2	13.2	2.2	2.3	0.02	14.6	2.6	31.8	25.4	6.7	1.6	100
3	20.7	5.1	2.5	0.02	18.2	1.6	25.6	19.4	5.1	2.1	100
4	21.8	7.5	3.3	0.04	20.8	1.1	24.4	15.2	3.6	2.5	100
5	27.9	7.4	3.3	0.05	23.0	1.1	19.4	13.1	2.5	2.5	100
6	33.6	6.4	3.5	0.09	21.8	1.0	18.8	10.3	1.7	3.1	100
7	33.8	6.1	4.3	0.10	22.2	1.1	18.2	9.3	1.4	3.8	100
8	37.5	6.0	4.7	0.20	22.9	1.0	15.2	8.0	1.4	3.4	100
9	38.0	5.7	5.4	0.25	25.5	1.2	12.8	6.0	1.2	4.1	100
11	42.0	4.9	4.7	0.60	26.2	1.2	9.3	6.2	1.4	3.7	100
Mean	28.9	5.4	3.6	0.14	20.4	1.3	20.2	13.9	3.5	2.8	100

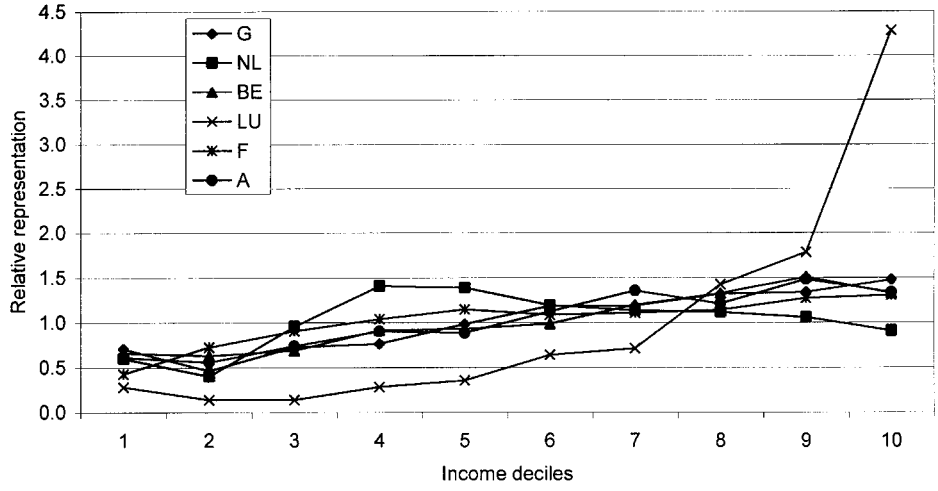
Source: Authors' calculations, ECHP (Wave 1995).
Note: Percentages might not sum up to 100 due to rounding errors.

the Southern-European states Italy, Spain and Portugal (as well as Ireland in the North) have larger shares in the lower income groups. For instance about 20 percent of all households in the bottom decile and 42 percent of the top income decile of Euroland are from Germany, that has an overall population share of 29 percent. The Portuguese on the contrary, having a mean population share of 3.5 percent, constitute almost 11 percent of the poorest and hardly more than 1 percent of the highest earners in Euroland.

The overall pattern of over- and under-representation of nationalities within the deciles becomes even more visible by examining the standardized share of each country according to its actual population size, the representation rate, over the Euroland income distribution. In Figures 1 and 2 the decile population shares are standardized by each country's overall population share. A representation rate above 1 indicates that the country is responsible for more people in that income group than its average population size would predict, hence this nation is over-represented in the respective income class.

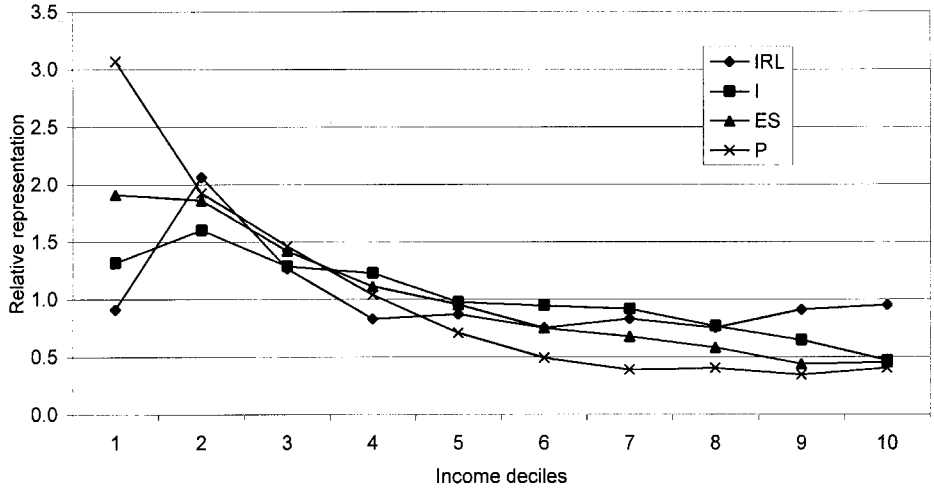
In Figure 1 the graphs of the group of central Euro countries Germany, Belgium, Luxembourg, France and Austria are clearly upward-sloping with increasing income decile. They switch from under-representation to over-representation somewhere between the fourth and the eighth decile. Luxembourg is an extreme case with a population share lower than half its mean population share in the lower half of the income distribution and a substantial over-proportional fraction in the highest decile. An exception to this central European pattern is the Netherlands which, after a remarkable over-representation in the fourth and fifth decile, experiences a decrease of its population share in higher income classes.

Italy, Spain and Portugal also reveal a common downward-sloping pattern as illustrated in Figure 2. Whereas the lowest 30 to 40 percent of incomes are relatively often received by Southern European residents, higher incomes are under-represented in these countries. Among the poorer states of Euroland, Ireland stands out of line due to its relatively high level of social protection in the



Source: Authors' calculations, ECHP (Wave 1995)

Figure 1. Income Distribution in Euroland—Relative Representation of Germany, Netherlands, Belgium, Luxembourg, France, and Austria



Source: Authors' calculations, ECHP (Wave 1995)

Figure 2. Income Distribution in Euroland—Relative Representation of Ireland, Italy, Spain, and Portugal

bottom deciles. With a most pronounced over-representation in the second decile and a sharp drop thereafter the Irish even improve their representation rate throughout the 40 percent highest income earners from 0.7 to almost 1. In other words the share of Irish among Euroland's highest income earners is almost equivalent to their average population share.

TABLE 2

SOURCES OF EUROLAND INEQUALITY BY COUNTRY

Source	Country-Theil	Annual Mean Income (ECU)	Economic weight (%)	Inequality Share (%)
Netherlands	0.1513	12,256	5.6	4.6
Austria	0.1518	13,582	3.2	2.6
France	0.1531	13,313	22.9	18.9
Germany	0.1568	13,777	33.6	28.5
Belgium	0.1603	13,487	4.1	3.6
Italy	0.1884	9,724	16.5	16.9
Luxembourg	0.1900	22,136	0.3	0.3
Spain	0.1942	8,831	10.3	10.9
Ireland	0.2326	11,249	1.2	1.5
Portugal	0.2446	7,617	2.3	3.0
Between countries	–	–	–	9.3
Euroland	0.1849	11,845	100	100

Source: Authors' calculations, ECHP (Wave 1995).
Note: Percentages might not sum up to 100 due to rounding errors.

With this indirect information about the national structures of the income distribution we now turn to the entropy measure and its more immediate since compressed indication of inequality. Table 2 reveals how the Theil index of 0.18 for Euro10 can be decomposed by the Euro countries' respective contributions to overall income inequality. Decomposition by countries shows that the country inequality indices range from a minimum of 0.15 (Netherlands) to a maximum of 0.24 (Portugal).

We can broadly distinguish three groups of states. Income is most equally distributed in the central or continental Northern European countries (Netherlands, Austria, France, Germany and Belgium) where the Theil index takes a value of about 0.155 with a variation below 1 percent across countries. Also worth noting is that these countries have mean incomes that are remarkably equal (over 12,000 to less than 14,000 ECU). Next comes the Southern European group consisting of Italy and Spain plus Luxembourg as a geographical outlier. The inequality measures in this second group vary only a little around 0.19 whereas average income levels deviate drastically. The "periphery" consisting of Ireland and Portugal shows greatest income inequality at about 0.24.

In terms of relative contributions we can see that the four largest countries Germany, France, Italy and Spain make up 75 percent of the overall Theil index. Differences between countries also account for almost 10 percent of Euroland inequality. This leaves only 15 percent to the remaining six countries. Interestingly, the actual income inequality does not show great variation across countries. It is instead the economic weights of the states that differ remarkably. The differences in economic weights are due to the countries' mean income levels as well as their population sizes. By construction of the Theil measure these weights play an important role in assessing an aggregate index for Euroland. As a result Germany comes in first in terms of relative contributions although its index is the fourth lowest of all country Theils. Germany is responsible for a share of 28.5 percent of overall inequality, since it constitutes almost 30 percent of the Euroland population. In contrast to this, Luxembourg brings up the rear by contributing only

0.3 percent of the aggregate measure despite its relatively high within-country income inequality. This is due to its average population share under 0.14 percent of all Euroland residents.

As noted earlier, the neglect of production within the household might lead to a bias in the inequality measures presented, since our comparisons are based on earned market income and unearned income alone. If household production plays a greater role in Southern Europe and Ireland, inequality will actually be smaller and the difference to Central Europe will also be smaller than the numbers suggest. This overestimation is confirmed by a sensitivity analysis with different household equivalence scales. As soon as a higher weight is assigned to children, the presence of whom being an indication for household production taking place, the indices have slightly lower values. This especially applies to Ireland and Portugal.

4.2. *Decomposition by Countries and by Demographic Groups*

After having accounted for the sources of Euroland inequality with respect to countries, we now focus on a further decomposition of the measure by demographic groups' respective household structures.

We divide the population into households in which the head of the household is 60 years and above and in those with younger heads. We also partition the younger households into those with and those without children. With this admittedly very rough categorization of households, we hope to capture the principle forces at work with respect to aggregate Euroland inequality. We would like to determine whether household types or country differences are primarily responsible for the observed structure of the income distribution in the European Monetary Union.

The purpose of this disaggregation is twofold. First we want to compare measured inequality across all subgroups. Second we want to evaluate the contribution of each group to overall inequality. An additional question would be whether differences between particular inequality measures can be explained by different structures of social protection expenditures in the ten member states.

Table 3 provides answers to the first question. For Euroland as a whole we can see that pensioner households seem to have the most unequally distributed income. This may come as something of a surprise since one might have expected the social security system to work towards a more equalized income distribution in old age. But one also needs to bear in mind that in many social security systems, pension payments are earnings-related and in this way reflect the cumulated unequal earnings of people over their entire working lives. In most cases pension payments are related to past gross earnings. In contrast to wage income, for example, such pensions are not subject to redistribution through the tax system, at least as long as they remain within the tax-free allowance. In addition to public pensions, private security plans are fed by past unequal incomes, and so also those revenues differ remarkably across older households. The Euroland Theil index for this group amounts to 0.1962. This is in contrast to young households with and those without children whose Theils have values of 0.1743 and 0.1772 respectively. As a result inequality is over 12 percent larger among the elderly than

among the young. With regard to the individual country measures this pattern is true for seven out of ten countries, with Luxembourg revealing the greatest inequality for older households. The high Theil measure for Luxembourg thus seems to be largely driven by the income inequality within this household type.

Another finding is that income is generally more equally distributed among households with children than among those without children. This pattern can also be observed in all but three of the Euroland countries. One reason for this observation might lie in the broad categorization of households. Since the last group comprises young couples or singles who do not yet have children at the time of the interview, as well as parents of older children who are above 16 years of age and therefore are not recognized as children anymore, income might well be quite heterogeneously distributed within this group. Of course, the category "households with children" also includes both couples and single parents. Nonetheless, inequality within this group seems to be of minor magnitude relative to the other two household types.

When comparing the variation of group Theils of different countries, it becomes obvious that in Germany and Italy the inequality index hardly differs across household types. The overall Germany-Theil index even exceeds that of each subgroup, meaning that measured income inequality in Germany as a whole is relatively higher than within any of the household types. Mean income levels however differ across subgroups with childless households having the highest and children-households having the lowest income. As a result, between-group inequality is responsible for the aggregate measure to exceed the subgroup average.

We now turn to the question of what is mainly shaping inequality in Euroland—whether it is differences between household types or differences between countries. Table 4 tells us that between-household-types inequality is responsible for 2.2 percent of the Euro10 measure while the contribution of between-country inequality amounts to 9.3 percent.[13] Moreover, there is large cross-country variation of inequality indices within household types. In Table 3, we saw that inequality for households over 60 varies between 0.11 in Austria and almost 0.29 in Ireland. This span is significantly larger than the overall span of 0.15 to 0.24 for all households together. At the same time, between-group variation among these households is 9.1 percent and thereby below the overall between-country variation (see Table 4). This indicates that although inequality within this demographic group varies a lot across countries, mean income differences seem to be of minor magnitude.

The same holds true, though to a lower extent, for the Theil measure for households with children. Here the $T(1)$ index ranges between 0.11 in the Netherlands to 0.24 in Portugal. That is, in the Netherlands households with children

[13]Conceição, Ferreira, and Galbraith (1999) also estimate the between country component of the Theil measure for European countries. Using the Structural Analysis (STAN) database of the OCED their focus is on manufacturing wage inequality in Europe as opposed to disposable household equivalent income inequality in Euroland. As a result of these differences they find manufacturing wage inequality to be higher in Europe compared to the US, whereas in our study household income inequality is lower in Euroland. Conceição *et al.* also analyze the relationship between unemployment and inequality. They finally recommend American-like continent-wide redistribution programs to reduce inter-regional inequality in Euroland.

TABLE 3

THEIL $T(1)$ INDICES BY COUNTRY AND HOUSEHOLD TYPE

	Age of Head of the Household (hh)			
	≥60	<60, with Children	<60, no Children	All hh
Netherlands	0.1566	0.1074	0.1693	0.1513
Austria	0.1114	0.1389	0.1661	0.1518
France	0.1890	0.1346	0.1461	0.1531
Germany	0.1566	0.1528	0.1501	0.1568
Belgium	0.2009	0.1277	0.1636	0.1603
Italy	0.1968	0.1855	0.1742	0.1884
Luxembourg	0.2606	0.1483	0.1807	0.1900
Spain	0.1674	0.2179	0.1763	0.1942
Ireland	0.2884	0.1769	0.2380	0.2326
Portugal	0.2651	0.2405	0.2174	0.2446
Euroland	0.1962	0.1743	0.1772	0.1849

Source: Authors' calculations, ECHP (Wave 1995).

have a Theil index 40 percent below the aggregate measure of 0.18 whereas Portuguese families face an income inequality exceeding the Euroland average by 30 percent. Again the mean income deviation between countries accounts for 9 percent of overall inequality in this group.

Only for the last household type (household head under 60, no children) is the range of country measures about the same as for all household types together, although the relative rankings of the countries differ. Most importantly, between country variation contributes 10.4 percent of the Euroland measure, meaning that although the country indices do not differ much, mean incomes do.

To develop some intuition for the differing indices, a look at European social protection payments is quite revealing (Europäische Kommission, 1999). For

TABLE 4

SOURCES OF EUROLAND INEQUALITY BY COUNTRY AND HOUSEHOLD TYPE

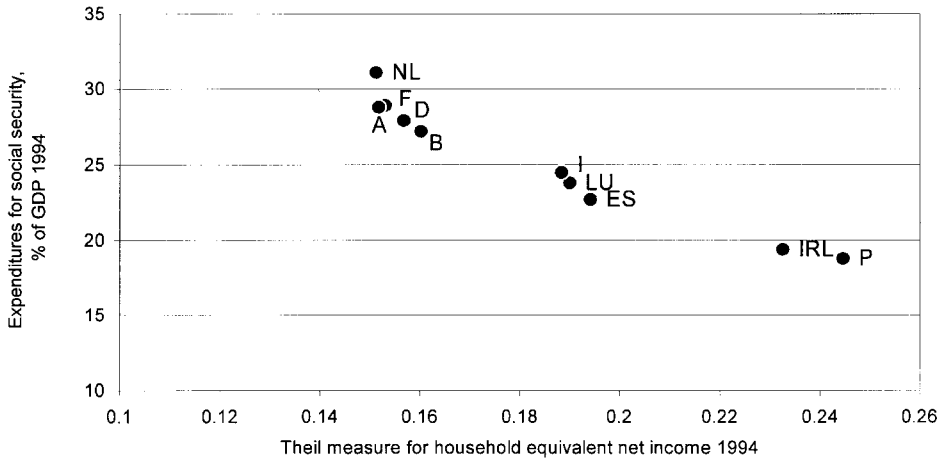
	Contribution to Country Inequality in %				
	Age of Head of the Household (hh)				
	≥60	<60, with Children	<60, no Children	Variation between hh	All hh Theil Index
Netherlands	21.12	26.95	46.37	5.57	0.1513
Austria	19.36	33.59	40.11	6.94	0.1518
France	28.66	38.6	33.98	1.77	0.1531
Germany	24.55	35.43	37.41	2.61	0.1568
Belgium	31.93	34.76	31.39	1.92	0.1603
Italy	33.93	35.30	29.24	1.53	0.1884
Luxembourg	28.90	32.34	35.60	3.17	0.1900
Spain	26.12	46.39	25.72	1.76	0.1942
Ireland	29.70	38.32	26.13	5.85	0.2326
Portugal	28.09	41.64	28.08	2.19	0.2446
Variation between countries, %	9.08	8.99	10.40	–	9.30
Euroland	27.64	37.00	33.17	2.20	0.1849

Source: Authors' calculations, ECHP (Wave 1995).

Note: Percentages might not sum up to 100 due to rounding errors.

instance, that elderly people in Ireland experience the greatest income inequality, deviating from the overall Euroland index by almost 56 percent, corresponds to its lowest share of social expenditures for elderly people and surviving dependents in comparison to other EU countries. High income inequality for Portuguese and Spanish households with children is consistent with having the lowest per-capita payments to families and children, in particular lowest levels of child benefit payments, among the member states of the European union. In Spain the share of social expenditures for families relative to GDP compared to the same figure for the elderly reveals a ratio of 1:24. In comparison the ratio for Germany is about 1:6 and for Ireland it is 1:2.

The relationship between a country's Theil measure and its social security budget relative to GDP for the same year can be seen in Figure 3 as a definitely pronounced negative relationship. The higher the social security payments in terms of GDP, the lower is income inequality. While this comparison does not tell us anything about the efficiency of social security systems, it provides information on the degree of similarity among the Euroland countries with respect to income inequality as well as to the role of the state. Interestingly, the clustering of countries into three groups already noted with respect to the inequality indices is also reflected in the share of social security expenditures.



Source: Authors' calculations, ECHP (Wave 1995) and data from Europäische Kommission

Figure 3. Social Security and Income Inequality in Euroland

However, in order to gauge the impact of social transfer payments on the income distribution within countries, it is useful to compare pre-transfer and post-transfer incomes.

5. The Redistribution Impact of Social Transfers in Euroland

A comparison of the distribution of net total incomes (including social transfers) standardized by a household equivalence scale with that of pre-government

TABLE 5

Sources of Euroland Inequality Before and After Social Transfer Payments

Source	Pre-Transfer Theil	Pre-Transfer Share (%)	Post-Transfer Theil	Post-Transfer Share (%)
Netherlands	0.4333	5.5	0.1513	4.6
Austria	0.3942	2.8	0.1518	2.6
France	0.4122	21.1	0.1531	18.9
Germany	0.4146	32.0	0.1568	28.5
Belgium	0.4781	4.1	0.1603	3.6
Italy	0.4145	15.8	0.1884	16.9
Luxembourg	0.4492	0.3	0.19	0.3
Spain	0.4672	11.3	0.1942	10.9
Ireland	0.4932	1.4	0.2326	1.5
Portugal	0.4316	2.4	0.2446	3.0
Between countries	0.0149	3.4	0.0172	9.3
Euroland	0.4388	100	0.1849	100

Source: Authors' calculations, ECHP (Wave 1995).
Note: Percentages might not sum up to 100 due to rounding errors.

(but post-tax) incomes indeed yields another striking result, shown in Table 5. Prior to social transfer payments hardly any differences in the Theil measures exist between countries. Government intervention not only reduces inequality but also appears to intensify differences between countries. Interestingly, the variation of country Theils even increases after social transfer payments. It seems that more wealthy states (like Benelux, Germany or France) can afford to shift the incomes of their poor to a greater extent than can less wealthy states (like Ireland and Portugal), thereby enhancing the disparities in country mean incomes. The relative contribution of between-country differences to overall inequality rises substantially from 3.4 percent before transfers to 9.3 percent after social transfer payments.

Further analysis of the data shows that, while prior to transfers the relations between countries' mean incomes and their Theil measures reveal little relationship to each other, adding social protection we find the correlation substantially more negative. This supports the conjecture from above that richer countries have more extensive social protection schemes in order to lower the gap between high and low income earners. Of course this tells us nothing about the causality of the relationship.

It is also interesting to note that there is a very high negative relationship between the relative size of the redistribution (as measured by the ratio of post-government to pre-government Theil) and the degree of social protection expenditures.[14] There is also no clear relationship between pre-government mean income and the pre-government $T(1)$, while post-government mean income is strongly related to the post-government Theil index.

However, due to the lack of reliability and availability with respect to data on tax payments within the ECHP these results need to be qualified, recalling

[14]The focus of this paper however is more on the variation of inequality measures depending on government interventions than on an evaluation of the redistributive effects in European social transfer systems as done in other studies (see e.g. Kraus, 2000 and references therein).

that we are looking at pre-transfer, but post-tax income. Thus at this point one government intervention has already taken place and we are not in a position to measure its impact on inequality. We can only assume that tax laws tend to promote a redistribution of income towards more equalization; therefore our analysis could underestimate the reduction of income inequality through government intervention and hence only provides a lower bound for an assessment of redistributive policy.

6. Summary and Conclusions

The purpose of this paper was to study the pattern of real income inequality in Euroland. Applying the Theil concept rather than simply comparing the countries' nominal measures thereby allows us to take into account between group variation which is implicitly ignored in nominal income inequality comparisons. The real contribution of each member state or demographic group to the overall measure is also assessed.

The Theil index of aggregate income inequality in Euroland is calculated to have a value of 0.18. It was computed using the 1995 wave of the European Community Household Panel, a new data set aimed at generating comparable social statistics at the EU level, together with complementary data from the Luxembourg Income Study. In comparison, the Theil index of income inequality in the US, as a region of comparable population size, calculated with data from the Luxembourg Income Study for 1994 is found to be 0.23.

Decomposition by countries shows that the distinct inequality indices for net income range from a minimum of 0.15 for the Netherlands to a maximum of 0.24 for Portugal. Between-country differences make up 9 percent of overall inequality, an indication that mean income levels still differ remarkably between the Euro countries. However, we find between-country variation to be substantially smaller prior to social transfer payments, contributing only 3 percent to the Euroland index.

Further decompositions by household structure reveal great disparities between the economic situations of different demographic groups across countries. Although responsible for substantial variation of income within countries, socio-economic characteristics (as captured by our categorization into household types) seem to play a minor role in shaping inequality in Euroland as a whole. Between-household differences make up only 2 percent of total inequality, indicating that, overall, income seems to be similarly distributed across demographic groups.

The analysis leads us to the conclusion that differences between countries are to a greater extent responsible for overall inequality in Euroland than differences between household types. At the same time, inequality within and between household types of certain countries is substantial. These findings could be a point of departure for a common social policy in Euroland. If such a policy is aimed at lowering income inequality within Euroland as a whole, it shall be targeted at reducing income inequality *within* specific household types of particular countries rather than at reducing the aggregate differences between demographic groups.

Nonetheless, definite conclusions must await both deeper empirical analysis and the building of consistent theory about income distribution.[15]

Another interesting policy question would concern the effects of an expansion of Euroland to other EU-members. The size of Euroland is not exogenously given or constant over time but can be subject to changes of political will. Obvious candidates are the EU countries that did not join the European Monetary Union on January 1, 1999, i.e. Greece, United Kingdom, and Denmark.[16] The data yield a Theil $T(1)$ of 0.1856 after including Greece and 0.1888 after extending the sample to include all three above mentioned countries. Hence, our inequality measure suggests that social cohesion will slightly decline with such a further extension of the European Monetary Union.

References

Atkinson, A. B., Income Distribution in Europe and the United States, *Luxembourg Income Study Working Paper Series*, No. 133, 1995.

Atkinson, A. B., L. Rainwater, and T. M. Smeeding, Income Distribution in OECD Countries: Evidence from the Luxembourg Income Study (LIS), *Social Policy Studies*, No. 18, OECD, Paris, 1995.

Berry, A., F. Bourguignon, and C. Morrison, The Level of World Income Inequality: How Much Can One Say?'', *Review of Income and Wealth*, 29, 217–41, 1983a.

———,Changes in the World Distributions of Income between 1950 and 1977, *Economic Journal*, 93, 331–50, 1983b.

Bourguignon, F., Decomposable Income Inequality Measures, *Econometrica*, 47, 901–20, 1979.

Conceição, P., P. Ferreira, and J. K. Galbraith, Inequality and Unemployment in Europe: The American Cure, UTIP Working Paper, No. 11, 1999. (published in J. Galbraith and K. Maureen (eds), *Inequality and Industrial Change: A Global View*, Cambridge University Press, 2001.)

Cowell, F., On the Structure of Additive Inequality Measures, *Review of Economic Studies*, 47, 521–31, 1980.

———, Measurement of Inequality, in A. B. Atkinson and F. Bourguignon (eds), *Handbook of Income Distribution*, North Holland, Amsterdam, 87–166, 2000.

de Tombeur, C. de and I. O'Connor, Luxembourg Income Study, Luxembourg Employment Study—Information Guide, *Luxembourg Income Study Working Paper Series*, No. 7, 1995.

Europäische Kommission, *Ausgaben und Einnahmen des Sozialschutzes*: *Europäische Union*, *Island und Norwegen—Daten* 1980–1996, Luxembourg, 1999.

Eurostat, *The European Community Household Panel* (ECHP), Volume 1, Survey Methodology and Implementation—Theme 3, Series E, Eurostat, OPOCE, Luxembourg, 1996a.

———, *The European Community Household Panel* (ECHP), Volume 1, Survey Questionnaires: Wave 1–3—Theme 3, Series E, Eurostat, OPOCE, Luxembourg, 1996b.

———, *ECHP Data Quality*, Working Group European Community Household Panel, Luxembourg, 1998.

Gottschalk, P. and T. M. Smeeding, Cross-National Comparisons of Earnings and Income Inequality. *Journal of Economic Literature*, 35, 633–87, 1997.

———, Empirical Evidence on Income Inequality in Industrialized Countries, in A. B. Atkinson and F. Bourguignon (eds), *Handbook of Income Distribution*, North Holland, Amsterdam, 261–307, 2000.

[15]Future research on the subject would comprise an assessment of the dynamics of the income distribution that includes income mobility as well as permanent income inequality. It is also desirable to strive for a deeper statistical and theoretical (i.e. structural) modeling of income inequality. The first step would contribute to a solution of the question whether the differences in income inequality revealed here are significant in a statistical sense. The latter would help to identify the causal determinants of inequality.

[16]There were no data available in the ECHP for Sweden which is also a possible candidate for the expansion of Euroland. Of course we could integrate Sweden into our analysis using LIS-data as shown in this paper for Finland. Another interesting policy question would be to determine the consequences for social cohesion of an enlargement that would include Eastern European countries like the Czech Republic, Hungary, Poland and the Slovak Republic.

Jenkins, S. P., The Measurement of Income Inequality, in Lars Osberg (ed.), *Economic Inequality and Poverty: International Perspectives*, M. E. Sharpe, Inc., London, 3–38, 1991.
Kraus, M., Social Security Strategies and Redistributive Effects in European Social Transfer Systems'', ZEW Discussion Paper No. 00–40, Mannheim, 2000.
Rainwater, L. and T. M. Smeeding, Doing Poorly: The Real Income of American Children in a Comparative Perspective'', *Luxembourg Income Study Working Paper Series*, No. 127, 1995. (published in J. H. Skolnick and E. Currie (eds), *Crisis in American Institutions*, 11th Edition, Allyn and Bacon, Boston, 118–25, 2000.)
Shorrocks, A. F., The Class of Additively Decomposable Inequality Measures, *Econometrica*, 48, 613–25, 1980.
Slottje, D. J., *The Structure of Earnings and the Measurement of Income Inequality in the US*, North-Holland, Amsterdam, 1989.
Theil, Henri, *Economics and Information Theory*, North-Holland, Amsterdam, 1967.
———, The Measurement of Inequality by Components of Income, *Economics Letters*, 2, 197–9, 1979a.
———, World Income Inequality and Its Components, *Economics Letters*, 2, 99–102, 1979b.
———, The Development of International Inequality 1960–1985, *Journal of Econometrics*, 42, 145–155, 1989.