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Comparing poverty, income inequality and mobility under panel attrition. A cross country comparison based on the European Community Household Panel

CHINTEX - The Change from Input Harmonisation to Ex-post Harmonisation in National Samples of the European Community Household Panel – Implications on Data Quality

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A cross country comparison based on the European Community Household Panel

by Andreas Behr, Egon Bellgardt, Ulrich Rendtel

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Abstract

The aim of the paper is analyzing the effect of attrition in the European Community Household Panel (ECHP) on different measurements of poverty, income inequality and income mobility. Since after the sixth wave attrition has cumulated to about 40% in the ECHP, there is a potential for a strong bias in empirical results due to non-random attrition. Our analysis is based on six waves for eleven countries. By splitting the first wave according to later response behaviour, we assess the effect of attrition on poverty and income mobility measures. Significance tests are carried out drawing nonparametric bootstrap replications. The overall finding is that attrition effects are rather mild and for no measure of poverty, income inequality and income mobility attrition biases results in the same direction for all eleven countries under consideration.

1. Introduction

The aim of this empirical paper is to explore the effect of attrition on different measures of poverty, income inequality and income mobility in the European Community Household Panel (ECHP). Since after the sixth wave attrition has cumulated to about 40% in the ECHP one might fear strong biases in empirical results due to non-random attrition. Our analysis is based on six waves for eleven countries. The method we apply to assess the effect of attrition is to split the first wave according to later response behaviour of wave 1 respondents. Significance tests are carried out drawing nonparametric bootstrap replications.

Since many different aspects of poverty have to be captured by the proposed measures, the literature offers a variety of poverty measures. Hence in the paper we adopt an ecclectic appraoch considering a number of different poverty meaures: the poverty rate, the average poverty gap ratio, the Gini coefficient of inequality and a combined measures proposed by Sen (1976), Shorrocks (1995) and Thon (1979) in subsequent papers, which assembles the information of all aformentionend into one index number.

To assess the effect of attrition on income mobility measures we consider the mobility between wave 1 and wave 2 and split the sample of wave 1 and wave 2 respondents into the subsample of persons responding throughout all six waves and the subsample of persons who attrite later on. The extent of income mobility we measure by several indicators. The first indicator is the proportion of persons staying in their income quintile between wave 1 and wave 2. Second, we use rank based measures of inquality, the spearman rank correlation coefficient as well as the average rank difference. A new measure, which weights the chance of persons belonging to the middle to climb in the income hierarchy against the risk of falling back is proposed.

We approximate the distribution of the bias resulting from attrition for all the different measures by drawing 2,400 bootstrap replications. This approximated distribution is used to assess the significance of the empirical bias.

2. The data base and panel attrition

2.1 The ECHP-UDB[1]

The first wave of the ECHP in 1994 covered about 130,000 individuals above 16 years living in about 60,000 households. In the first wave 12 countries took part, Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain and UK. While Austria took part from the second wave on in 1995, Finland started its participation in 1996 and Sweden in 1997.

The ECHP was aimed "in response to the increasing demand in the European Union for comparable information across the Member States on income, work and employment, poverty and social exclusion, housing, health, and many other diverse social indicators concerning

[1] The analysis is based on the December 2002 release of the ECHP-User Data Base (UDB).

living conditions of private households and persons".[2] The most attractive feature of the ECHP for research is its standardization.

In most of the participating countries the survey was newly started, while a couple of countries made use of already existing panel surveys. In Belgium, the Netherlands and Sweden already ongoing surveys were used to create the national subsamples, while in three countries, Germany, Luxembourg and the UK a unique situation emerged as for three years two surveys ran parallel. In 1997 the newly started ECHP surveys in these three countries were terminated and the data for the ECHP from that year on are derived from the already existing national surveys. These are the German Social Economic Panel (GSOEP), the Luxembourg's Social Economic Panel (PSELL) and the British Household Panel Survey (BHPS). The User Data Base only covers the ECHP survey in Luxembourg, hence we only regard parallel surveys in Germany and the UK in our comparative analysis.

In our analysis we include only countries which took part in all six waves of the ECHP stating in 1994. Hence, the countries included are named in table 1 below.

2.2. The national samples and the weights of the ECHP

Table 1 gives an overview on the samples analysed in this paper. As can be seen, the national subsamples of the ECHP neither have a common ratio of sample to population (column 6) nor an identical number of sample persons (4) . The largest nation subsamples is the Italian which includes almost 17,000 persons, while the smallest subsample for Denmark includes about 5,600 persons. Since the sample weights are standardized for each country the sum of weighted persons (5) is about the number of sample persons. The numbers of sample persons available for the mobility analysis (7) is sleigthly smaller compared to the number available for the static poverty analysis. The last column (8) indicates the number of persons responding in all six waves.

Table 1: Population and national ECHP-subsamples

Country	Population			Wave 1 sample			Mobility analysis	
	Total population in 1994, mio.	Adult population in 1994, mio.	House-holds in 1994, mio.	No. of sample persons	Weighted no. of persons	Sample to population (%)	No. of sample persons	Overall respon-dents
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Germany SOEP	80.59	67.17	35.95	11,607.00	11,441.24	0.017	11,553	8,743
United-Kingdom BHPS	57.51	45.49	24.04	8,572.00	8,536.58	0.019	8,463	6,679
Denmark	5.22	4.25	2.36	5,607.00	5,598.73	0.132	5,603	2,913
Ireland	3.52	2.58	1.13	9,445.00	9,496.20	0.366	9,433	4,322
The Netherlands	15.08	12.34	6.42	8,160.00	8,137.77	0.066	8,110	5,934
Belgium	9.97	8.02	4.07	6,517.00	6,509.84	0.081	6,473	3,952
France	56.09	44.63	22.81	13,959.00	13,934.76	0.031	13,447	8,350
Spain	38.78	31.10	12.07	17,356.00	17,337.29	0.056	17,221	9,467
Portugal	9.89	7.92	3.24	10,979.00	11,095.89	0.139	10,815	8,209
Italy	56.30	46.98	20.41	17,051.00	16,923.26	0.036	16,662	11,624
Greece	10.21	8.47	3.71	11,956.00	11,995.26	0.141	11,889	7,220

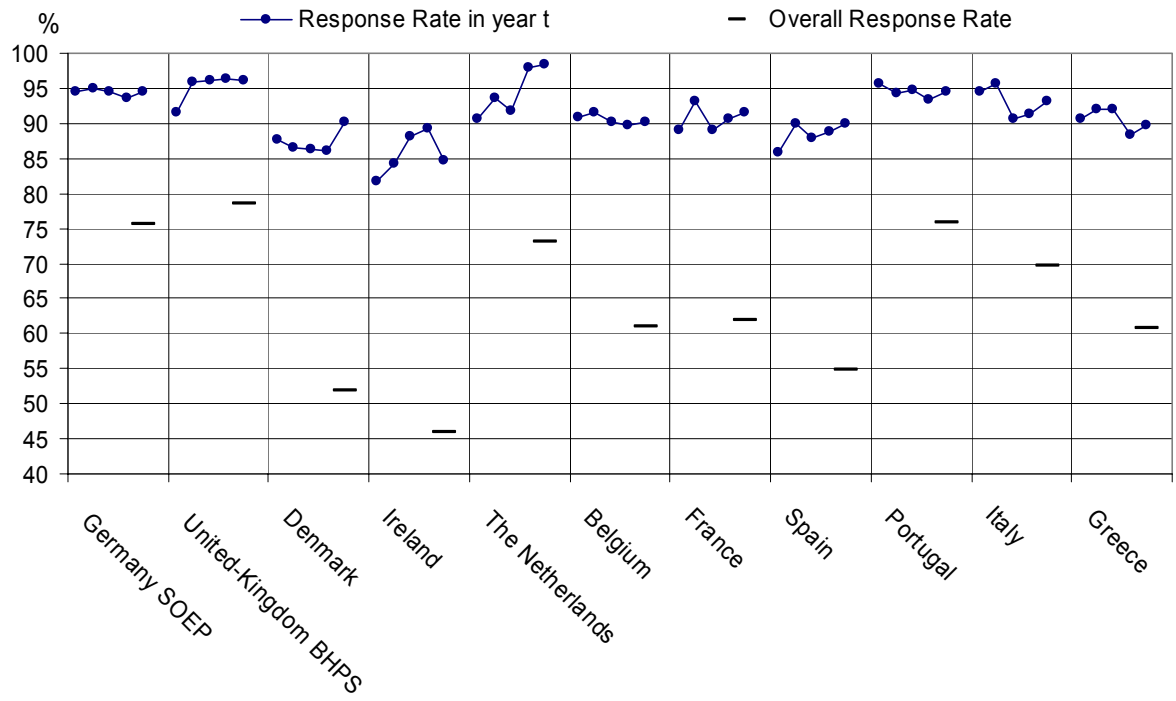
[2] Eurostat (1996), cited after Peracchi (2002), p. 64.

2.3. The participation in the ECHP

In the following we concentrate on individuals as the relevant unit. A detailed description of participation patterns based on the household as the relevant unit is given by Peracchi (2002). At the individual level the attrition in the ECHP is studied by Nicoletti/Peracchi (2002) and Behr/Bellgardt/Rendtel (2002).

In the following figure we display the response rates in wave 2 up to wave 5 as well as the overall response rate in the latest wave.[3]

Fig. 1: Response rates across countries for wave 2 to wave 6 and the overall response rate



Turning to the ratio of respondents in the last wave (horizontal bar in the figure) to respondents in wave 1, we find considerable differences across countries. The ECHP is most affected by attrition in Ireland where the remaining share of respondents dropped to 46%. Beside in the Irish subsample, response rates are also below average in Denmark and Spain. For the UK-BHPS and the German-SOEP, which both are already ongoing national surveys, we find the highest overall response rates across the EU (about 76 and 79% respectively). High response rates were also attained in Portugal and the Netherlands.

The figure also makes evident, that there is no clear tendency across all countries in the response rates to rise or fall. While we have increasing response rates in the Netherlands and Spain, we find a sharp fall in the response rate in Ireland and a strong increase in Denmark.

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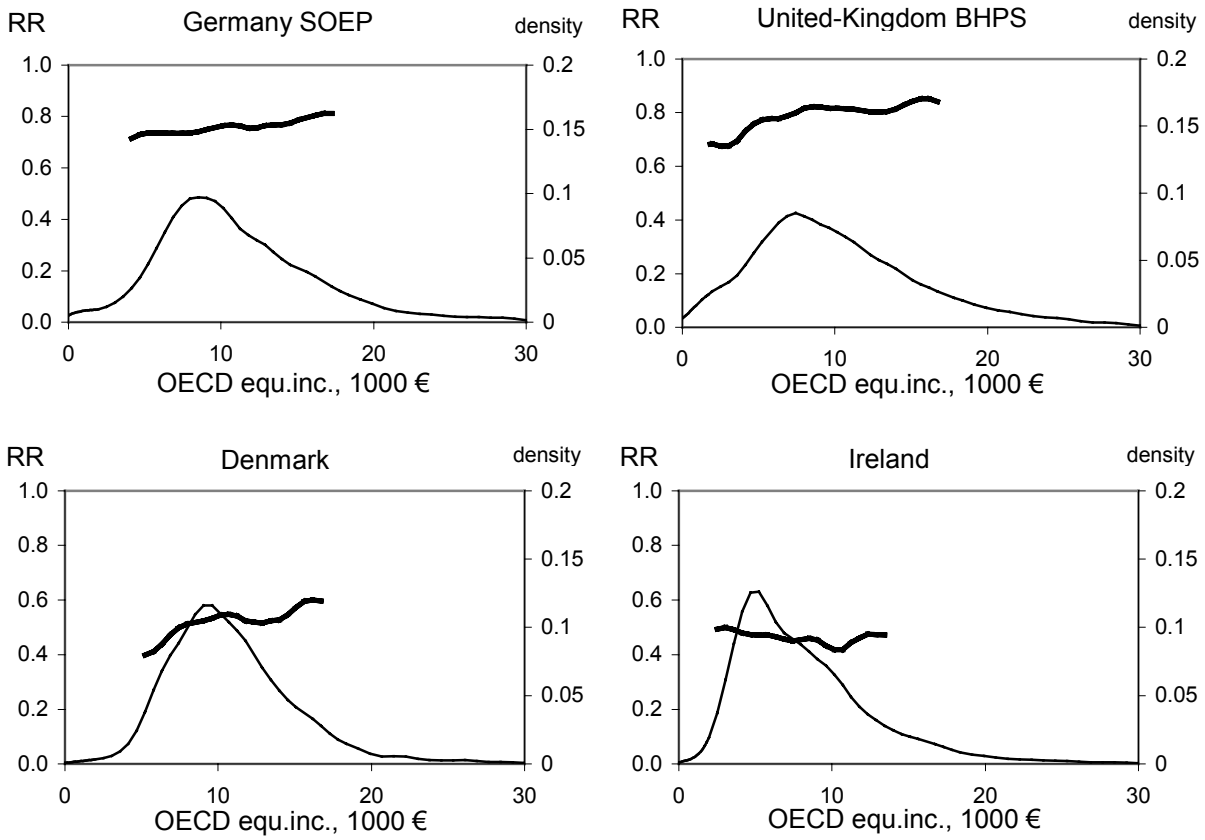
3 Rendtel (2002) provides an overview of panel attrition and proposed strategies in the literature.

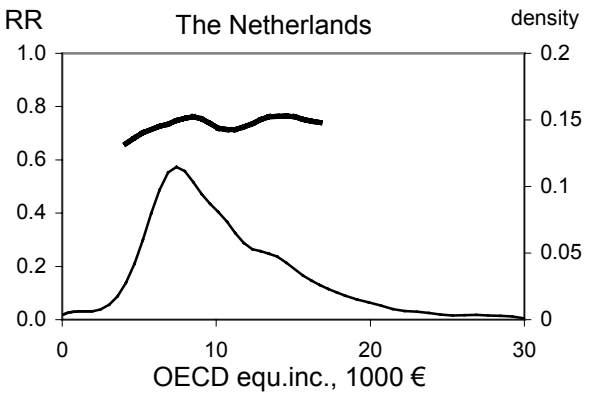
2.4. OECD-Income and response behavior

In this section we analyze the relation between OECD-household incomes and the response behavior.[4] For each of the eleven surveys we show in one figure the density distribution for the first wave (thin line and right scale) as well as the overall response rate (persons responding throughout all six waves).

Fig. 2: OECD-income and overall response rates across countries



[4] For about one third of all households some kind of imputation was made for household income items. See Peracchi (2002) for details about income item-nonresponse and imputation methods in the ECHP.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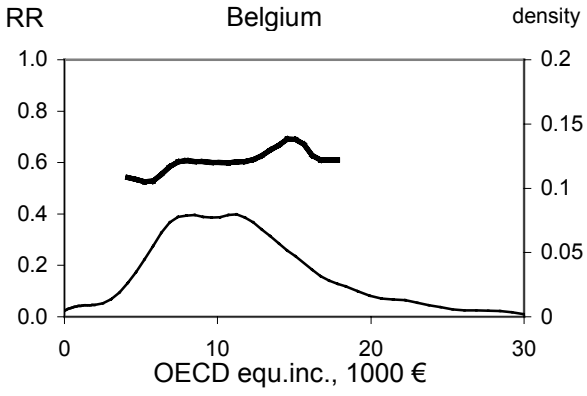
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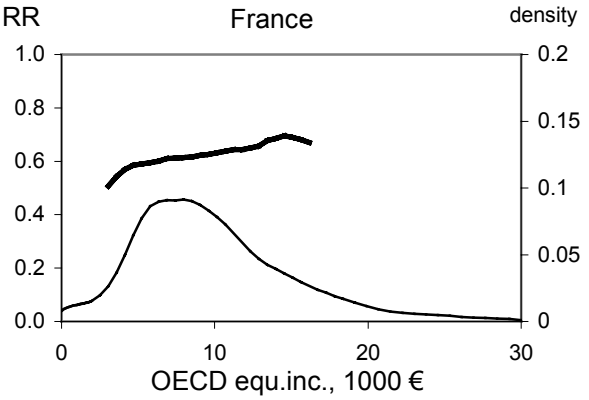
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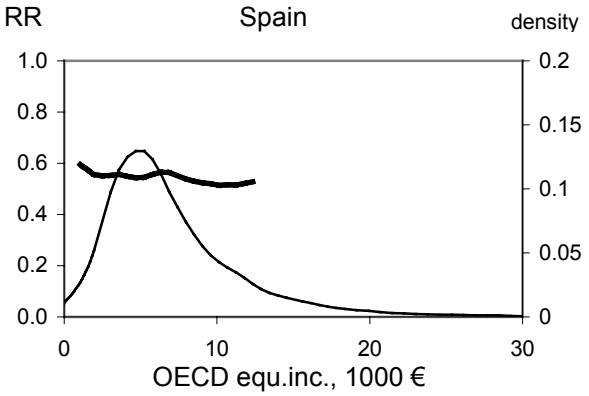
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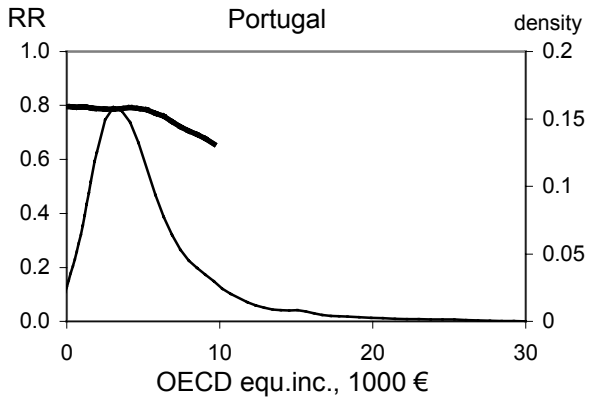
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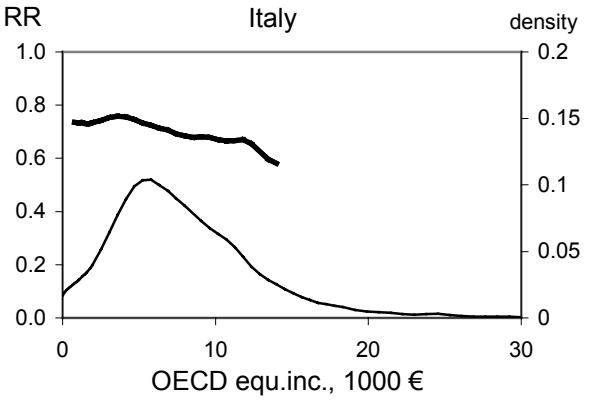
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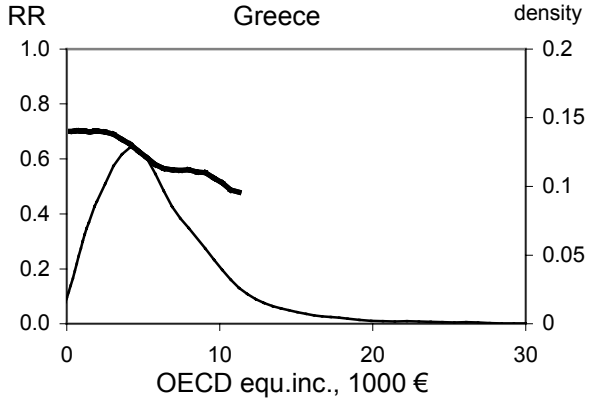
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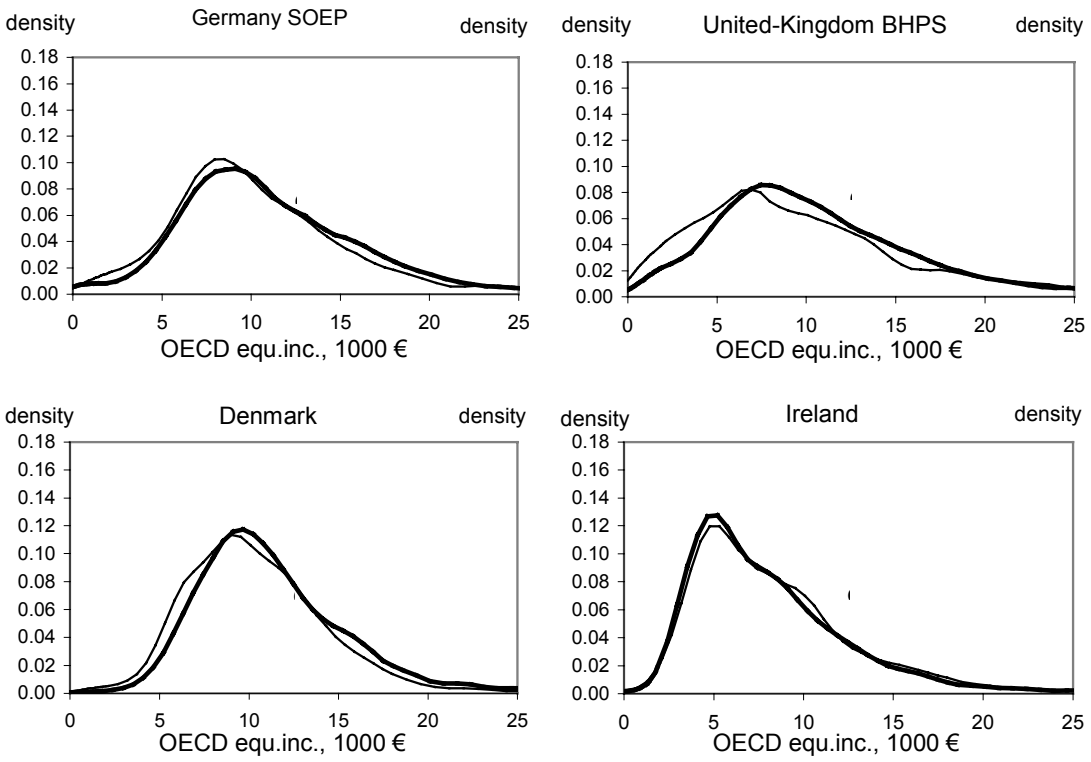
To obtain the density of household incomes we employ a triangular kernel with a constant bandwidth of ??? for all countries. The response rate is obtained through the estimation of non-parametric regressions using triangular kernels as weights and bandwidth ???.[5]

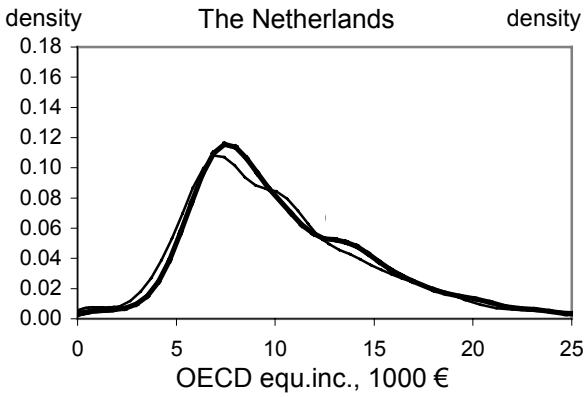
There is no clear relation visible that holds for all countries. But we find the remarkable result, that the response rate is increasing with income in the northern countries, especially in the UK, Denmark and France and sharply declining with income in southern countries, especially in Italy, Portugal and Greece.

Figure 3 displays the two density distribution for overall respondents (fat line) and for the attritors (thin line). The result of figure 2 is also visible in the comparisons of the distributions. For the UK and Denmark, we find the distribution for overall respondents to be shifted downwards, hence towards lower incomes. The opposite is found for Italy, Portugal and Greece. But the difference in the distrubtions is in general rather small.

Fig. 3: Distribution of OECD-income, overall respondents (fat line) and attritors (thin line)



5 See e.g. Härdle (1990) for an overview of non-parametric methods.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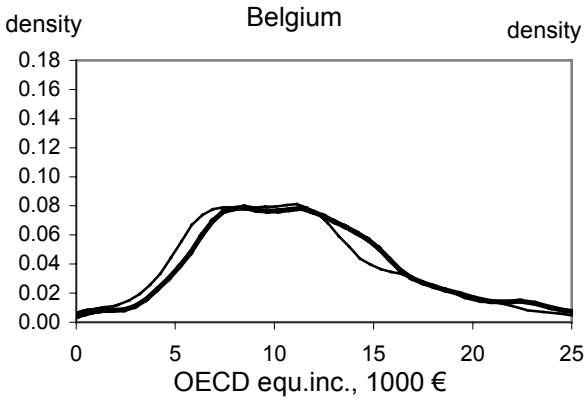
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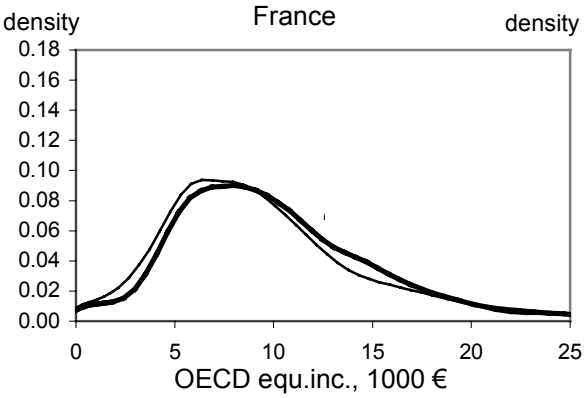
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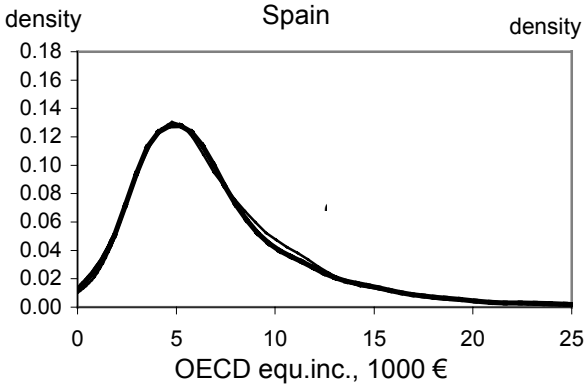
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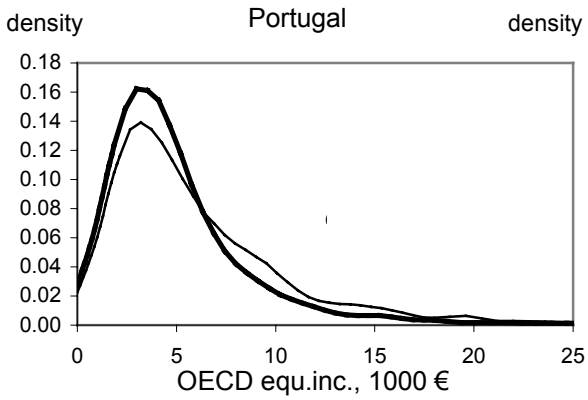
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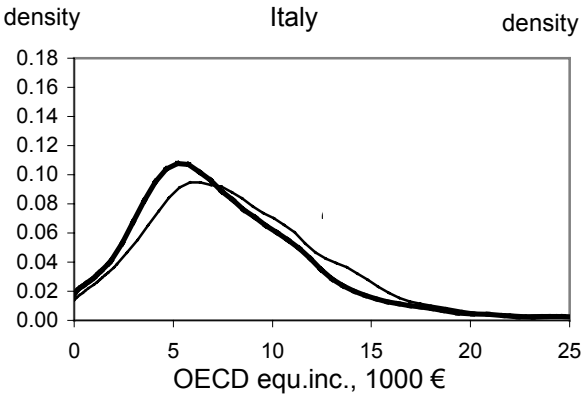
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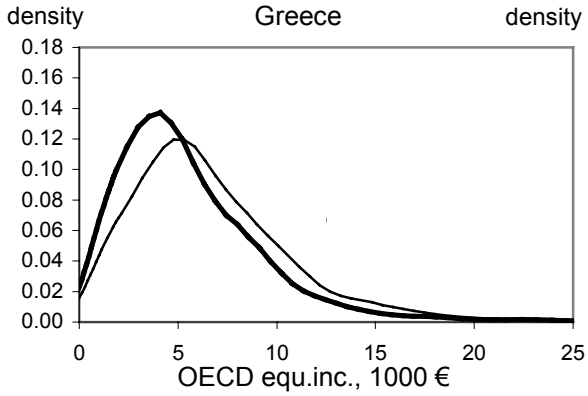
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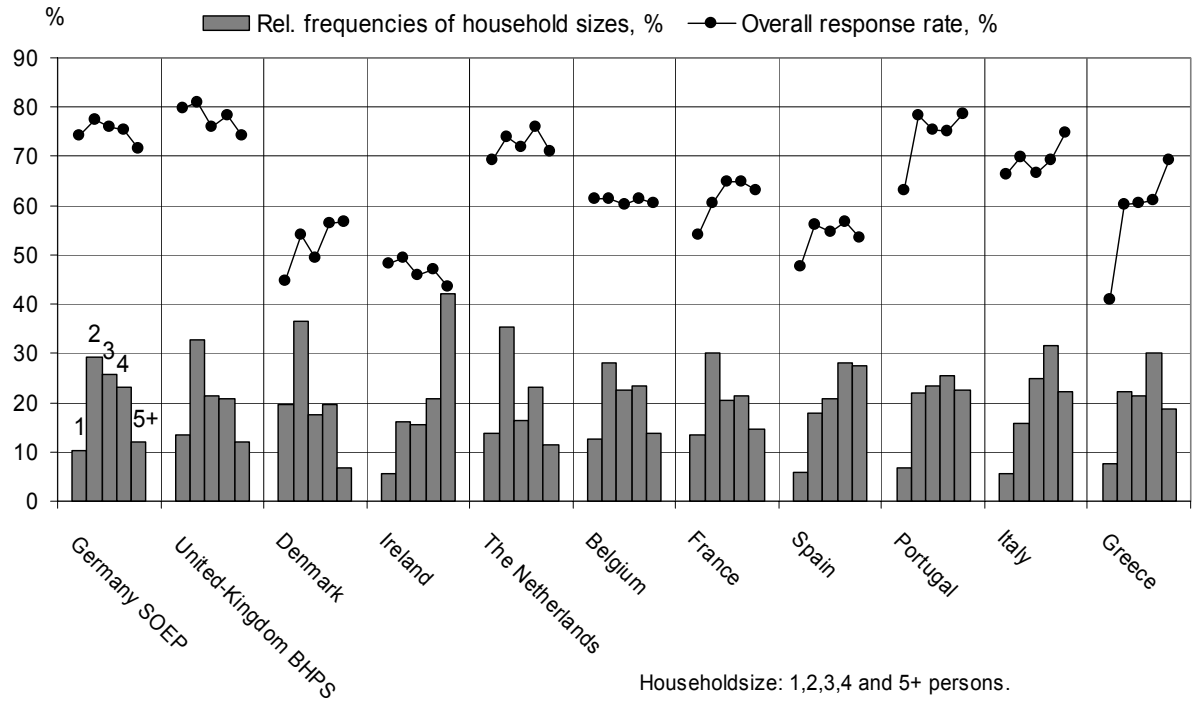
Poverty can be assumed to be present with higher probability the larger the number of persons living in one household is (Lanjouw and Ravallion 1995), but of course the correlation depends on the chosen equivalence scale (Buhmann et al. 1988). In figure 4 we display the sample distribution by household size in wave 1 in the eleven national subsamples of the ECHP as well as the overall response rate for the different household sizes.

The figure exhibits some remarkable results. The distributions of household sizes differ strongly between the different countries, with a clear north-south pattern. In northern countries the household size is on average much smaller compared the more southern countries. But not only the distribution of household sizes differ strongly, so do also the patterns of attrition by household size. While we find response rates to decrease with household size in Germany, the UK and Ireland, the opposite pattern occurs in Denmark, France, Portugal, Italy and Greece. Single households show a very strong tendency to attrite in France, Spain, Portugal and especially Greece.

Fig. 4: Distribution of household size and overall respondents (thin line)



2.5. Assessing the bias through splitting the initial wave

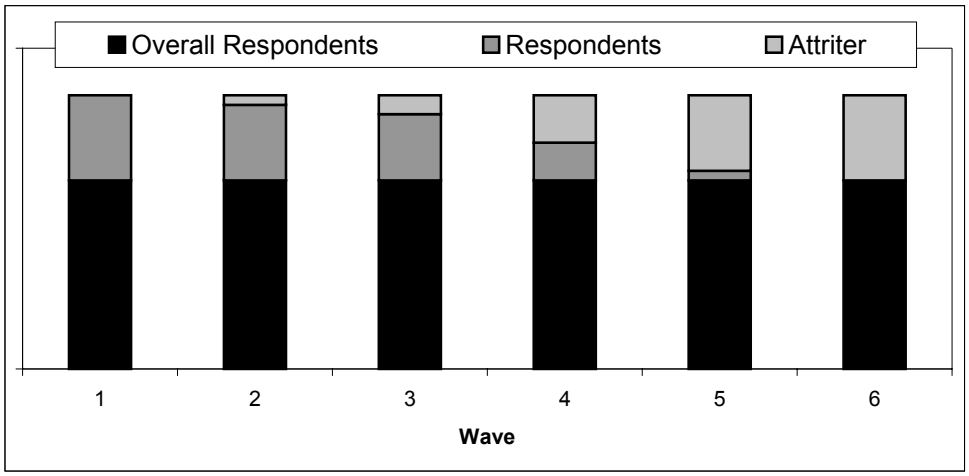
Since the researcher does not see the variables of interest for persons attritting, there is no way of analysing the true effect of attrition on the results of the analysis. One method applied in the research area of attrition effects is the splitting of observable samples according to the attrition behaviour of future waves (Fitzgerald/Gottschalk/Moffitt 1998, Behr/Bellgardt/ Rendtel 2003). An Analysis of Sample Attrition in Panel Data. The Michigan Panel Study of Income Dynamics, The Journal of Human Resources, Vol. 33, pp. 251-299.. Throughout the paper we splitt the first wave respondents into two groups, whether persons respond in all waves or attrite later on. By this procedure we are able to assess whether the attition affects sertously the results of the empirical analysis. To draw conclusions about the effect of attrition at the time it happens, one has to rely on the assumption, that the differences found

for the full as well as the reduced sample according to future response behaviour mimic the true attrition effects in the period of attrition (Behr/Bellgardt/Rendtel 2003). The figure 5 displays the procedure followed throughout the poverty and income mobility analysis.

We apply bootstrap sampling to assess the significance of the parameter differences between the estimators based on the full sample ($\beta_{0,1}$) and based on the respondents (β_1) respectively. For each wave we draw 2,400 non-parametric bootstrap replications with replacement. This non-parametric bootstrap is carried out by sampling of observations with replacement until the original sample size is obtained. Hence, the bootstrap samples differ from the original sample in the way that some observations are included plurally and other observations are not included.

The bootstrap method is applied to simulate the distribution of the bias $\hat{b}(\beta) = \hat{\beta}_1 - \hat{\beta}_{0,1}$. For each realization we got $\hat{\beta}_1^*$ and $\hat{\beta}_{0,1}^*$, the bootstrap versions of $\hat{\beta}_1$ and $\hat{\beta}_{0,1}$. To assess the significance of the estimated bias, we used the 2.5% and 97.5% quantiles of the bootstrap distributions.

Fig. 5: The splitting of the initatial wave according to future attition (neu)



3. Measurement issues of poverty and poverty intensity

When trying to measure poverty, the researcher faces the problem of defining an adequate indicator of poverty. The literature on poverty research has produced a large number of different measures, but following Sen (1976), three main indicators can be distinguished, the percentage of the poor, the average poverty gap of the poor and the inequality of income among the poor.[6]

Each of these indicators relies on the definition of the poverty line. While there are many different possible ways to define the poverty, one measure used often in cross sections as the poverty line is half of the median income. Of course the question whether poverty should only

6 See Kakwani (1993), p. 632. Bishop/Formby/Smith (1993) propose a stochastic dominance ordering to avoid the use of a fixed poverty line. This approach is not taken up in this paper.

be seen as a relative phenomenon or should also incorporate absulute measures arises again when comparing poverty among different countries or regions in cross sections (Sen (1976)).

Since in our analysis we want to assess and compare poverty across 11 countries in Europe[7], there are good arguments to pool the data in the spirit of an unified Europe and use one fix poverty line across all countries. Nevertheless we will use country specific poverty lines throughout this paper and hence take a pure relative view of poverty. The still existing large gaps in income levels across countries lead us to do so. But of course this implies, that a person catergorized as poor in one country can be well above the poverty line of an other country, even when standardizing the incomes through the use of purchasing power parities.[8]

The second measurement issue concerns the choice of the equivalence scale. While there is evidence that results of poverty studies to some extent rely on the equivalence scale chosen (Buhmann et. al. (1988)), the use of the OECD-equivalence scale is by now a standard measure and its use assures comparability with other studies. The OECD equivalenve scale weights the head of the houshold with 1, further adults living in the household with 0.7 and children below 14 years with the weight 0.5.

4. Poverty rates

The analysis is based on incomes, originally measured in the countrie's currencies, transformed into Euro making use of 1993 purchasing power parities.[9] The poverty line is calculated separately for each country as the half of the median OECD-income. Throughout the analysis we use sample weights, derived as inverse sampling probabilities and standardized to an average of 1, to infer to the pupultion instead of the stratified survey samples.

4.1. Poverty lines and the definition of the poverty rate

The following figure shows the different levels of the poverty lines across countries of the first wave in 1994.[10] While column 1 shows the poverty line calculated on the basis of all wave 1 respondents, the second column shows the resulting poverty line when relying on overall respondents only. There is no uniform under- or overestimation of the poverty line present. The differences (column 3) are strongest for Portugal with an underestimation of the poverty line of 5% and for Greece (-8%). In Denmark, Belgium and France the poverty line is overestimated by about 3% when relying on respondents only.

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7 We consider the countries only which took part in all six waves, that is Germany (SOEP), United Kingdom (BHPS), Denmark, Irland, The Netherlands, Belgium, France, Spain, Portugal, Italy, Greece.

8 For a discussion see Sen (1983).

9 The first wave we consider is 1994, but the reported household incomes refer to the last period, hence 1993.

10 The reported incomes in national currencies refer to the year befor interview. To improve comparability of the different income levels, we applied 1993 purchasing power parities to transform all national currencies into Euro.

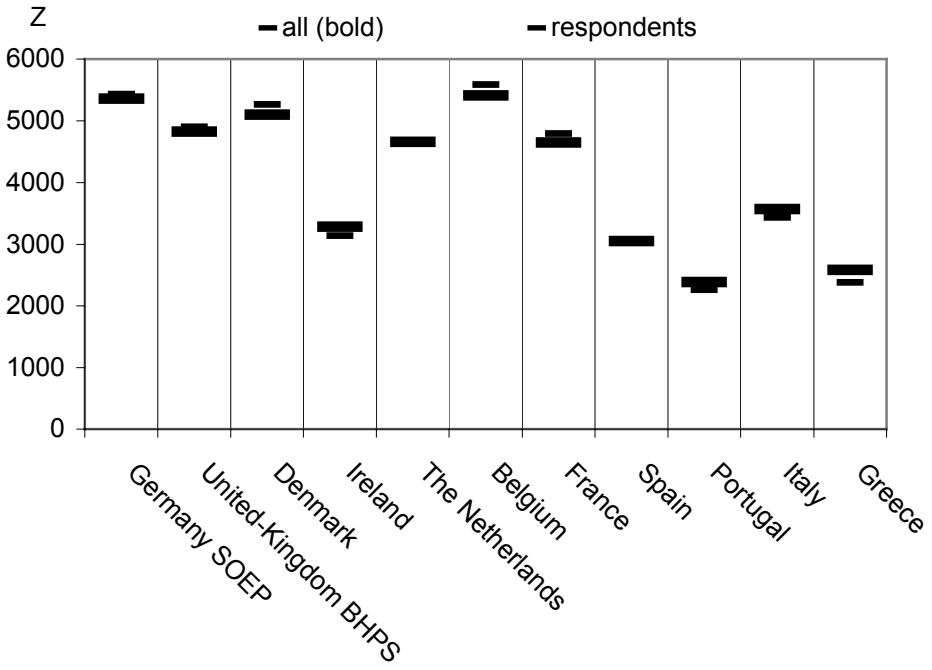
Table 2: The country specific poverty lines, € per year

	Poverty Line	
	all	respondents
Germany SOEP	5358	5427
United-Kingdom BHPS	4819	4897
Denmark	5094	5260
Ireland	3283	3138
The Netherlands	4656	4671
Belgium	5407	5583
France	4642	4791
Spain	3050	3046
Portugal	2383	2257
Italy	3571	3433
Greece	2584	2379

Figure 6 makes evident, that the income levels and the resulting poverty lines vary strongly across the eleven countries under consideration. Since we assess poverty throughout the paper in relation to national poverty lines, it has to be kept in mind that we apply a pure relative notion of poverty. This relative notion of poverty will in the most extrem cases result in a person considered poor, for instance in Belgium, that has twice the income of a person considered as non-poor living in Portugal. Since we applied purchasing power parities, the national price levels are already taken into consideration and still resulting differences in the poverty line have to be justified by purely relativistic views of poverty. Taking the idea of Europe seriously there are reasons to follow a different definition of poverty (absolute) which will result in completely different rankings of countries than obtained in our relativistic analysis. When drawing bootstrap replications, the poverty line is calculated in each run on the basis of the bootsrap sample and differs in general between the full sample and the sample consisting of respondents.[11]

[11] Making use of asymptotic standard errors Preston (1995) finds the two sources of sampling error, the poverty line and the proportion below a fixed line, to show some offesetting effects.

Fig. 6: Poverty lines (Z) across Europe



If we refer to the household as the relevant unit by the index i and introduce n_i and w_i as the number of persons living in household i and the sampling weight of household i respectively, we have the following definitions, where we use lower case symbols if we refer to the sample and upper case symbol if we refer to the population (all observations are sorted in the way that i=1 denotes the poorest and i=m denotes the richest household):

m number of households in the sample

v number of poor housholds, defined as households with OECD-equivalence income below 0.5 times the median of the OECD-equivalence income

n_i number of persons in household i

w_i sample weight of household i

n number of persons in the sample, $n = \sum_{i=1}^{m} n_i$

N number of persons in the population, $N = \sum_{i=1}^{m} n_i w_i$, since weights are normalized we have $n = \sum_{i=1}^{m} n_i w_i$ and $N = \frac{N}{n} \sum_{i=1}^{m} n_i w_i$

p number of poor persons in the sample, $p = \sum_{i=1}^{v} n_i$

P number of poor households in the population, $P = \sum_{i=1}^{v} n_i w_i$

PR poverty rate, defined as $PR = \frac{\sum_{i=1}^{v} n_i w_i}{\sum_{i=1}^{m} n_i w_i} = \frac{P}{N}$

4.2. Poverty rates across countries

Table 3 shows the poverty rates (see the definition in section 4.1.) for first wave respondents and overall respondents as well as the absolute and relative bias. Whether the difference in the average poverty rates between first wave and overall respondents is significant we indicate by an asterix (*).

Table 3: The attrition effect on the measured poverty rate

	PR01	*PR1*	Bias	
			abs.	rel., %
Germany SOEP	0.097	0.089	**-0.008***	**-8.7**
United-Kingdom BHPS	0.130	0.123	**-0.007***	**-5.7**
Denmark	0.036	0.027	**-0.009***	**-24.2**
Ireland	0.084	0.064	**-0.02***	**-24.3**
The Netherlands	0.062	0.058	**-0.005***	**-7.8**
Belgium	0.097	0.094	-0.003	-3.1
France	0.108	0.104	-0.004	-4.0
Spain	0.126	0.126	0	0.2
Portugal	0.153	0.151	-0.001	-0.9
Italy	0.148	0.144	-0.003	-2.3
Greece	0.173	0.176	0.003	2.0

* Significant, α=0.05

Fig. 7: Poverty rates and significance of the attrition bias

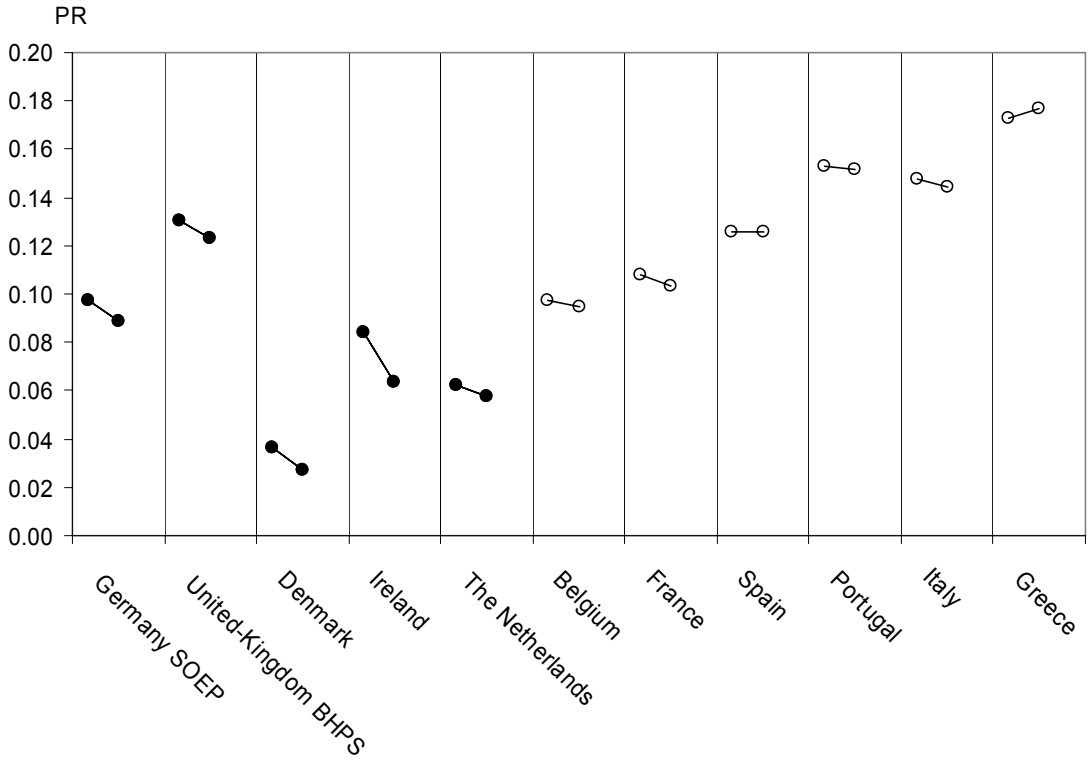


Figure 7 shows the estimated poverty rate across countries in the first wave of 1994. For each country we display two measures of the poverty rate. The left dot indicates the poverty rate using all available wave 1 observations, while the second dot presents the poverty rate that results if using overall respondents only. If the difference between the two measured poverty rates is significant at the 5%-level is indicated by the kind of symbols used. The filled circle indicates significance of the difference while the empty circle indicates insignificant difference.

Of course it has to be kept in mind when interpreting the figure, that we applied national poverty lines, hence the cross country comparison reflects differences in inequality rather than differences in poverty.

We find a clear north-south pattern, the southern countries showing higher poverty rates. The only one exception in this clear pattern is United Kingdom, where the poverty rate is about the same as in Spain. The poverty rates range from very low three percent for Denmark to the highest value of 17 percent for Greece.

In five out of the eleven countries we find the differencce of the poverty rate to be biased significantly downward when using only the overall respondents. Only for Spain and Greece we find a higher poverty rate when relying on overall respondents only, albeit in neither of the two countries the attrition effect is significant.

5. The average poverty gap

Since the counting of persons classified as poor does not contain any information of the deprivation of poverty, we calculate now the average poverty gap which tells, what is the average OECD-equivalence income of poor persons in percent of the poverty line *z*.

Hence we define the poverty gap ratio *x* as

$$x_i = \begin{cases} \dfrac{z - y_i}{z} & if \;\; y_i < z \\ 0 & else \end{cases}$$

The estimate of the population average poverty gap ratio making use of household size n_i as well as sampling weights w_i is definied as

$$APG = \frac{\sum_{i=1}^{v} x_i n_i w_i}{\sum_{i=1}^{v} n_i w_i} = \frac{\sum_{i=1}^{m} x_i n_i w_i}{\sum_{i=1}^{v} n_i w_i}$$

Table 4 shows the average poverty gap across countries for first wave respondents and overall respondents as well as the absolute and relative bias. .

Table 4: The attrition effect on the measured average poverty gap

	APG01	*APG1*	Bias	
			abs.	rel., %
Germany SOEP	0.409	0.373	**-0.036***	**-8.8**
United-Kingdom BHPS	0.319	0.322	0.003	0.9
Denmark	0.220	0.207	-0.013	-5.9
Ireland	0.192	0.173	-0.02	-10.3
The Netherlands	0.390	0.379	-0.011	-2.8
Belgium	0.345	0.336	-0.008	-2.5
France	0.285	0.272	-0.013	-4.4
Spain	0.338	0.337	-0.001	-0.3
Portugal	0.352	0.355	0.003	0.8
Italy	0.378	0.379	0.002	0.5
Greece	0.331	0.314	**-0.017***	**-5.0**

* Significant, α=0.05

Fig. 8: Average poverty gap ratios and significance of the attrition bias

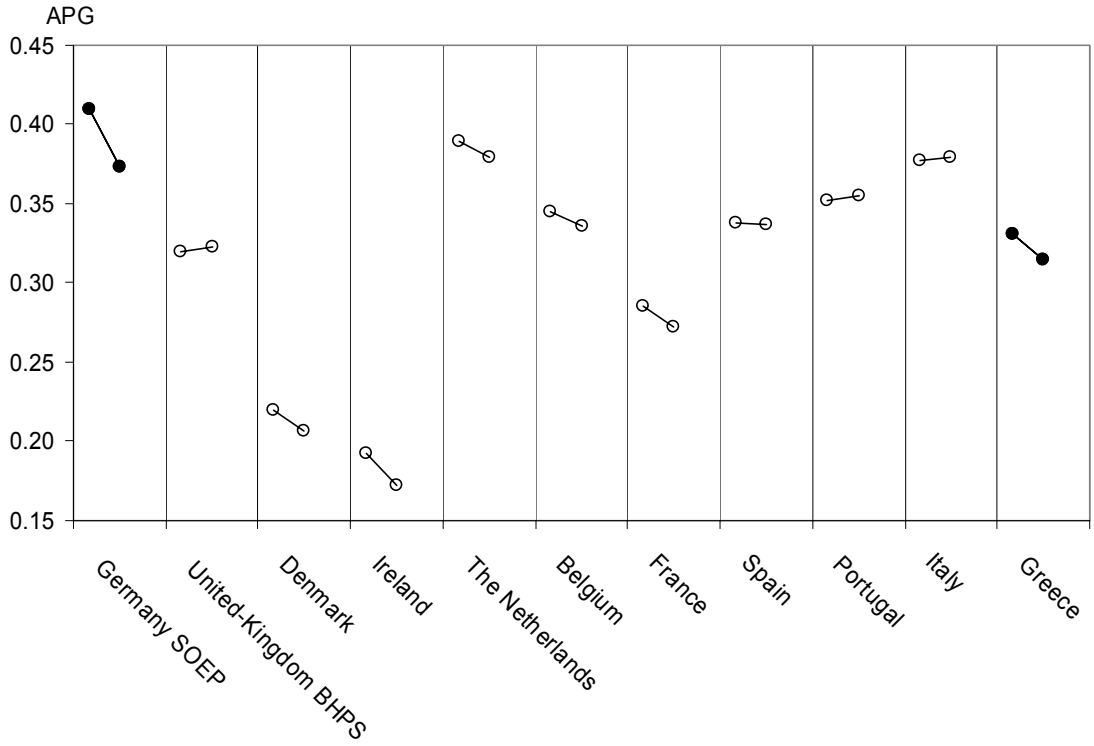


Figure 8 displays some remarkable findings. While the poverty rate in Germany and especially in The Netherlands is rather below average, we find that the persons below the poverty line in these countries face extremely poverty gaps in average of about 40%. Very small poverty gaps are found for Denmark and Ireland.

In seven out of the eleven countries the average poverty gap is found lower when using overall respondents instead all of the first wave participants. But only in Germany and Greece the underestimation is significant.

6. Attrition effects on the measurement of inequality through Gini-coefficients

In this section we apply the Gini-coefficient to compare inequality across countries and assess through splitting the initial sample according to the overall attrition behaviour of persons, whether the inequality measure is affected by attrition.

6.1. The Gini and the area of concentration

The well know Gini-coefficient is an aggregate measure of inequality, which compares the actual cumulated distribution of income with the fictional distribution that would result at absence of inequality. The Gini coefficient G we define making use of household size n_i as well as household weights w_i:

$$G = 1 - \sum_{i=1}^{m} \left(\frac{n_i w_i}{\sum_{i=1}^{m} n_i w_i} \right) \left(\frac{\sum_{k=1}^{i} y_k n_k w_k - \sum_{k=1}^{i-1} y_k n_k w_k}{\sum_{i=1}^{m} y_i n_i w_i} \right)$$

where y_i denotes the household OECD-equivalence income and $y_1 \le y_2 \le ... \le y_i \le ... \le y_N$ and $y_0 = 0$.

6.2. Attrition effects on the inequality measures

The cross country comparison of Gini coefficients reveals that inequality is lowest in Denmark (0.235) and highest in Portugal (0.385).

Table 5: The attrition effect on Gini coefficients

	G01	*G1*	Bias	
			abs.	rel., %
Germany SOEP	0.298	0.293	-0.005	-1.8
United-Kingdom BHPS	0.315	0.308	**-0.006***	**-2.1**
Denmark	0.235	0.226	**-0.009***	**-3.8**
Ireland	0.330	0.323	-0.006	-1.9
The Netherlands	0.275	0.267	**-0.008***	**-2.9**
Belgium	0.304	0.308	0.003	1.1
France	0.350	0.341	**-0.009***	**-2.5**
Spain	0.342	0.348	**0.006***	**1.7**
Portugal	0.385	0.370	**-0.015***	**-3.9**
Italy	0.339	0.341	0.002	0.7
Greece	0.368	0.375	**0.007***	**2.0**

* Significant, α=0.05

Fig. 9: Poverty rates and significance of the attrition bias

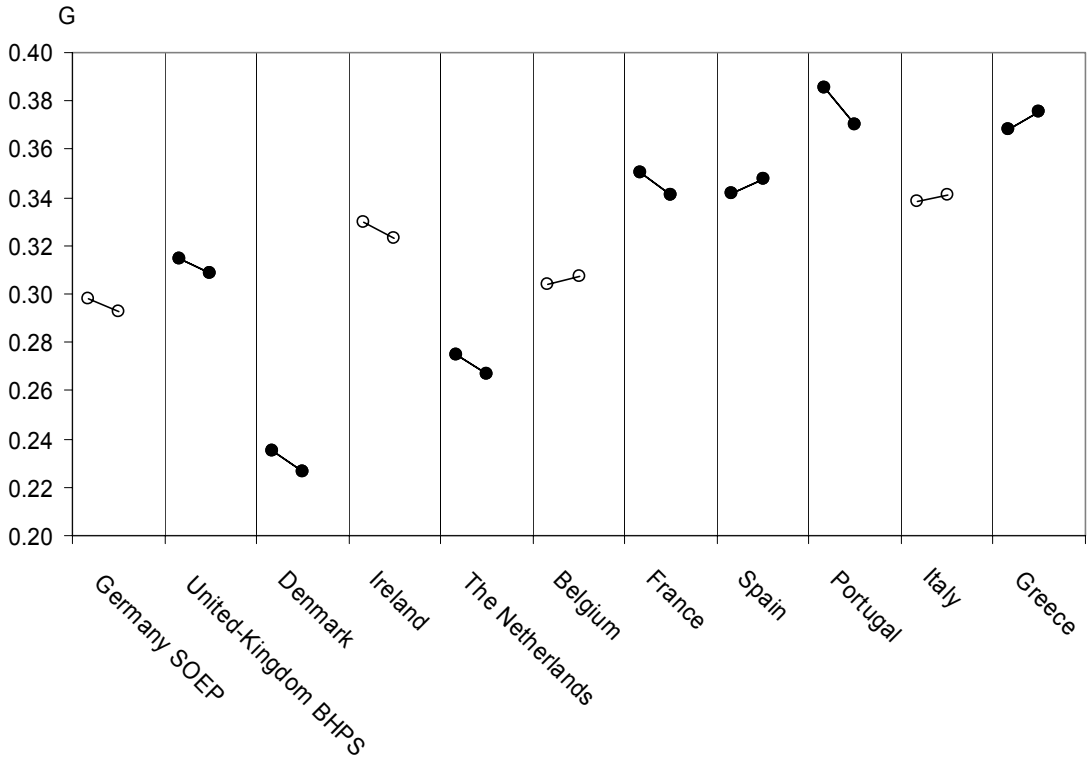


Figure 9 reveals a pattern very similar to the pattern of the poverty rate, where a clear north-south pattern is visible. Turning to the differences between wave 1 respondents and overall respondents, we find no clear tendency of over- or underestimation of inequality when using only the overall respondents. In five countries the attrition results in a significant under-estimation, while in Spain and Greece inequality is significantly overestimated.

7. The poverty intensity index

While we have so far calculated the poverty rate, probably the most common measure of poverty, and the Gini coefficient to measure inquality, we now turn to a more complex measure of the poverty intensity. The aim of this index is to combine several information which is not reflected in either of the two measures discussed so far. The intensity index was developed in subsequent papers by Sen (1976), Shorrocks (1995) and Thon (1979) and applied by Osberg and Xu (2000) to the Luxembourg Income Study. In the following we refer to that index by the acronym *SST*, as was suggested by Osberg und Xu.[12]

SST could be calculated based on individual population data, which in our case are not available, as

$$SST(P) = \frac{1}{N}\sum_{i=1}^{P}(2N - 2i + 1)\frac{z - y_i}{z}$$

[12] An asymptotic standard error, which could be calculated alternatively to the bootstrap method is derived by Bishop/Formby/Zheng (1997).

where

z poverty line, calculated as the 0.5 times the median of the OECD-household income

N number of individuals in the population

P Number of persons below the poverty line, and hence N-P is the number of the non-poor

y_i OECD-equivalence income

One especially attractive feature of the poverty intensity index is its potential decomposition into three meaningfull components, which are of interest in their own. The poverty rate *PR*, the average poverty gap among the poor *APG*, that is the mean of the distance to the poverty line and the Gini index *G* of inequality applied to the poverty gap ratio (x)

$$SST = PR \cdot APG \cdot (1 + G(x))$$

Taking together the parts definied previously, we have the estimate of the poverty intensity index of population based on the sample making use of the sample weights given as:

$$SST = \left(\frac{\sum_{i=1}^{v} n_i w_i}{\sum_{i=1}^{m} n_i w_i} \right) \left(\frac{\sum_{i=1}^{v} x_i n_i w_i}{\sum_{i=1}^{v} n_i w_i} \right) \left(1 - \sum_{i=1}^{m} \left(\frac{n_i w_i}{\sum_{i=1}^{m} n_i w_i} \right) \left(\frac{\sum_{k=1}^{i} x_k n_k w_k - \sum_{k=1}^{i-1} x_k n_k w_k}{\sum_{i=1}^{m} x_i n_i w_i} \right) \right) \right)$$

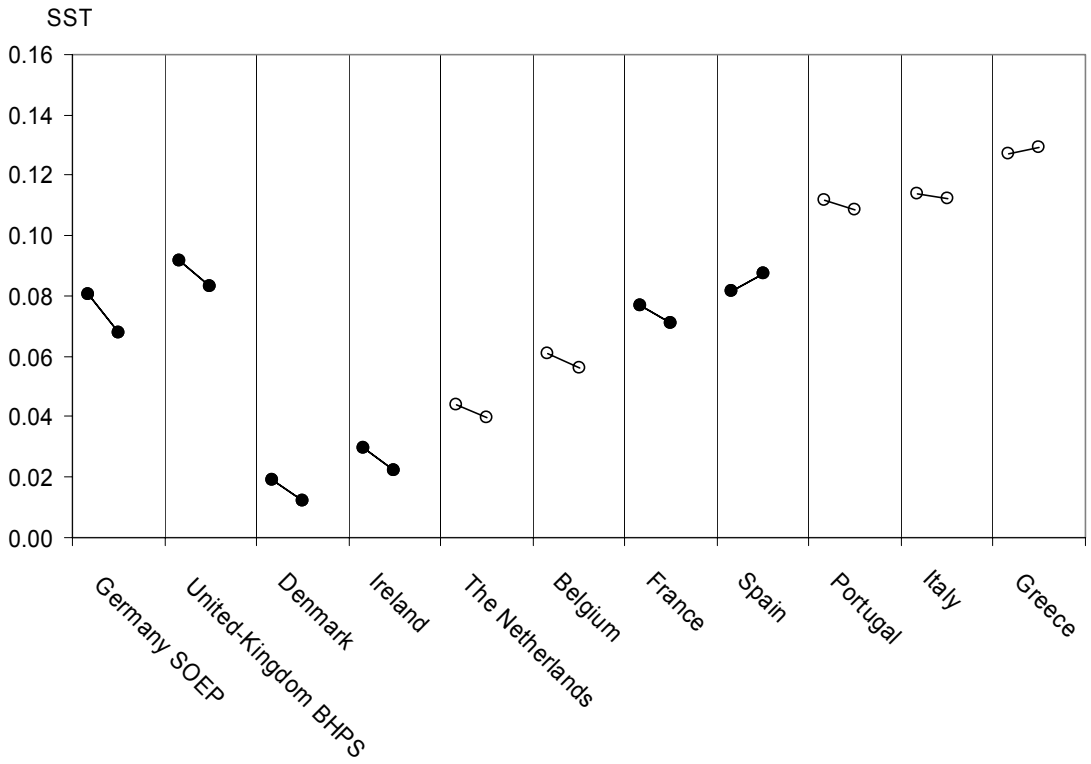
which contains the estimates of the poverty ratio, the average poverty ratio among the poor and the Gini coefficient of inequality among the poor.

Table 6: The attrition effect on the measured poverty intensity index (SST)

	SST01	*SST1*	Bias	
			abs.	rel., %
Germany SOEP	0.081	0.068	**-0.013***	**-16.0**
United-Kingdom BHPS	0.091	0.083	**-0.008***	**-9.1**
Denmark	0.019	0.012	**-0.007***	**-34.7**
Ireland	0.030	0.022	**-0.007***	**-24.5**
The Netherlands	0.044	0.040	-0.004	-9.8
Belgium	0.061	0.056	-0.005	-7.5
France	0.077	0.071	**-0.006***	**-7.6**
Spain	0.082	0.087	**0.006***	**6.9**
Portugal	0.112	0.109	-0.003	-3.0
Italy	0.114	0.113	-0.001	-1.2
Greece	0.127	0.129	0.002	1.6

* Significant, α=0.05

Fig. 10: Poverty intensity



The pattern of the poverty intensity across Europe resembles the pattern of the poverty rate.[13] Poverty intensity is strongly increasing from north to south, beeing highest in Greece. With France and Italy beeing the only exceptions, attrition tends to an underestimation of the intensity of poverty. In five out of eleven countries we find the underestimation of the poverty intensity to be statistically significant.

8. Income mobility between wave 1 and 2 and the effect of attrition

In this section we want to analyze the effect of attrition on different measures of income mobility between wave 1 and wave 2. Because the analysis of mobility has to be based on two waves at least, we split the data set consisting of persons who respondent in wave 1 and wave 2 into two subsamples, the smaller one consisting of respondents of all waves only.

8.1 The effect of attrition on transition matrizes

We calculate the transition matrix using income quintiles between wave 1 and wave 2. The transition rate tr_{ij} denotes the percent of persons that belonged to the *i*th quintil in wave 1 and to the *j*th quintile in wave 2.[14]

We have the property, that

---

13 The rang correlation is 0.95. See section 9.

14 For a discussion of the Markov assumptions see Shorrocks (1976).

$$\sum_{j=1}^{5} tr_{ij} = 1 \text{ for } i=1,\ldots,5$$

One measue of mobility is the sum of the main diagonal which consists of persons only who did not leave their income quintil between the two waves. The share of persons staying in their income quintil we denote by *ST*, which is calculated as:

$$ST = \frac{1}{5} \sum_{i=1}^{5} tr_{ii}$$

Table 7: The attrition effect on the share of stayer

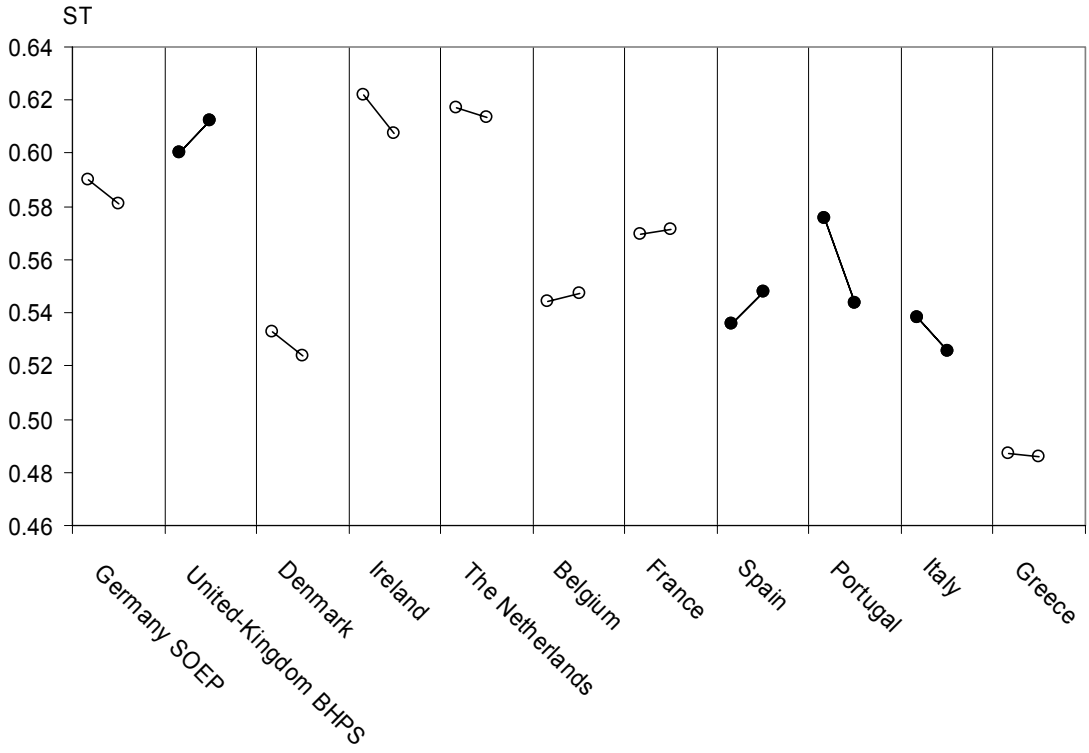
	ST01	*ST1*	Bias	
			abs.	rel., %
Germany SOEP	0.590	0.581	-0.009	-1.6
United-Kingdom BHPS	0.600	0.612	**0.012***	**2.0**
Denmark	0.533	0.524	-0.009	-1.7
Ireland	0.622	0.607	-0.015	-2.4
The Netherlands	0.617	0.613	-0.004	-0.6
Belgium	0.544	0.547	0.003	0.6
France	0.570	0.572	0.002	0.3
Spain	0.536	0.548	**0.012***	**2.2**
Portugal	0.576	0.544	**-0.032***	**-5.5**
Italy	0.538	0.526	**-0.013***	**-2.3**
Greece	0.487	0.486	-0.001	-0.3

* Significant, α=0.05

Since a high share of stayer indicates a low mobility, we find a rather strong evidence for low income mobility across Europe. Greece being the only exception, in all countries more than fifty percent of all persons stay in there income quintil between wave one and wave two.

United Kingdom, Ireland and The Netherlands are found to have the highest share of stayer. Income mobility tends to be rather high in Denmark and Greece. Turning to the effect of attrition, the picture is rather mixed. While there is no clear tendency of over- or underestimation of mobility due to attrition, for Portugal we find a considerable and statistically significant lower share of stayer when analyzing overall respondents.

Fig. 11: The share of stayer



The share of stayer considers neither the movement of persons within an income quantil nor the the extent of moves when persons leave their income quintil. In the following section we therefore analyze the change in individual ranks of persons in the income hierarchy.

8.2. The effect of attrition on rank-based measures of income mobility

In this section we want to assess income mobility through comparing the ranks of OECD-equivalence incomes in wave 1 ($r_{i,1}$) and wave 2 ($r_{i,2}$) . Since the maximum difference in the rank of one person is n-1, for example the poorest person becoming the richest, the division by n-1 leads to the relative rank difference with is bound to the intervall [0,1]:

$$d_i = \left| r_{i,2} - r_{i,1} \right|$$

$$rd_i = d_i /(n-1) \text{ with } 0 \le rd_i \le 1$$

The overall mobility within the society we assess by averaging the relative rank differences (*ARD*) using sampling weights w_i:

$$ARD = \frac{1}{\sum_{i=1}^{n} w_i} \sum_{i=1}^{n} rd_i w_i \text{ with } 0 \le ARD \le 1$$

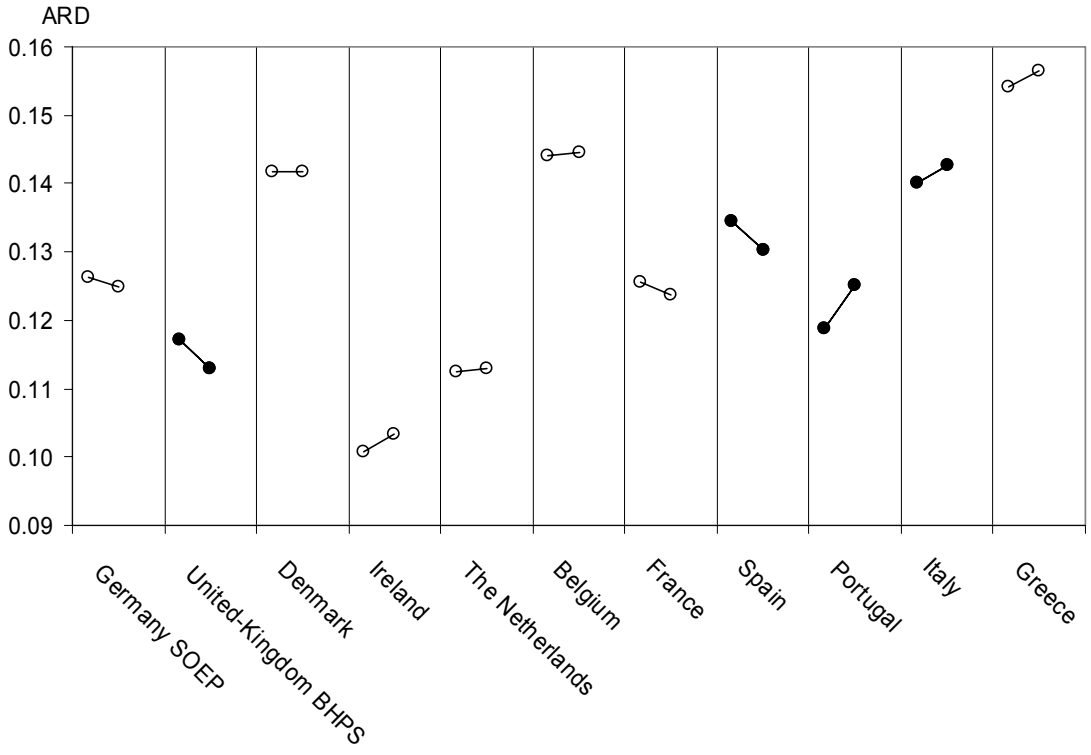
Table 8: The attrition effect on the average rank difference between wave 1 and wave 2

	ARD01	*ARD1*	Bias	
			abs.	rel., %
Germany SOEP	0.126	0.125	-0.002	-1.2
United-Kingdom BHPS	0.117	0.113	**-0.004***	**-3.6**
Denmark	0.142	0.142	0	0.0
Ireland	0.101	0.103	0.003	2.7
The Netherlands	0.112	0.113	0	0.4
Belgium	0.144	0.145	0.001	0.4
France	0.126	0.124	-0.002	-1.4
Spain	0.134	0.130	**-0.004***	**-3.0**
Portugal	0.119	0.125	**0.006***	**5.3**
Italy	0.140	0.143	**0.003***	**1.8**
Greece	0.154	0.156	0.002	1.5

* Significant, α=0.05

Figure 12 displays the average rank differences for the eleven countries we analyze. The average rank difference is lowest for Ireland (0.101) and highest in Greece (0.154). Hence, each person on average is left behind by or overtakes about 10% of all persons in Ireland between wave 1 and wave 2. As it was the finding for the share of stayer we find no clear pattern of over- or understimation of mobility when relying on the overall respondents instead of all wave 1 respondents.

Fig. 12: The average rank difference of incomes between wave 1 and wave 2



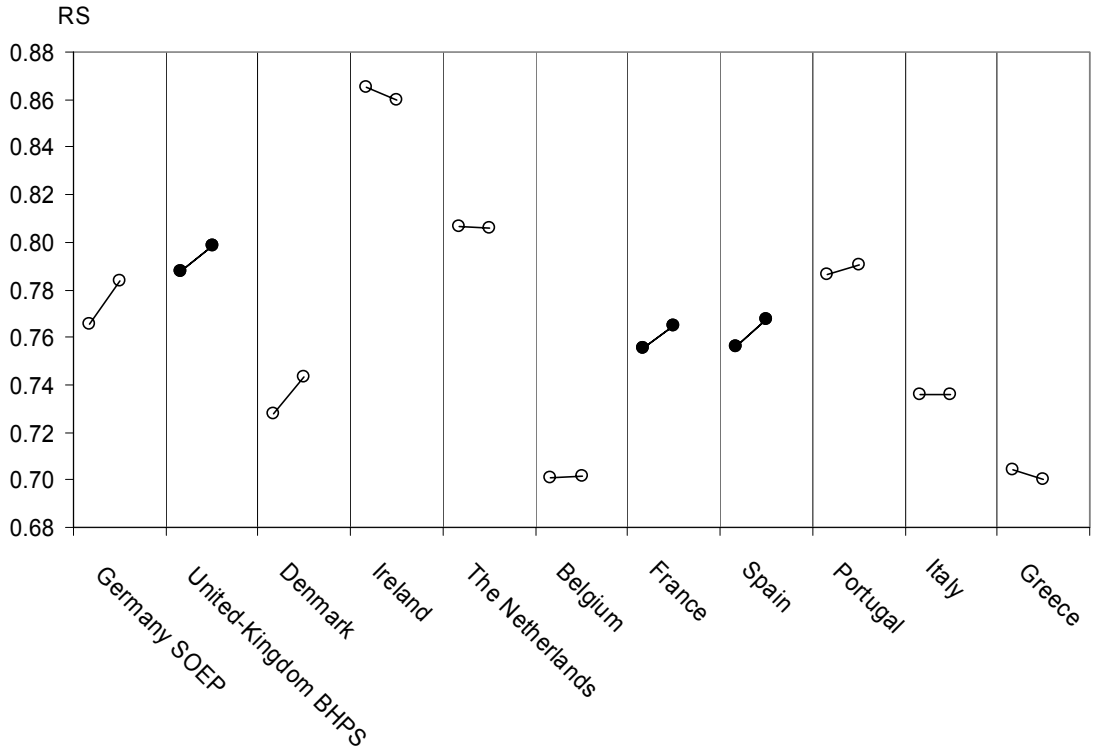
The average rank difference shown has the advantage of being highly illustrative, nevertheless the most often used measure to assess the similarity of two rank distributions is the correlation coefficient of Spearman. Table 9 contains the results for the Spearman rank correlation between wave 1 and wave 2 for all wave 2 (and wave 1) respondents as well as future overall respondents.

Table 9: The attrition effect on the rank correlation of incomes between wave 1 and wave 2

	RS01	*RS1*	Bias	
			abs.	rel., %
Germany SOEP	0.765	0.784	0.018	2.4
United-Kingdom BHPS	0.788	0.799	**0.011***	**1.3**
Denmark	0.728	0.744	0.016	2.2
Ireland	0.865	0.860	-0.005	-0.6
The Netherlands	0.807	0.806	-0.001	-0.1
Belgium	0.701	0.702	0.001	0.1
France	0.756	0.765	**0.009***	**1.3**
Spain	0.756	0.768	**0.012***	**1.5**
Portugal	0.786	0.790	0.004	0.5
Italy	0.736	0.736	0	0.0
Greece	0.704	0.700	-0.004	-0.6

* Significant, α=0.05

Fig. 13: The rank correlation of incomes between wave 1 and wave 2



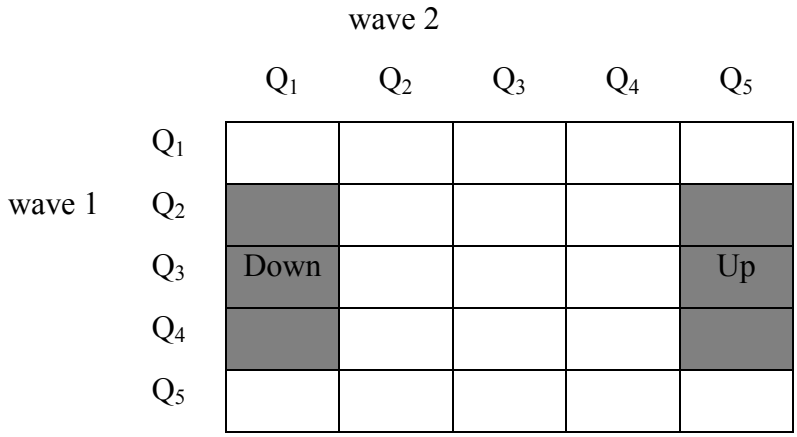
In five out of the eleven countries we find a strong increase of the rank correlation when using the overall respondents, hence a decreased extent of mobility. Three out of these five decreases turn out to be statistically significant at the five percent level according to the bootstrap results.

The Irish society is according to the results the most immobile across all eleven countries, while on the other hand ordering of incomes changes most between wave 1 and wave 2 in Belgium and Greece.

Next we propose a measure to assess the mobility of the middle class. The middle class we define as persons having an OECD equivalence income higher than the poorest 20 percent and lower than the richest 20 percent of all persons. Hence the middle class containes the centered 60% of the population. We define persons leaving the middle class into the highest quintil, hence become one of the 20 percent richest persons in the society as "Up", while we denote wave 1 middle class persons becoming poor, what in this context means belonging to the poorest 20 percent in wave 2 as "Down". The ratio (*UpDown*) of the share of persons leaving the middle class to the highest quintil to the share of persons leaving the middle class to the lowest quintil indicates whether the middle class faces a higher chance to improve compared the risk of impoverishment (*UpDown*>1). If the middle class faces a higher risk of impoverishment, the measure will take a value below 1.

The following figure illustrates the proposed measure:

Fig. 14: Measuring the risk and the chances of the "middle class"



The measure *UpDown* is then defined on the basis of the transition matrix containing the transition probabilities tr_{ij} , indicating the percent of persons belonging to the i^{th}-quintil in wave 1 and the j^{th}-quintil in wave 2 as:

$$UpDown = \frac{\sum_{i=2}^{4} tr_{i,5}}{\sum_{i=2}^{4} tr_{i,1}}$$

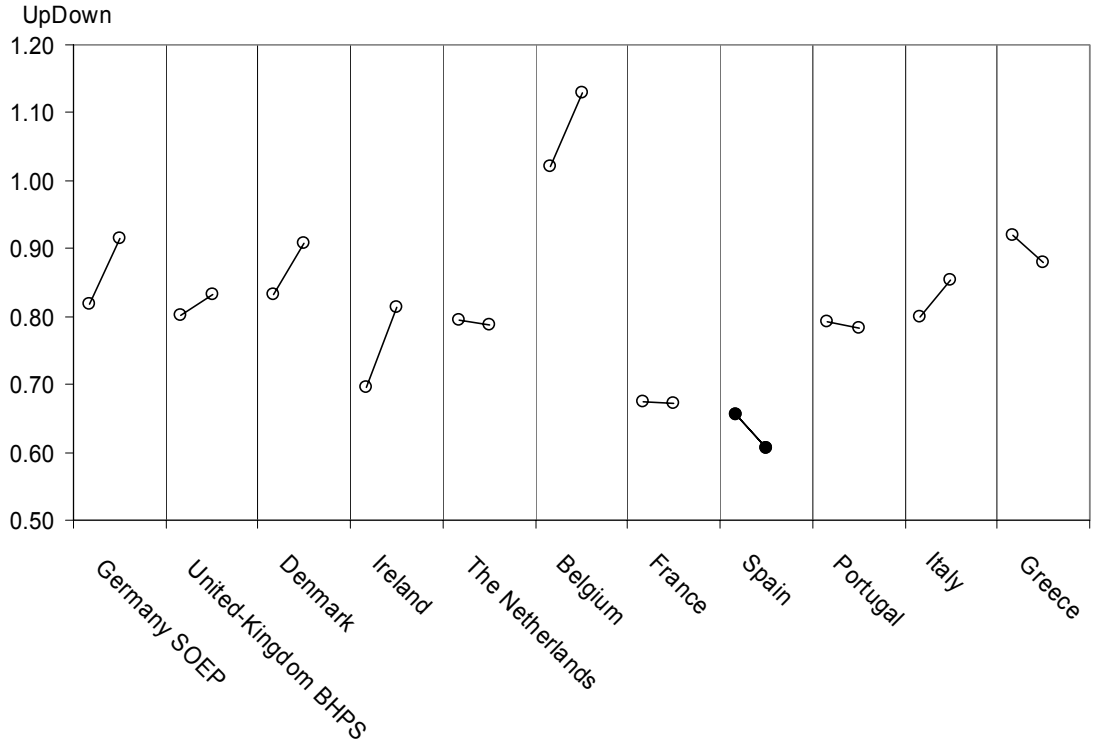
Table 10: The ratio of middle class climbers to sliders between wave 1 and wave 2

	UpDown01	*UpDown1*	Bias	
			abs.	rel., %
Germany SOEP	0.819	0.916	0.097	11.9
United-Kingdom BHPS	0.803	0.832	0.03	3.7
Denmark	0.833	0.908	0.075	9.0
Ireland	0.696	0.814	0.118	17.0
The Netherlands	0.795	0.787	-0.008	-1.0
Belgium	1.021	1.130	0.108	10.6
France	0.675	0.673	-0.002	-0.4
Spain	0.655	0.606	**-0.049***	**-7.5**
Portugal	0.793	0.783	-0.01	-1.2
Italy	0.799	0.854	0.055	6.9
Greece	0.920	0.880	-0.04	-4.3

* Significant, α=0.05

For most countries we find the risk of falling into the lowest quintil for the "middle class" to exceed the chance to reach the highest income quintil. The ratio is lowest for France and Spain, here we find the ratio beeing as low as 0.655. The only country for whom we find the chance to exceed the risk is Belgium. Despite some visible differences in the ratio for wave 1/wave 2 respondents and overall respondents, for Spain only the difference is statistically significant.

Fig. 15: The rank correlation of incomes between wave 1 and wave 2



9. Comparing the ranking of the poverty and mobility measures

In our analysis we made use of four different measures to assess the extent of poverty as well as of four meausres to assess the extent of income mobility. The following tabel 11 shows the rank correlation between the nation's ordering according to the different measures. Since the poverty rate, the average poverty gap and the Gini measure of inequality among the poor are components of the *SST*-index one should expect rather high positive correlations. Somewhat surprising, we find a strong rank corrlation of the index with the poverty rate and the Gini coefficient, but a rather low correlation with the average poverty gap of the poor. Interesting is also the almost absent correlation of the poverty rate and the average poverty gap ratio.

As should have been expected, the two rank based measures of income mobility correlate rather strong. Since a high correlation indicates low mobility as does a high percentage of stayers in their income quintiles a strong negative correlation is evident.

One result that is remarkable is the positive correlation between the ratio of middle class chances to risks and the income mobility.

Table 11: The rank correlation of the country ordering according to different measures

	PR	*GAP*	*G*	*SST*	*ST*	*ARD*	*RC*	*UpDown*
Poverty Rate (*PR*)	1.00	0.15	0.84	0.95	-0.35	0.27	-0.23	-0.02
Average Poverty Gap (*GAP*)	0.15	1.00	-0.10	0.35	0.10	0.06	0.02	0.15
Gini (*G*)	0.84	-0.10	1.00	0.70	-0.24	0.06	-0.07	-0.40
SST-Index	0.95	0.35	0.70	1.00	-0.34	0.29	-0.20	0.05
Stayer (*ST*)	-0.35	0.10	-0.24	-0.34	1.00	-0.91	0.86	-0.33
Average Rang Difference (*ARD*)	0.27	0.06	0.06	0.29	-0.91	1.00	-0.96	0.62
Rank Correlation (*RC*)	-0.23	0.02	-0.07	-0.20	0.86	-0.96	1.00	-0.58
Ratio Ups/Downs (*UpDown*)	-0.02	0.15	-0.40	0.05	-0.33	0.62	-0.58	1.00

Table 12 contains the rank correlation between the ordering of the 11 countries when using the full sample and the reduced sample containing overall respondents only.

Table 12: The rank correlation of the country ordering for wave 1 and overall respondents

Measure	Rank Correlation
Poverty Rate	0.99
Average Poverty Gap	0.95
Gini	0.98
SST-Index	0.98
Stayer	0.88
Average Rang Difference	0.96
Rank Correlation	0.98
Ratio Ups/Downs	0.93

We find that the rank correlation is extremely high for all static poverty measures and most of the mobility measures. The lowest correlation is found for the nation's ordering according to the share of income quintile-stayers. Hence, if the interest of the empirical analysis is mainly focused on the ordering of the countries under consideration, it can be stated, that the influence of attrition on the results is only of minor concern.

10. Conclusion

The aim of this empirical paper is to explore the effect of attrition on measures of poverty and income mobility. The data base underlying our research is the European Community Household Panel (ECHP) giving unique opportunity for cross country comparisons in the European Union on the level of individuals and households. Since the ECHP is plagued by panel attrition, which is documented in detail by Behr, Bellgardt and Rendtel (2002), we analyzed whether possible biases caused by panel attrition have to be a subject of greater concern when using the ECHP data base.

Overall we find that the effects of attrition are rather mild. Conclusions about the ordering of European countries are almost uneffected by attrition. Nevertheless for some countries significant biases were found for different measures. The conjecuture stated by Rendtel (1995) that attrition is linked to mobility cannat be confirmed by our results. The effects go in either direction for different countries. This conclusion is very much in accordance to our previous studies of attrition effects, where we find the attrition effects to be very heterogeneous across the different national subsamples of the ECHP.

Appendix

Comparison of findings based on register data and the ECHP-UDB

While our analysis is based on the ECHP-User Data Base, for Finland register data are available which facilitates a direct analysis of attrition effects.

Since Sisto (2003) analysed the effects of attrition on several measures of poverty, inequality and income mobility, we compare our findings based on the panel data base with the results obtained by Sisto on the basis on register based income data.

Since we do not observe units in the wave of attrition, we have to use the response behaviour of the following wave to split our sample into two subsamples. Our definition of attrition precludes ineligible persons in the analysis, hence, we do not inlcude children and elderly people. In this respect the findings of Sisto are based on a different methodology, since the register information of income items are observable in the wave of attrition as well.

We carried out the comparison for three different measures, the Gini-coefficient, the percentage of the poor and selected interquintile transition rates ("stayer").

Table A1 contains the Gini-coefficients for the years 1996-1998. We find a remarkable resemblance of the findings. The Gini-coeffiicients obtained from panel data are almost identical to the coefficients obtained based on register data. In neither case we find strong biases due to attrition.

A1: Gini-coefficients

Year	Sisto's findings, external control			Our findings, internal control		
	RESP	*OBS*	*bias*	*R01*	*R1*	*bias*
1996	0.228	0.228	0.000	0.232	0.227	-0.005
1997	0.232	0.231	-0.001	0.229	0.227	-0.002
1998	0.243	0.243	0.000	0.240	0.240	0.001

The results for the percentages of the poor differ to a larger extent (Table A2). In each year the share of persons having less than 50% of the median income based on register data exceeds the share obtained with the ECHP-UDB. This effect might be due to the exclusion of children in our analysis, which in general can be assumed to face a higher risk of being poor. In both analysis the biases found are small and not statistically significant.

A2: Percentages of poor

Year	Sisto's findings, external control			Our findings, internal control		
	RESP	*OBS*	*bias*	*R01*	*R1*	*bias*
1996	4.4	4.4	0.0	3.4	3.2	-0.2
1997	5.2	5.0	-0.2	3.3	3.1	-0.1
1998	5.7	5.3	-0.4	3.7	3.5	-0.2

Turning to the analysis of income mobility (Table A3), we find that in four out of the five quintiles the share of stayer based on panel data exceeds slightly the share based on register information. This is in accordance with the conjecture that persons less mobile have a higher

tendency to particicpate in surveys. This is also reflected in the majority of biases being positive (75%). Again, in our analysis the biases were not found to be significant.

A3: Selected interquintile transition rates ("stayer")

Transition 1 -> 1

Year	Sisto's findings, external control			Our findings, internal control		
	RESP	*OBS*	*bias*	*R01*	*R1*	*bias*
1997	68.2	69.0	0.8	70.1	69.8	-0.3
1998	63.2	66.4	3.2	62.3	62.9	0.6

Transition 2 -> 2

Year	Sisto's findings, external control			Our findings, internal control		
	RESP	*OBS*	*bias*	*R01*	*R1*	*bias*
1997	55.2	54.8	-0.4	52.8	52.9	0.1
1998	50.4	51.3	0.9	48.2	48.9	0.7

Transition 3 -> 3

Year	Sisto's findings, external control			Our findings, internal control		
	RESP	*OBS*	*bias*	*R01*	*R1*	*bias*
1997	50.4	49.6	-0.8	52.9	53.0	0.1
1998	45.8	46.3	0.5	45.2	46.5	1.4

Transition 4 -> 4

Year	Sisto's findings, external control			Our findings, internal control		
	RESP	*OBS*	*bias*	*R01*	*R1*	*bias*
1997	54.4	55.2	0.8	58.1	58.1	-0.1
1998	46.6	48.2	1.6	46.3	47.6	1.3

Transition 5 -> 5

Year	Sisto's findings, external control			Our findings, internal control		
	RESP	*OBS*	*bias*	*R01*	*R1*	*bias*
1997	73.2	74.6	1.4	79.0	78.1	-0.9
1998	67.4	68.2	0.8	69.3	70.2	0.8

This comparison of the two methods of estimation reveals that our method based on stronger assumptions does lead to similar conclusions as the direct approach with the register information.

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