Economic Inequality in Portugal: A Picture in the Beginnings of the 21st century

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Abstract

This article uses data from the 1994-2001 waves of the European Community Household Panel to study economic inequality in Portugal. It reports data on the Portuguese distributions of income, labor earnings, and capital income, and on related features of inequality, such as age, employment status, educational attainment, marital status and economic mobility. It also documents changes in inequality from 1994 to 2001, a period of economic expansion in Portugal. The statistical significance of the observed changes is assessed using non-parametric tests based on bootstrap techniques. The paper shows that income, earnings, and, very especially, capital income are very unequally distributed in Portugal. It also shows that over the sample years income and earnings inequality decreased, whilst capital income inequality tended to increase.

Keywords: Inequality; Income distribution; Labour earnings distribution; Capital income distribution.

JEL Classification: D31, J31.

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0. Introduction

Economic inequality is a major concern for governments. Citizens are aware of the distributional aspects of relevant economic variables and use this information to evaluate how the economy fares in terms of equality when confronted with other economies and with previous periods. According to several studies, mass policy preferences on inequality importantly influence the policy output of welfare states in developed democracies (Brooks and Manza, 2006a, 2006b). Moreover, inequality indicators are an important tool for policy makers, researchers and institutions in the task of evaluating the inequality-reducing scope attributed to certain policies and improving the design of inequality programs.

This paper examines economic inequality in Portugal. According to most indicators, Portugal is one of the countries with the highest inequality levels among developed countries (OCDE, 2005). In this paper, we provide an anatomy of the extent and dimensions of such inequality. We focus on Portuguese households and on three relevant economic variables: income, labour earnings and, a proxy of wealth, capital income. While most other papers focus on a single variable, this paper simultaneous analyzes three different distributions. This allows us to document similarities and differences between the poor and the rich in each distribution. Given the multidimensional nature of inequality, the paper also examines inequality facts along a variety of dimensions, including age, employment status, education, marital status and economic mobility.

The paper also describes changes in the distributions of income, earnings and capital income from 1994 to 2001. This is a well-delimited period in the Portuguese economy. In the run-up to European Monetary Union in the second half of the 1990s, Portugal experienced, among other macroeconomic achievements, significant growth rates, with average GDP and household disposable income growing at an average of 4% and 3.3%, respectively. This expansion trend ended by 2001, when the high debt level of private agents, the external and fiscal imbalances of the Portuguese economy and a weak international activity resulted into a severe deceleration (Portuguese Ministry of Finance, 2002, European Commission, 2004). It is intriguing to speculate what happened to economic inequality during the expansion years. This question is addressed here by tracking the distributions of income, labour earnings and capital income during the 1994-2001 period. In order to asses the statistical significance of observe changes, the paper includes a set of non-parametric tests based on bootstrap techniques.

The data is taken from the European Community Household Panel dataset (ECHP, henceforth). This dataset presents two appealing features. The first one is comparability. The ECHP is a standardized survey that was carried out in the European Union on a yearly basis from 1994 to 2001. It is based on a common questionnaire and the harmonisation of concepts across countries, including definitions of relevant variables and the validation, imputation and weighting of the data. These characteristics allow for straightforward comparisons between the surveyed countries, reducing the number of conceptual and measurement problems that typically arise when conducting cross-country comparisons with household income data[2]. Even though the aim of this paper is not to conduct an international analysis, the calculations reported here could be easily extended to any other country included in the ECHP. As a second advantage, the ECHP allows for the possibility of continuously monitoring the same group of families and individuals over the years. This feature allows us to examine the dynamics of economic mobility in Portugal.

Finally, the aim of the paper is not to provide explanations. Rather, it concentrates on establishing a large set of inequality facts. These facts are expected to be a useful guide for researchers in the field interested in modelling and testing theories of inequalities. The data, moreover, is reported in a format that should help in the task of establishing a consistent empirical benchmark for policy-oriented models, particularly for those concerned with the Portuguese economy. The study of the distributions of relevant economic variables is a key ingredient for models designed to evaluate the inequality and welfare implications of public policies. The accuracy and reliability of such models crucially depend on their capacity to reproduce stylized facts of the economy, such as the distribution of income and earnings, the households' income structure, and the socioeconomic characteristics of specific population groups. This paper attempts to highlight these facts in a coherent and summarized fashion.

The rest of the paper is organized as follows. Section 1 reviews the literature on economic inequality in Portugal. Section 2 briefly describes the dataset and the longitudinal structure of the data. Section 3 reports basic facts regarding the range, shape, concentration and skewness of the income, earnings and capital income distributions. Section 4 examines the socioeconomic characteristics of households located in different segments of these three distributions. In Sections 5, 6, 7 and 8 households are partitioned by, respectively, age, employment status, education and marital status groups, and then relevant statistics for the resulting categories are reported. Section 9 computes income mobility matrices for different

[2] See Gottschalk and Smeeding (2000) for a discussion of these problems.

population groups. Section 10 analyzes changes in inequality over the 1994-2001 period and assesses the statistical significance of the observed changes. Section 11 presents the concluding remarks. The paper includes two Appendices. Appendix A contains the definition of the income, labour earnings and capital income variables used in the paper. Appendix B briefly describes the bootstrap methods used in the paper.

1. Review of the literature

The study of economic inequality has a long tradition among economists[3]. Still, the available evidence for Portugal is scarce, probably due to data limitations. One of the first attempts to describe the extent of inequality in Portugal is due to Gouveia and Tavares (1995). These authors use data from the Survey of Family Budgets to describe the Portuguese income distribution. They also examine changes over the 1980-1990 period and find that over these years income inequality tended to decrease. In a work related to the present paper, Rodrigues (1999) uses data from the 1994 ECHP and the Household Budget Survey 1994/1995 to explore the connection between household income and several socioeconomic factors, such as the household's composition, region and the employment status of the household head. In a policy-oriented paper, Gouveia and Rodrigues (2002) evaluate the impact of the Portuguese Guaranteed Minimum Income Programme on the income distribution in Portugal. According to their results, this program reduces the Gini index by 0.5%.

Cardoso (1998), in turn, focuses in earnings inequality rather than income inequality. She reports that during the eighties and the first half of the nineties wage dispersion increased sharply in Portugal. The results in Machado and Mata (2001) and Hartog et al. (2001) suggest that a substantial part of this increase was motivated by higher dispersion in the returns to education. Martins and Pereira (2004) find that in Portugal wage levels and wage dispersion are highly increasing in education levels. This results in an earnings distribution that is more unequally distributed than in most European countries. Consistent with this view, Carneiro (2007) reports that most part of the earnings variation in the Portuguese labour market is due to educational disparities. Vieira et al. (2005) focus on wage differentials between Portuguese regions and find that differences in educational attainment as well as in the returns to schooling are an important determinant of the large inter-regional inequalities found in the data. Finally, Cardoso (2006) compares the degree of wage mobility in Portugal and the UK

[3] For a broad coverage of the subject, including inequality measures, cross-country evidence and international trends, see Silber (1999) and Atkinson and Bourguignon (2000). Kaplow (2005) contains an interesting discussion on the convenience of measuring inequality.

and finds that, despite different labour market settings, the patterns of mobility are very similar in the two countries.

An important lesson from the literature is that up to date studies on the wealth distribution are mostly lacking in Portugal. This is due to the lack of statistical data on financial and, particularly, non-financial wealth. Cardoso and Cunha (2005) attempt to estimate the amount of wealth owned by Portuguese households using temporal series of capital formation from 1980-2004. Even though the paper does not deal with distributional aspects, it contains rich information about the different sources of household wealth in Portugal.

2. The dataset

The European Community Household Panel (ECHP) is a standardized survey that is carried out in the European Union. Its period is yearly and its purpose is to obtain "comparable information across the member states on income, work and employment, poverty and social exclusion, housing, health, and many other diverse social indicators concerning the living conditions of households and persons" (Eurostat, 1996).

The ECHP defines a household as a group of people that share the same dwelling and have common living arrangements. The first year in which the Portuguese data was collected was 1994. The original Portuguese sample was made up of 4,881 households. The survey then follows the sample people, and it includes the children born to the initial sample women and the new households formed by members of the original ones. In this and in other aspects the ECHP resembles the University of Michigan's Panel Study of Income Dynamics (PSID). In 2001, the last wave of the ECHP, the Portuguese sample contained 4,614 households.

In panel data analysis the reduction of observations between waves raises the typical problem of the loss of representativity of the sample. Peracchi (2002) analyzes attrition rates in the first three waves of the ECHP as well as in other popular household surveys, including the German Socio-Economic Panel (GSOEP), the Luxembourg's Socio-Economic Panel (PSELL), the British Household Panel Survey (BHPS), and the Panel Study of Income Dynamics (PSID). He reports estimates that range between 9% and 38%. Luckily to us, the overall attrition rate in the Portuguese ECHP (i.e., the percentage decrease in the number of observations between waves 1994 and 2001) is as low as 6%, suggesting that the loss of representativity of the Portuguese sample due to attrition has been small. This feature will be particularly valuable in Sections 9 and 10, where we exploit the longitudinal structure of the survey.

3. Income, Earnings, and Capital Income Inequality

The dimensions of inequality that are most frequently studied in the literature are income, wages and wealth. Portugal, however, lacks an adequate data source reporting information on households' wealth. Given this limitation, this paper reports facts on income, labour earnings and, a proxy of wealth, capital income. These variables are measured on a yearly basis and constructed as described in Appendix A. The analysis that follows uses the 2001 wave of the ECHP to describe the main inequality facts regarding these distributions.

3.1 Ranges and shapes of the distributions

Fig. 1 illustrates the main differences in the range and shape of the distributions. Panel 4 contains the distribution of earnings when the households headed by a retiree are excluded from the sample. In these figures, the levels have been normalized by the mean, and the last intervals of the distributions represent the frequencies of households with more than 10 times the corresponding averages.

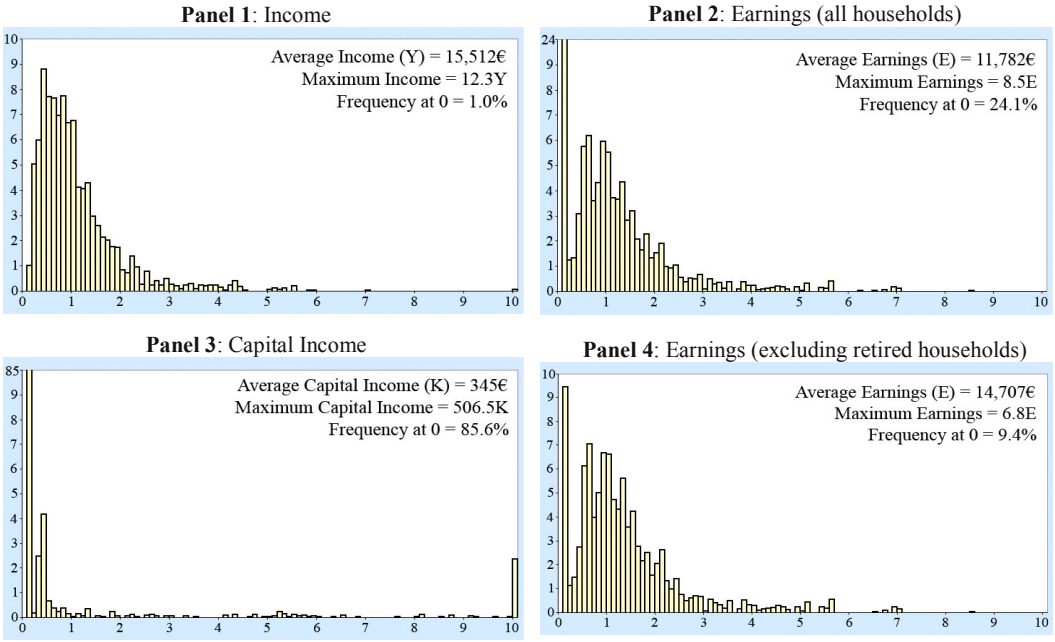


Fig. 1 The Portuguese distributions of income, earnings and capital income. *Panel 1:* Income, *Panel 2:* Earnings (all households), *Panel 3:* Capital income, *Panel 4:* Earnings (excluding retired households). Levels displayed in the horizontal axes have been normalized dividing by the mean. The last observations represent the frequencies of households with more than 10 times the corresponding averages. *Source*: Portuguese Survey of the 2001 European Community Household Panel

There are substantial differences in the ranges of the distributions. Income ranges from zero to 12.3 times average income, earnings range from zero to 8.5 times average earnings, and capital income ranges from zero to a startling 506.5 times average capital income. The sample averages of income, earnings and capital income are, respectively, 15,512 euros, 11,782 euros and 345 euros. The extremely large normalized range of the capital income distribution is due to the fact that 85.6% of the households report zero capital income and that maximum capital income is fairly large (174,463 euros). The top-coding used to draw these figures hides the large dispersion of capital income: while 94% of the sample households report less than average capital income (345 euros), 2.4% of the households report more than ten times that value. As regards the shape of the distributions, income, earnings and, particularly, capital income are significantly skewed to the right, with very short and fat lower tails and very thin and long upper tails.

3.2 Concentration

The concentration of a distribution is well described by its Lorenz curve. As Fig. 2 shows, capital income is by far the most unequally distributed of the three variables, since its Lorenz curve lies significantly below the Lorenz curves of both earnings and income in their entire domains. Earnings is more unequally distributed than income for a similar reason. The fact that income is more equally distributed than earnings is partly due to the equalizing effect of transfers, such as, for example, unemployment benefits and retirement pensions. The diagonal line represents a perfectly equal distribution.

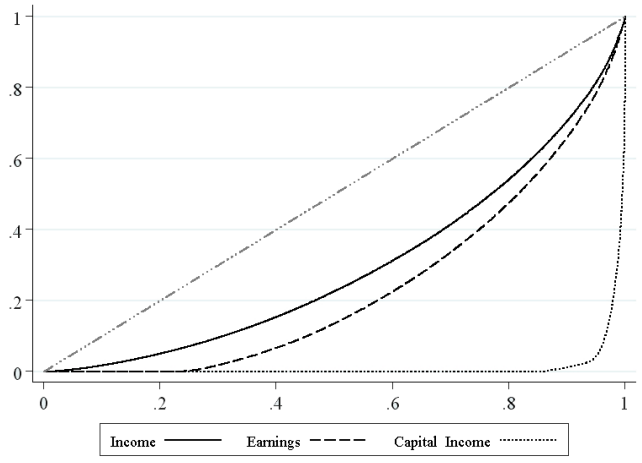


Fig. 2. The Lorenz curves of income, earnings, and capital income. *Source*: Portuguese Survey of the 2001 European Community Household Panel

To complement the picture, in Table 1 we report the Gini indexes, the coefficients of variation and the ratios of the average income, earnings and capital income earned by the top 10% and the bottom 90% of each distribution. These statistics unambiguously show that income is the most equally distributed of the three variables, and that capital income is the most unequally distributed of the three.

Table 1. The Concentration of the income, earnings, and capital income distributions

	Income	Earnings	Capital Income
Gini index	0.40	0.53	0.97
Coeficient of variation	0.85	1.06	11.98
Top 10%/Bottom 90%	3.76	4.64	706.52

Source: Portuguese Survey of the 2001 European Community Household Panel

3.3 Skewness

In Table 2, we report three measures of the skewness of the income, earnings, and capital income distributions. In symmetric distributions, the mean is located in the 50th percentile, so that the mean-to-median ratio is one. As the skewness to the right of a variable increases, the location of its mean moves to a higher percentile, and its mean-to-median ratio also increases. The first two rows of Table 2 report the percentiles in which the means are located and the mean-to-median ratios. According to these two statistics, capital income is by far the most skewed to the right of the three variables[4].

Table 2. The Skewness of the income, earnings and capital income distributions

	Income	Earnings	Capital Income
Location of Mean%	64.4	61.0	94.2
Mean/Median	1.26	1.23	∞
Skewness	3.00	2.07	35.2

Source: Portuguese Survey of the 2001 European Community Household Panel

The last row of Table 2 reports the skewness coefficient proposed by Fisher. This statistic is defined as $\gamma = \sum_I f_i (x_i - \bar{x})^3 / \sigma^3$, where f_i is the relative frequency of realization i, and $\bar{x}$ and σ are, respectively, the mean and the standard deviation of the distribution. This coefficient is zero for symmetric unimodal distributions, it is positive for unimodal distributions that are skewed to the right, and it increases as right-hand skewness of the distributions increases. This statistic confirms that all three distributions are significantly

[4] As the median capital income is zero (85.6 % of the sample households report zero capital income), the mean-to-median ratio of this variable rockets to infinity.

skewed to the right, that capital income is, by far, the most skewed, and that income is somewhat more skewed than earnings.

3.4 Correlation

Table 3 reports the correlation coefficients between income, earnings, capital income, and transfers. The data shows that all four variables are positively correlated, albeit to varying degrees. Earnings and income are moderately correlated with capital income (0.37 and 0.36 respectively). The large positive correlation between income and earnings (0.87) is not surprising since earnings account for the lion share of income (75.9% on average). The negative correlation between earnings and transfers (–0.22) can have various interpretations. First, it is further evidence of the large role played by unemployment benefits and particularly retirement pensions. If retirement pensions are excluded, this correlation drops to (-0.04). The remaining negative correlation could be evidence that transfers are indeed going to the most needy, or that the many of the transfer recipients choose not to work.

Table 3. The Correlation between income and its components

	Income	Earnings	Capital Income	Transfers
Income	1	0.87	0.36	0.19
Earnings	0.87	1	0.37	-0.22
Capital Income	0.36	0.37	1	0.02
Transfers	0.19	-0.22	0.02	1

Source: Portuguese Survey of the 2001 European Community Household Panel

4. The poor and the rich

In Tables 4, 5 and 6 we describe the main inequality facts of the income, earnings and capital income distributions along several dimensions. We distinguish between the poor and the rich in terms of income, earnings, and capital income. We organize these facts into two groups: those that pertain to the households in the bottom tails of the distributions, which we refer to generically as the poor, and those that pertain to the households in the top tails of the distributions, which we refer to generically as the rich. We have chosen this organization criterion because one of the hardest tasks faced by any theory of inequality is to account for both tails of the distributions simultaneously.

Note that in Table 5 the poorest group is the bottom 30% of the distribution because 24.1% of the sample households report zero earnings. Likewise, the poorest group in Table 6 is the

bottom 90%. We discuss the main inequality facts that arise from these partitions in the subsections below.

Table 4. Portuguese households ranked by income

	The Poor			Quintiles					The Rich			All
	1	1-5	5-10	1st	2nd	3rd	4th	5th	10-5	5-1	1	
Minimum and maximum income ($x10^3$ euros)												
Min income	0.00	1.54	2.83	0.00	6.00	10.08	14.43	21.93	29.53	39.36	65.49	0.00
Max income	1.52	2.82	4.16	6.00	10.07	14.42	21.92	90.83	39.29	65.23	190.83	190.83
Average income, earnings, capital income and transfers ($x10^3$ euros)												
Avg income	0.75	2.35	3.52	3.97	8.01	12.29	17.71	35.53	33.79	50.57	79.18	15.51
Avg earnings	0.33	0.21	0.38	0.95	4.88	9.58	14.28	29.17	27.74	42.07	60.82	11.78
Avg cap inc	0.02	0.03	0.03	0.06	0.05	0.11	0.17	1.32	0.48	2.33	8.49	0.35
Avg transfers	0.40	2.10	3.11	2.96	3.08	2.60	3.27	5.05	5.56	6.17	9.87	3.39
Shares of the sample totals (%)												
Income	0.05	0.60	1.12	5.09	10.32	15.86	22.68	45.88	10.88	12.45	6.20	100
Earnings	0.03	0.07	0.16	1.60	8.28	16.31	24.12	49.69	11.79	13.66	6.28	100
Cap inc	0.07	0.34	0.45	3.68	3.13	6.68	9.65	76.86	7.06	25.91	30.11	100
Transfers	0.11	2.49	4.54	17.39	18.20	15.36	19.18	29.86	8.21	6.97	3.54	100
Income sources (%)												
Labor	43.45	9.05	10.72	23.85	60.86	77.94	80.61	82.10	82.11	83.19	76.81	75.94
Capital	3.18	1.24	0.89	1.60	0.67	0.93	0.94	3.70	1.43	4.60	10.73	2.21
Transfers	53.38	89.71	88.39	74.54	38.47	21.13	18.45	14.20	16.45	12.21	12.46	21.85
Age (%)												
≤ 30	3.56	2.15	1.45	3.83	10.01	9.96	10.24	3.84	2.96	1.08	0.00	7.58
31-45	36.05	2.23	4.34	11.47	24.32	31.32	30.42	27.30	23.80	23.85	43.33	24.97
46-65	43.75	24.02	21.33	24.24	36.10	38.87	41.02	57.03	63.59	63.53	46.49	39.47
>65	16.64	71.60	72.89	60.46	29.57	19.85	18.32	11.83	9.65	11.54	10.18	27.98
Average age	51.06	70.66	70.68	65.14	53.84	50.30	49.72	51.78	53.23	52.73	49.41	54.15
Education (%)												
≤ Lower Secondary	99.65	97.77	99.38	98.37	93.42	90.30	79.19	51.30	49.37	15.54	15.48	82.49
Upper secondary	0.35	1.76	0.21	1.18	4.61	7.52	11.79	14.24	18.45	10.03	9.07	7.87
Tertiary	0.00	0.47	0.42	0.46	1.97	2.18	9.02	34.46	32.17	74.42	75.44	9.64
Employment Status (%)												
Worker	11.39	2.39	5.72	11.45	39.49	52.76	49.08	55.62	44.21	70.25	59.52	41.70
Self-employed	51.29	18.83	12.56	18.38	20.35	18.15	23.43	17.50	20.66	11.91	19.83	19.56
Retired	3.95	64.16	65.33	54.85	28.28	21.75	18.57	19.76	22.44	15.76	20.65	28.53
Non-worker	33.36	14.62	16.40	15.32	11.88	7.34	8.92	7.12	12.69	2.08	0.00	10.11
Marital Status (%)												
Married	52.26	23.98	35.96	46.44	65.92	78.76	85.27	82.35	87.53	80.53	88.46	71.77
Single man	9.35	12.40	10.51	11.97	10.46	4.14	2.15	5.95	6.22	7.44	0.00	6.93
Single woman	38.39	63.62	53.53	41.59	23.62	17.10	12.58	11.70	6.25	12.03	11.54	21.30
Household size												
Avg size	2.34	1.60	1.69	2.03	3.01	3.64	3.80	3.86	4.33	3.45	3.84	3.27

Source: Portuguese Survey of the 2001 European Community Household Panel

Table 5. Portuguese households ranked by earnings

	The Poor		Quintiles			The Rich			All
	0-30	30-40	3rd	4th	5th	10-5	5-1	1	
Minimum and maximum income ($x10^3$ euros)									
Min earnings	0.00	4.75	6.70	11.63	18.45	25.60	35.41	63.02	0.00
Max earnings	4.75	6.70	11.63	18.45	99.76	34.97	62.84	99.76	99.76
Average income, earnings, capital income and transfers ($x10^3$ euros)									
Avg income	6.79	8.63	12.10	17.53	33.43	31.40	45.58	72.54	15.51
Avg earnings	0.73	5.73	9.33	14.68	30.91	29.37	45.59	71.10	11.78
Avg cap inc	0.30	0.02	0.15	0.63	0.47	0.57	1.12	0.15	0.35
Avg transfers	5.76	2.88	2.62	2.22	2.05	1.46	1.87	1.29	3.39
Shares of the sample totals (%)									
Income	13.11	5.56	15.60	22.63	43.10	10.13	12.48	4.76	100
Earnings	1.84	4.87	15.84	24.96	52.48	12.47	15.43	6.15	100
Cap inc	26.55	0.63	0.25	1.08	0.79	8.31	13.03	0.45	100
Transfers	50.88	8.48	15.43	13.09	12.11	2.15	2.19	0.39	100
Income sources (%)									
Labor	10.69	66.43	77.15	83.75	92.46	93.54	93.85	98.02	75.94
Capital	4.48	0.25	1.24	3.61	1.40	1.82	2.31	0.21	2.21
Transfers	84.83	33.32	21.62	12.64	6.14	4.64	3.84	1.77	21.85
Age (%)									
≤ 30	1.38	8.74	13.26	12.63	5.54	4.92	0.96	0.00	7.58
31-45	7.23	27.09	31.79	33.99	34.65	35.12	26.72	51.79	24.97
46-65	24.66	43.98	39.91	43.81	54.61	53.55	67.49	46.32	39.47
>65	66.73	20.19	15.05	9.57	5.21	6.40	4.83	1.90	27.98
Average age	67.65	51.54	48.70	46.46	48.38	49.36	50.59	45.14	54.15
Education (%)									
≤ Lower Secondary	94.45	93.19	88.94	83.92	51.37	50.62	18.16	4.34	82.49
Upper secondary	3.35	5.30	6.98	10.28	14.41	20.70	9.98	14.85	7.87
Tertiary	2.21	1.51	4.08	5.79	34.22	28.68	71.87	80.81	9.64
Employment Status (%)									
Worker	7.57	40.98	54.47	58.77	63.33	57.12	79.12	85.04	41.70
Self-employed	13.45	25.66	20.21	22.78	21.77	25.22	13.30	12.52	19.56
Retired	64.22	21.61	16.98	10.03	9.09	11.39	7.33	2.45	28.53
Non-worker	14.76	11.75	8.33	8.42	5.81	6.27	0.25	0.00	10.11
Marital Status (%)									
Married	53.97	66.07	72.69	85.90	86.16	85.43	82.45	100.00	71.77
Single man	10.27	11.53	6.23	2.54	4.74	6.19	6.73	0.00	6.93
Single woman	35.76	22.39	21.09	11.56	9.09	8.38	10.82	0.00	21.30
Household size									
Avg size	2.13	3.64	3.50	3.91	3.92	4.03	3.64	4.05	3.27

Source: Portuguese Survey of the 2001 European Community Household Panel

Table 6. Portuguese households ranked by capital income

	The Poor	The Rich			All
	0-90	10-5	5-1	1	
Minimum and maximum income ($x10^3$ euros)					
Min capital inc	0.00	0.11	0.62	7.10	0.00
Max capital inc	113.05	0.61	6.82	17.46	17.46
Average income, earnings, capital income and transfers ($x10^3$ euros)					
Avg income	14.36	23.02	23.77	48.36	15.51
Avg earnings	11.21	18.61	13.86	21.72	11.78
Avg cap inc	0.00	0.20	2.60	22.11	0.35
Avg transfers	3.15	4.22	7.31	4.53	3.39
Shares of the sample totals (%)					
Income	83.31	7.27	6.29	3.14	100
Earnings	85.58	7.73	4.83	1.86	100
Cap inc	1.25	2.84	31.08	64.83	100
Transfers	83.72	6.09	8.84	1.35	100
Income sources (%)					
Labor	78.00	80.82	58.31	44.91	75.94
Capital	0.03	0.87	10.94	45.72	2.21
Transfers	21.96	18.32	30.75	9.37	21.85
Age (%)					
≤ 30	8.16	2.85	2.05	0.73	7.58
31-45	25.84	20.62	14.72	10.93	24.97
46-65	38.70	50.06	41.90	46.89	39.47
>65	27.30	26.48	41.33	41.45	27.98
Average age	53.64	56.69	60.00	63.34	54.15
Education (%)					
≤ Lower Secondary	84.45	62.31	67.45	67.32	82.49
Upper secondary	7.94	6.47	6.72	13.18	7.87
Tertiary	7.61	31.22	25.83	19.50	9.64
Employment Status (%)					
Worker	42.80	45.41	19.19	17.21	41.70
Self-employed	19.25	14.28	30.33	28.84	19.56
Retired	27.70	32.54	42.53	35.83	28.53
Non-worker	10.25	7.77	7.95	18.12	10.11
Marital Status (%)					
Married	71.08	76.55	78.52	82.13	71.77
Single man	7.05	5.81	7.38	0.59	6.93
Single woman	21.87	17.65	14.09	17.28	21.30
Household size					
Avg size	3.27	3.26	3.31	3.50	3.27

Source: Portuguese Survey of the 2001 European Community Household Panel

4.1 The income-poor

In the first four columns of Table 4 we report some of the economic characteristics of the bottom percentiles and the bottom quintile of the income distribution. We find that every household in the 2001 Portuguese survey of the ECHP reports a strictly positive income. This fact contrasts sharply with the 24.1% of the sample households who report zero earnings, and the 85.6% of the households who report zero capital income. If the households headed by retirees are excluded from the sample, the proportion of households reporting a positive income and zero earnings falls to 9.4%. Naturally, the income of these households is either capital income or transfers. These facts suggest that in Portugal a significant number of working-age households has some form of a safety net, either public or private, that allows them to live without working.

We find that the households in the bottom percentile of the income distribution (the income-poorest) are extremely poor, that they are mostly self-employed, middle-aged, have a low educational attainment, and tend to be single. Moreover, we find that the Portuguese income-poorest receive more than 50% of their income from transfers. We discuss each of these features in the paragraphs immediately below.

Specifically, the average income of the income-poorest was only 753 euros, which is 4.8% of the sample average household income. This number more than triplicates when we move to the bottom 1-5% of the distribution (2,346 euros), and it increases by more than five times when we move to the bottom quintile (3,966 euros). In Fig. 3 we report the average income, earnings and capital income of the income-poor. Not surprisingly, the income-poor tend to be among the earnings-poor and the capital income-poor as well. More specifically, the average earnings and capital income of the households in the first quantile of the income distribution are 946 and 63 euros, respectively, i.e., 0.8% and 18.4% of the respective sample averages. In turn, their average transfers are 2,957 euros, a value that represents 87.2% of the sample average. The results for the income-poorest are qualitatively similar.

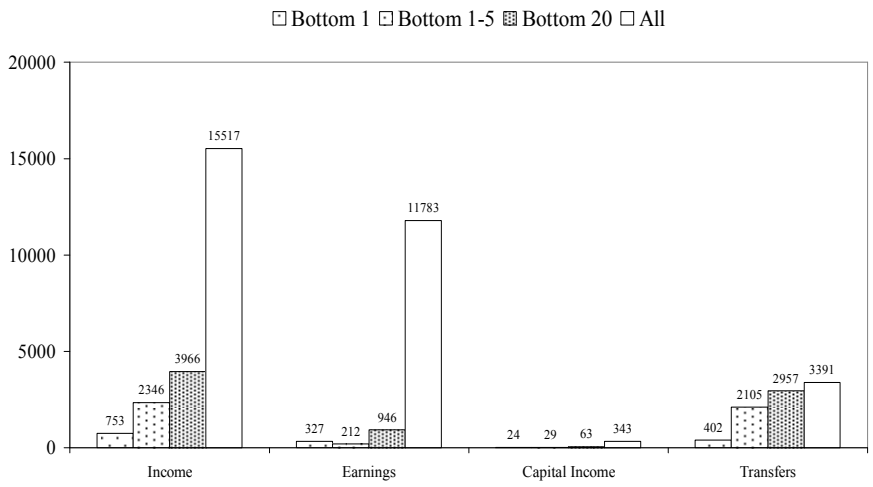


Fig. 3 Average income, earnings, capital income and transfers of the income poor (in euros).
Source: Portuguese Survey of the 2001 European Community Household Panel

Regarding the shares of income accounted for by transfers, we find that transfers account for 53.4% of the income of the households in the bottom percentile of the income distribution, while this number jumps to 89.7%, 88.4% and 74.5% when we move to the bottom 1-5%, the bottom 5-10%, and the bottom quintile, respectively. This could mean that the income-poorest benefit to a large extent from social assistance and other non-contributive public transfers.

Amongst the income-poorest, a striking 51.3% of the household heads report self-employment to be their primary occupation. This number is 30 percentage points above the sample average (19.6%), and it decreases rapidly as we move to the bottom 1-5% and the bottom 5-10% of the income distribution (18.8% and 12.6%, respectively).

In contrast, amongst the 2001 income-poorest less than 4% of the households were headed by retirees. Surprisingly, this number jumps to 54.9% when we consider the bottom quantile of the income distribution. This share is well above the sample average (28.5%), suggesting that the Portuguese pension system makes it possible for the elderly to escape from extreme income poverty but not from severe income deprivation.

Interestingly, an overhelming 99.7% of the heads of the income-poorest households belong to the lowest education category. This number, which is similar to the corresponding one for the bottom quintile of the distribution, steadily declines as we move to higher quantiles of the distribution.

Many income-poor households were headed by single females: 38.4% of those in the bottom percentile, and 41.6% of those in the bottom quintile. These numbers contrast sharply with the 21.3% figure obtained for the total sample.

4.2 The earnings-poor

As mentioned above, 24.1% of the Portuguese ECHP households report zero labour earnings. In spite of this fact, the average income of households in the bottom 30% of the earnings distribution is relatively large (6,790 euros), and it would put these households in the second quintile of the income distribution. This group of households receives the lion share of total transfers (50.9%), and transfers account for almost all (84.8%) of this group's income.

As could be expected, the heads of the earnings-poor households tend to be old (66.7% are over 65), uneducated (94.5% have not completed upper secondary education), and are retired (64.2%). Many of the households in this group are headed by single women (35.8%), and the average household size of this group (2.1 people) is rather small. This is partly because this group of households includes a significant number of widows who live alone. Specifically, 8.3% of the sample households were headed by widows who lived alone.

4.3 The capital income-poor

An overhelming majority of Portuguese households (85.6%) report zero capital income. This is partly because the ECHP does not impute any rent to owner-occupied houses, and over 89.0% of the sample households report that they own the houses in which they live. Given its large size, the group of households with zero capital income is very close to the sample averages in every dimension of inequality.

4.4 The income-rich

In the last columns of Table 4 we report some of the economic characteristics of the top quintile and the top percentiles of the income distribution. We find that the households in the top percentile of the income distribution (the income-richest) are income, earnings and, especially, capital income rich; that they receive 30% of the total sample capital income; that they are mostly workers (59.5%) and between 31 and 65 years old (89.8%); and that almost everyone of them has gone to college (75.4%) and is married (88.5%).

Specifically, we find that the households in the top income percentile earn on average 5.1 times the sample's average income, and that this number drops to 2.3 times when we consider the households in the top quintile of the income distribution. As Fig. 4 shows, the income-rich tend to be also among the earnings-rich as well as the capital income-rich. In particular, the average earnings and capital income of the households in the top quantile of the income distribution (29,173 and 1,315 euros, respectively) situates them in the top 10% of the earnings distribution and the top 5% of the capital income distribution. Similarly, the average earnings and capital income of the households in the top percentile of the income distribution (60,824 and 8,494 euros, respectively) situates them in the top 5 % of the earnings distribution and in the top 1% of the capital income distribution.

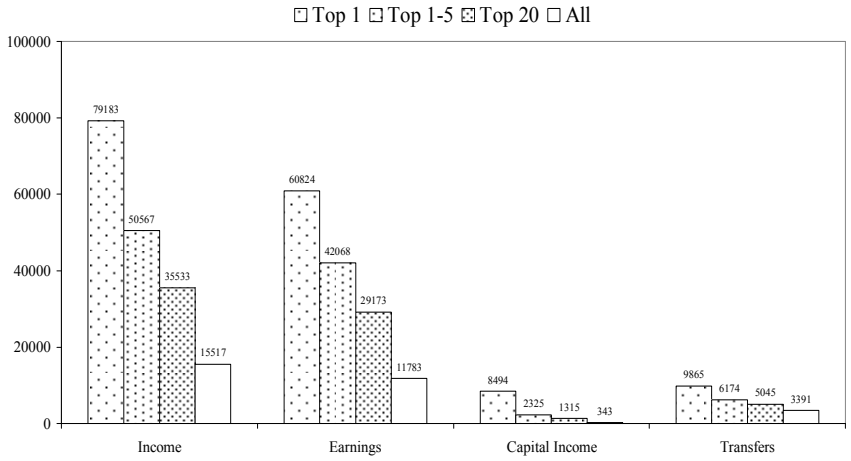


Fig. 4 Average income, earnings, capital income and transfers of the income rich (in euros).
Source: Portuguese Survey of the 2001 European Community Household Panel

We also find that capital income is extremely concentrated in the hands of the income-rich. Specifically, the households in the top percentile of the income distribution receive 30.1% of the total sample capital income, and this number increases to 76.9% when we consider the top quintile. These facts notwithstanding, the income-richest receive a share of total transfers (3.5%) that is significantly larger than the share received by the bottom percentile (0.1%).

Among the income-richest, there were no households heads aged below 30, and only 10.2% were over 65. A very large number household heads in the top 1% of the income distribution (75.4%) report that they have completed college. This number is similar for the top 1-5% of the income distribution and drops dramatically for the top 10-5% and the top quantile of the distribution (32.2% and 34.5%, respectively)

Most household heads in the top percentile of the income distribution (59.5%) are wage earners, no one is a non-worker, and a significant fraction is retired (20.7%).

Finally, the income-rich are mostly married, and they tend to live in large households. Specifically, 88.5% household heads in the top 1% of the income distribution are married, and the average size of these households is 3.8 people. These numbers are very similar to the corresponding numbers in the top quantile (82.4% and 3.9 people, respectively) and remarkably larger than the sample averages (71.8% and 3.3 people, respectively).

4.5 The earnings-rich

As Table 5 shows, the average earnings of the households in the top quintile (the earnings-rich) are almost 2.6 times the sample's average, and the average earnings of those in the top 1% of the earnings distribution (the earnings-richest) are 6.0 times the sample's average earnings.

We find that the shares of income accounted for by capital income and transfers are rather small for these two groups of households. Specifically, capital income accounts for 0.8% of the income of the earnings-rich, and transfers account for 12.1%. In the case of the earnings-richest these numbers are 0.5% and 0.4%, respectively.

Probably, the most remarkable feature is the connection between education and earnings. The proportion of household heads with tertiary education in the top quantile of the earnings distribution is 34.2% and this number increases up to 80.8% when we consider the top 1% of the distribution. These figures are, respectively, 3.5 and 8.4 times above the corresponding figure for the total sample. Overall, this pattern is consistent with Martins and Pereira' (2004) finding that in Portugal the returns to education are particularly large, probably due to the low proportion of high-educated workers.

Finally, we find that among the earnings-richest, all household heads are married and tend to live in large households. Specifically, the average household size in the top quintile of the earnings distribution is 3.9 people, while that in the bottom 30% of the earnings distribution is only 2.1 people. In fact, both the average share of married households and the average household size of the quintiles of the earnings partition are increasing in earnings.

4.6 The capital income-rich

The total capital income is in the hands of a small fraction of households (14.4%). The households who belong to the top 1% of the capital income distribution (the capital income-richest) earn 64.8% of the total sample capital income. When compared with the rest of the households in the sample, the average capital income of these households is also very large. Specifically, the capital income-richest earn 65 times the sample average. These two facts notwithstanding, capital income accounts for a relatively small share of total income for the households in the top tail of the capital income distribution (45.7% in the case of the top percentile).

Another outstanding feature of the capital income partition is that it is mostly the old who are capital income rich. Specifically, the share of households in the top capital income percentile who are older than 45 is 88.3%.

Finally, among the capital income-richest the proportion of married people (82.1%), university graduates (19.5%), and self-employed individuals (28.8%) is well above the sample averages (71.8%, 9.6% and 19.6%, respectively).

5. Age and inequality

Some of the income differences across households can be attributed to age. Ideally, we would like to follow a sample of households through their entire lifecycles to compare the lifetime inequality statistics with their yearly counterparts. Unfortunately, the ECHP is not long enough for this purpose, and this forces us to use cross-sectional data to quantify the age-related differences in inequality.

Specifically, we do the following: we partition the 2001 Portuguese ECHP sample into 11 cohorts according to the age of the household heads, we compute the relevant statistics for each cohort, and we compare them with the corresponding statistics for the entire sample. These statistics are the cohort average income, earnings, capital income, and transfers and their respective Gini indexes; the average shares of income earned by each cohort from various income sources; the number of people per household in each cohort and the relative cohort size. We report these statistics in Table 7.

Table 7. Portuguese households partitioned by age

Age	Averages (2001 euros)				Gini indexes			Sources (%)			Size[e]	H(%)[f]
	Y[a]	E[b]	K[c]	Z[d]	Y	E	K	E	K	Z		
≤ 25	11,526	10,771	80	675	0.27	0.26	0.97	93.45	0.69	5.86	2.6	2.4
26-30	13,784	13,303	43	439	0.25	0.26	0.98	96.51	0.31	3.18	2.6	5.2
31-35	13,675	12,159	83	1,432	0.28	0.34	0.98	88.92	0.61	10.47	3.5	5.9
36-40	19,047	17,411	196	1,44	0.36	0.40	0.95	91.41	1.03	7.56	3.9	10.8
41-45	17,309	16,107	49	1,153	0.33	0.37	0.96	93.06	0.28	6.66	4.1	8.2
46-50	18,726	17,021	167	1,538	0.34	0.37	0.95	90.89	0.89	8.22	3.8	10.7
51-55	20,935	18,198	408	2,329	0.37	0.42	0.95	86.93	1.95	11.12	4.0	9.5
56-60	19,971	14,148	1,043	4,78	0.42	0.49	0.98	70.84	5.22	23.93	3.7	10.0
61-65	14,641	9,344	445	4,852	0.38	0.52	0.96	63.82	3.04	33.14	3.2	9.1
66-70	12,235	5,699	246	6,29	0.40	0.66	0.95	46.58	20.01	51.41	2.6	9.3
>70	9,308	2,853	450	6,005	0.43	0.81	0.96	30.65	4.84	64.51	2.1	18.7
Total	15,512	11,782	345	3,391	0.40	0.53	0.97	75.94	2.21	21.85	3.3	100.0

Source: Portuguese Survey of the 2001 European Community Household Panel

a Income

b Earnings

c Capital Income

d Transfers

e Average number of persons per household

f Percentage number of households per age group

In Panel 1 of Fig. 5 we represent the average income, earnings, capital income, and transfers of each cohort. As this figure illustrates, earnings displays the typical hump-shape conventionally attributed to the life-cycle. Perhaps more interestingly, the life-cycle patterns of capital income and transfers differ significantly. More specifically, average cohort capital income is moderately increasing until age 60, and it drops again thereafter. On the other hand, average cohort transfers are clearly increasing with age. The sharpest increase occurs after age 55, when households' heads retire and start receiving their pension plans. Altogether, the life-cycle behavior of these variables implies that income also displays the familiar life-cycle hump-shape, with the highest level in the 51-55 cohort.

In Panel 2 of Fig. 5 we represent the Gini indexes of income, earnings, and capital income of the age cohorts. The Gini index of capital income is very similar across cohorts. As opposite, the Gini indexes of income and, particularly, earnings are highly increasing with age. For earnings, it is as low as 0.26 for the under-25 cohort, it increases to 0.40 in the 36-40 cohort and, after age 50, it increases sharply up to 0.66 in the 66-70 cohort and 0.81 in the above-70 cohort. This finding is not surprising since the number of households whose earnings are zero increases very significantly around the retirement age and thereafter.

Finally, in Panel 3 of Fig. 5 we represent the income sources of the age cohorts. Their shapes are also very characteristic. The share of income accounted for by earnings shows low variation until age 56 while, thereafter, it declines sharply, from 86.9% in the 51-55 cohort to 30.7% in the above-70 cohort. As opposite, the share of transfers is remarkably low until the

51-55 cohort, and it rises steadily thereafter, from 11.1% to 64.5% in the above-70 cohort. Finally, the share of income accounted for by capital income is less than 2% until age 56, it jumps to 20.0% in the 66-70 age group, and it drops to 4.8% in the above-70 cohort.

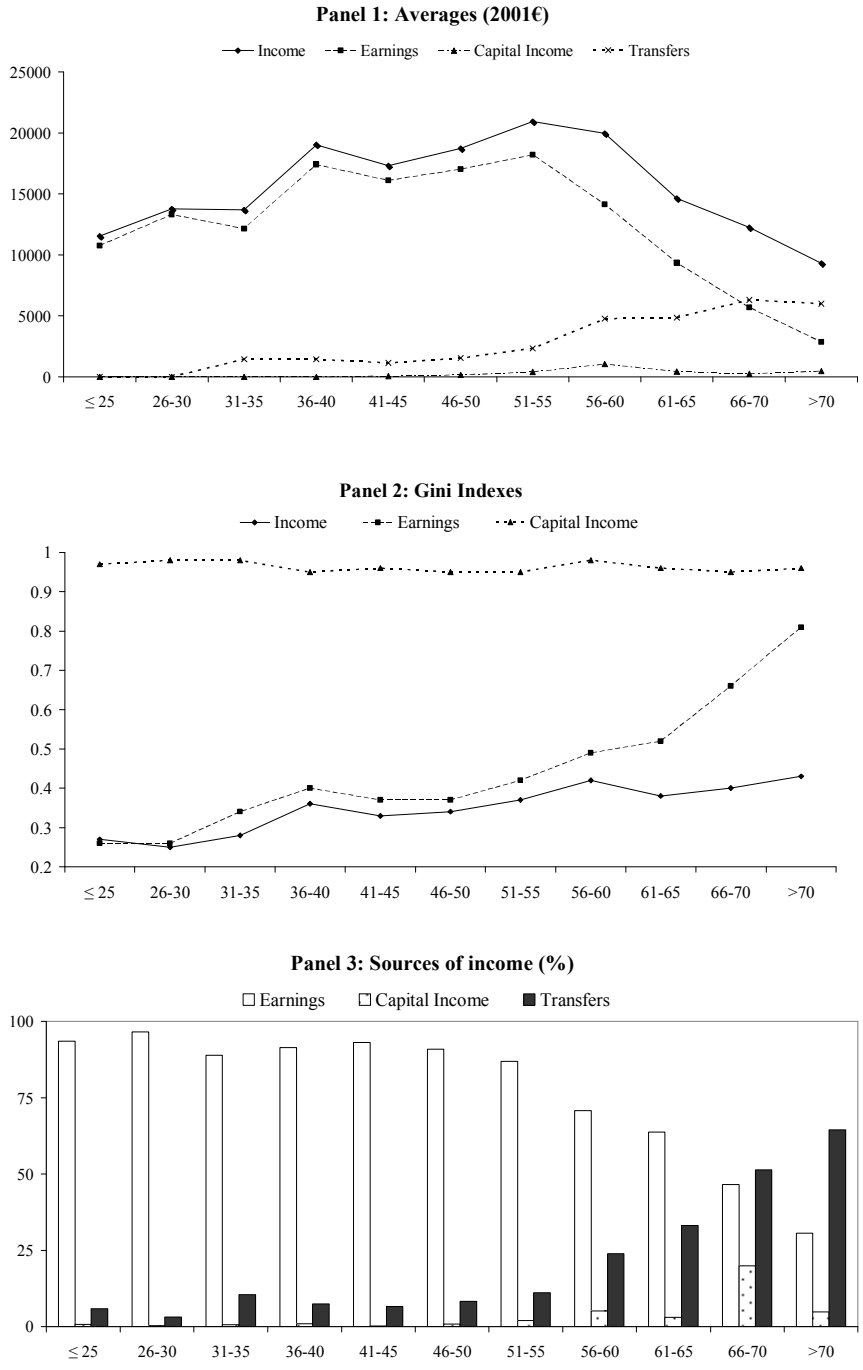


Fig. 5 Portuguese households partitioned by age. *Panel 1:* Averages (in euros), *Panel 2:* Gini indexes, *Panel 3:* Sources of income (%). *Source*: Portuguese Survey of the 2001 European Community Household Panel

6. Employment status and inequality

In this subsection the Portuguese ECHP sample is partitioned into workers, the self-employed, retirees and non-workers, according to the occupation declared by the heads of the households. In Table 8 we report the average income, earnings, capital income, and transfers; the Gini indexes for income, earnings, and capital income; the shares of income obtained from various sources; the number of people per household; and the relative size of each employment status group.

Table 8. Portuguese households partitioned by employment status

Employment status	Averages (2001 euros)				Gini indexes			Sources (%)			Size[e]	H(%)[f]
	Y[a]	E[b]	K[c]	Z[d]	Y	E	K	E	K	Z		
Worker	18,853	17,262	284	1,308	0.35	0.37	0.99	91.56	1.50	6.94	3.5	41.7
Self-employed	15,344	12,800	363	2,181	0.39	0.45	0.94	83.42	2.37	14.21	3.7	19.6
Retired	11,993	4,469	372	7,152	0.44	0.75	0.96	37.26	3.10	59.64	2.6	28.5
Non-worker	12,061	7,923	473	3,666	0.40	0.56	0.97	65.69	3.92	30.39	3.5	10.1
Total	15,512	11,782	345	3,391	0.40	0.53	0.97	75.94	2.21	21.85	3.3	100.0

Source: Portuguese Survey of the 2001 European Community Household Panel

a Income

b Earnings

c Capital Income

d Transfers

e Average number of persons per household

f Percentage number of households per employment status group

In Panel 1 of Fig. 6, we represent the average income, earnings, capital income, and transfers of the employment status groups. It turns out that the differences across these groups are substantial. Workers make up 41.7% of the sample and they are by far the largest group. Their income is 21.5% higher than the sample average, and their earnings are 46.5% higher, but their average capital income and transfers are significantly smaller than the sample average. The self-employed households make up 19.6% of the sample, their average income and their average capital income are close to the sample averages, but their average transfers are 35.7% lower than the sample average. The retirees account for 28.5% of the sample. Relative to workers and self-employed households, their average income is 57.2% and 27.9% lower, respectively, but their average transfers are 5.5 and 3.3 times larger. Finally, households headed by a non-worker account for 10.1% of the sample. Their average income is very close to the average income earned by the retirees, but their earnings and capital income are larger and their transfers smaller.

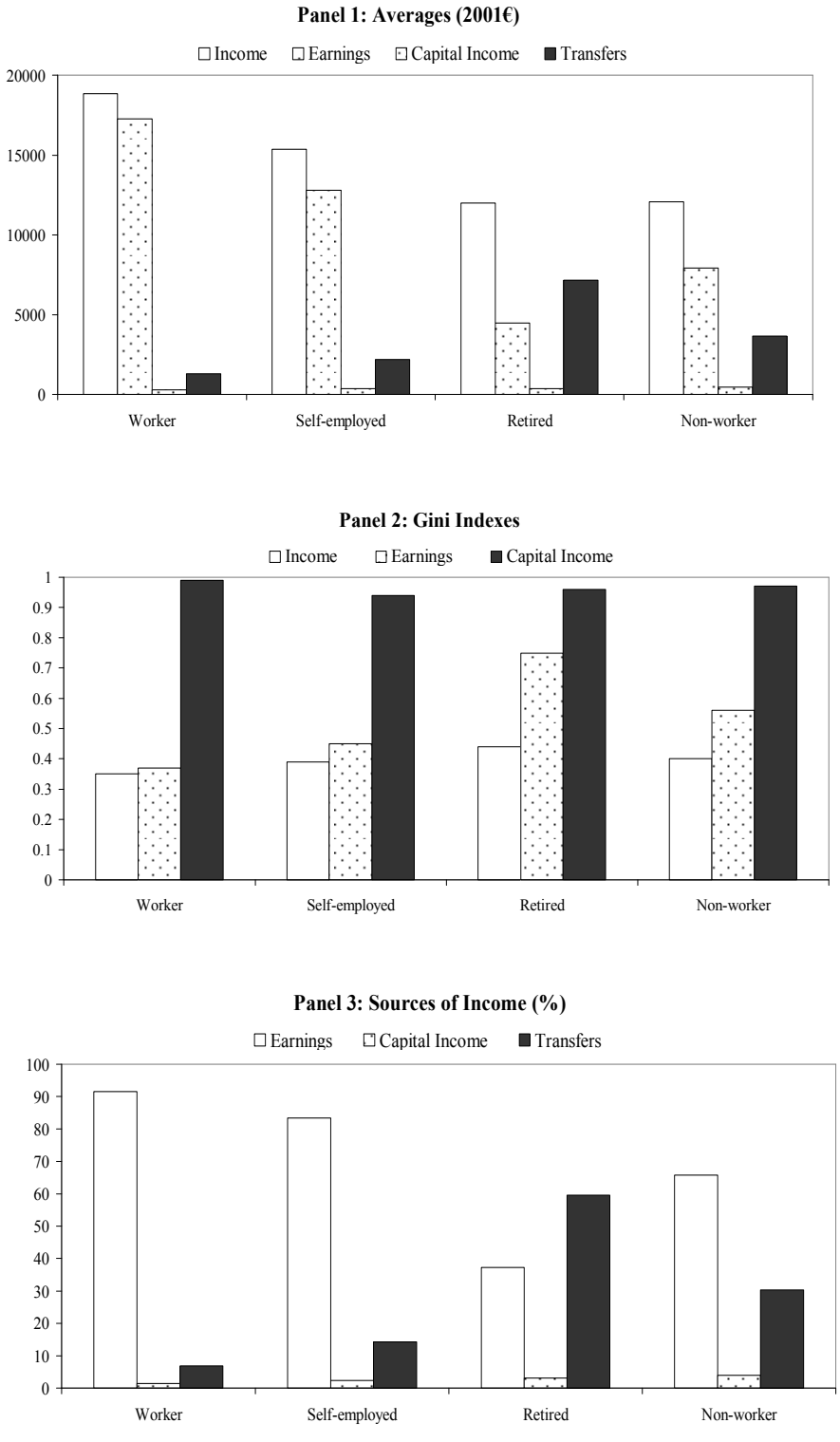


Fig. 6 Portuguese households partitioned by employment status. *Panel 1:* Averages (in euros), *Panel 2:* Gini indexes, *Panel 3:* Sources of income (%). *Source*: Portuguese Survey of the 2001 European Community Household Panel.

In Panel 2 of Fig. 6 we depict the Gini indexes of income, earnings, and capital income for the employment status groups. Income and earnings are most equally distributed amongst workers and most unequally distributed amongst the retired. The Gini indexes of capital income are very similar for all the employment status groups.

In Panel 3 of Fig. 6 we focus on the different income sources. The shares of income accounted for by labour, capital, and transfers differ significantly with the primary occupation of the household heads. The most noteworthy feature of this figure is the significant share of transfers obtained by the retirees (59.6%), and the fact that labor income, presumably earned by the spouse, accounts for 65.7% of the income of the households headed by a non-worker. It is also remarkable that this group is also the second largest recipient of transfers (30.4%). Finally, we find that the retired tend to belong to households that are smaller than average.

7. Education and inequality

To document the relationship between education and inequality, the 2001 Portuguese ECHP sample is partitioned into three education groups based on the level of education attained by the head of the household. The summary statistics are presented in Table 9.

Table 9. Portuguese households partitioned by education

Education	Averages (2001 euros)				Gini indexes			Sources (%)			Size[e]	H(%)[f]
	Y[a]	E[b]	K[c]	Z[d]	Y	E	K	E	K	Z		
≤ Lower secondary	12,578	9,046	297	3,235	0.36	0.51	0.98	71.92	2.36	25.72	3.3	82.5
Upper secondary	20,780	16,722	525	3,533	0.29	0.39	0.97	80.47	2.53	17.00	3.1	7.9
Tertiary	36,376	31,178	588	4,610	0.29	0.34	0.89	85.71	1.62	12.67	3.3	9.6
Total	15,512	11,782	345	3,391	0.40	0.53	0.97	75.94	2.21	21.85	3.3	100.0

Source: Portuguese Survey of the 2001 European Community Household Panel

a Income

b Earnings

c Capital Income

d Transfers

e Average number of persons per household

f Percentage number of households per education group

In Portugal, the fraction of household heads with less than upper secondary education is remarkably large (82.5%). The remaining groups, upper secondary and tertiary education, account for less than 10% of the sample each. The average income, earnings, capital income, and transfers of the education groups are depicted in Panel 1 of Fig. 7.

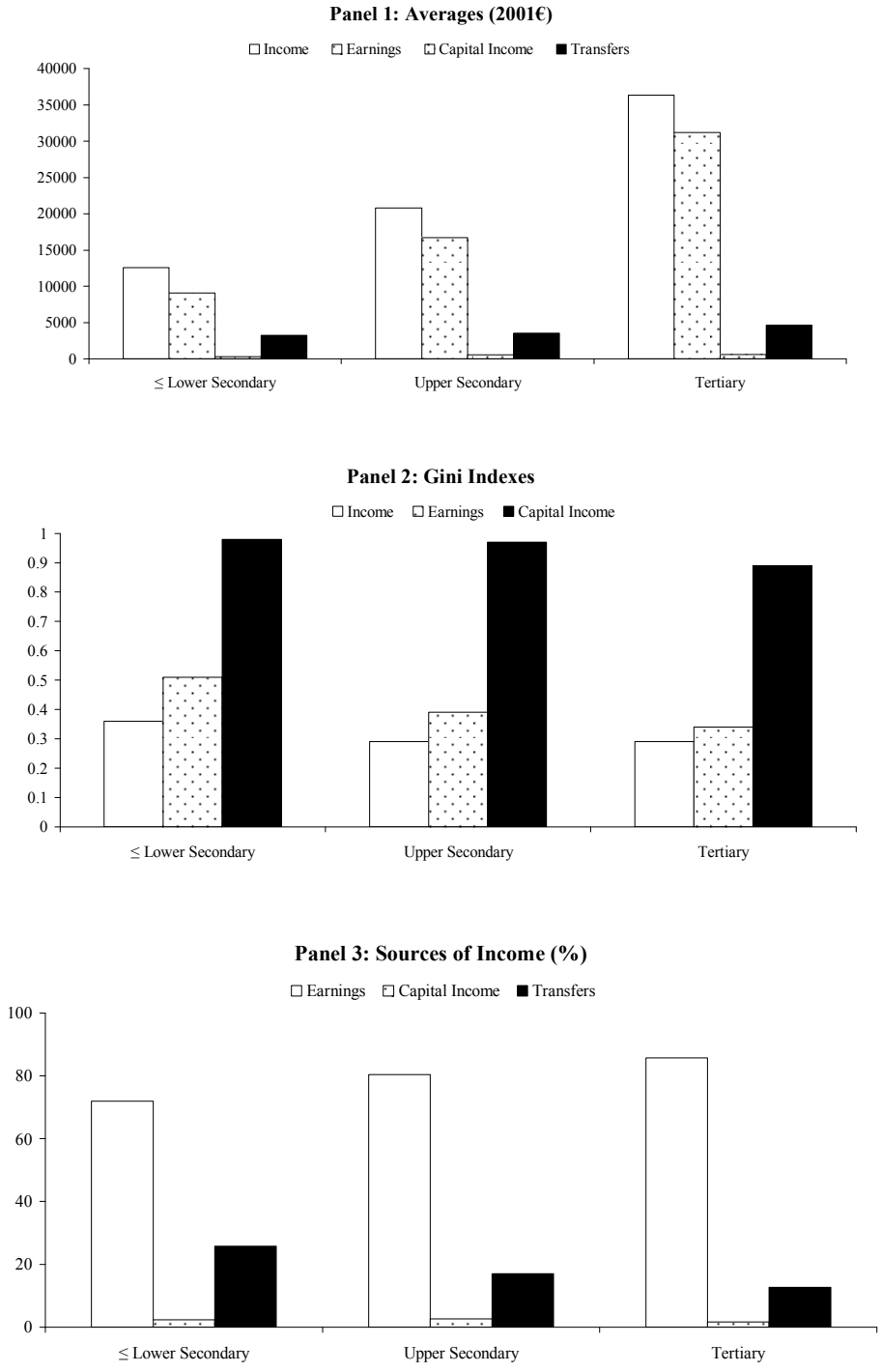


Fig. 7 Portuguese households partitioned by education. *Panel 1:* Averages (in euros), *Panel 2:* Gini indexes, *Panel 3:* Sources of income (%). *Source*: Portuguese Survey of the 2001 European Community Household Panel.

There is a close association between the education level and the economic performance of households. Specifically, the average income of tertiary and upper secondary education

households are, respectively, 2.9 and 1.7 larger than the income of the less than upper secondary group. Earnings, capital income and transfers display a similar pattern, suggesting that as far as economic performance is concerned, the high educated are the king of the hill in Portugal.

As Panel 2 of Fig. 7 illustrates, the concentrations of income and capital income are similar across education levels. This is not the case with earnings, which are most unequally distributed amongst the less educated households. In Panel 3 of Fig. 7, we represent the income sources of the education groups. The shares of income accounted for by earnings are clearly increasing in the education level, while the opposite occurs with transfers. The share of income accounted for capital income is very small in all education groups (about 2%), and it is slightly lower in the tertiary group. Finally, the differences in household size across the three education groups are relatively small.

8. Marital status and inequality

The household's composition can be closely related to its economic performance. To investigate this, we split the Portuguese households into different marital status groups. We differentiate between married, single with dependents and single without dependents. We also subdivide these last two groups according to the sex of the household heads. In Table 10 we report the averages for income, earnings, capital income, and transfers; the Gini indexes for income, earnings, and capital income; the shares of income obtained from various sources; the number of people per household; and the relative group sizes for these marital status groups. The main statistics are summarized in Fig. 8.

Table 10. Portuguese households partitioned by marital status

Marital status	Averages (2001 euros)				Gini indexes			Sources (%)			Size[e]	H(%)[f]
	Y[a]	E[b]	K[c]	Z[d]	Y	E	K	E	K	Z		
Married	17,270	13,616	389	3,265	0.37	0.47	0.97	78.84	2.25	18.90	3.6	71.8
Singles w/o	10,675	6,392	278	4,005	0.48	0.72	0.98	59.88	2.61	37.51	1.8	21.9
Singles w	12,444	9,697	52	2,695	0.27	0.32	0.95	77.92	0.42	21.66	4.6	6.3
Single man w/o	11,958	8,094	180	3,683	0.46	0.67	0.95	67.69	1.51	30.80	1.9	5.7
Single woman w/o	10,222	5,790	313	4,119	0.48	0.73	0.98	56.64	3.06	40.29	1.7	16.1
Single man w	11,168	9,579	6	1,583	0.18	0.26	0.96	85.77	0.05	14.17	4.3	1.2
Single woman w	12,744	9,724	63	2,957	0.26	0.30	0.93	76.30	0.50	23.20	4.7	5.1
Total	15,512	11,782	345	3,391	0.40	0.53	0.97	75.94	2.21	21.85	3.3	100.0

Source: Portuguese Survey of the 2001 European Community Household Panel
a Income
b Earnings
c Capital Income
d Transfers
e Average number of persons per household
f Percentage number of households per marital status group

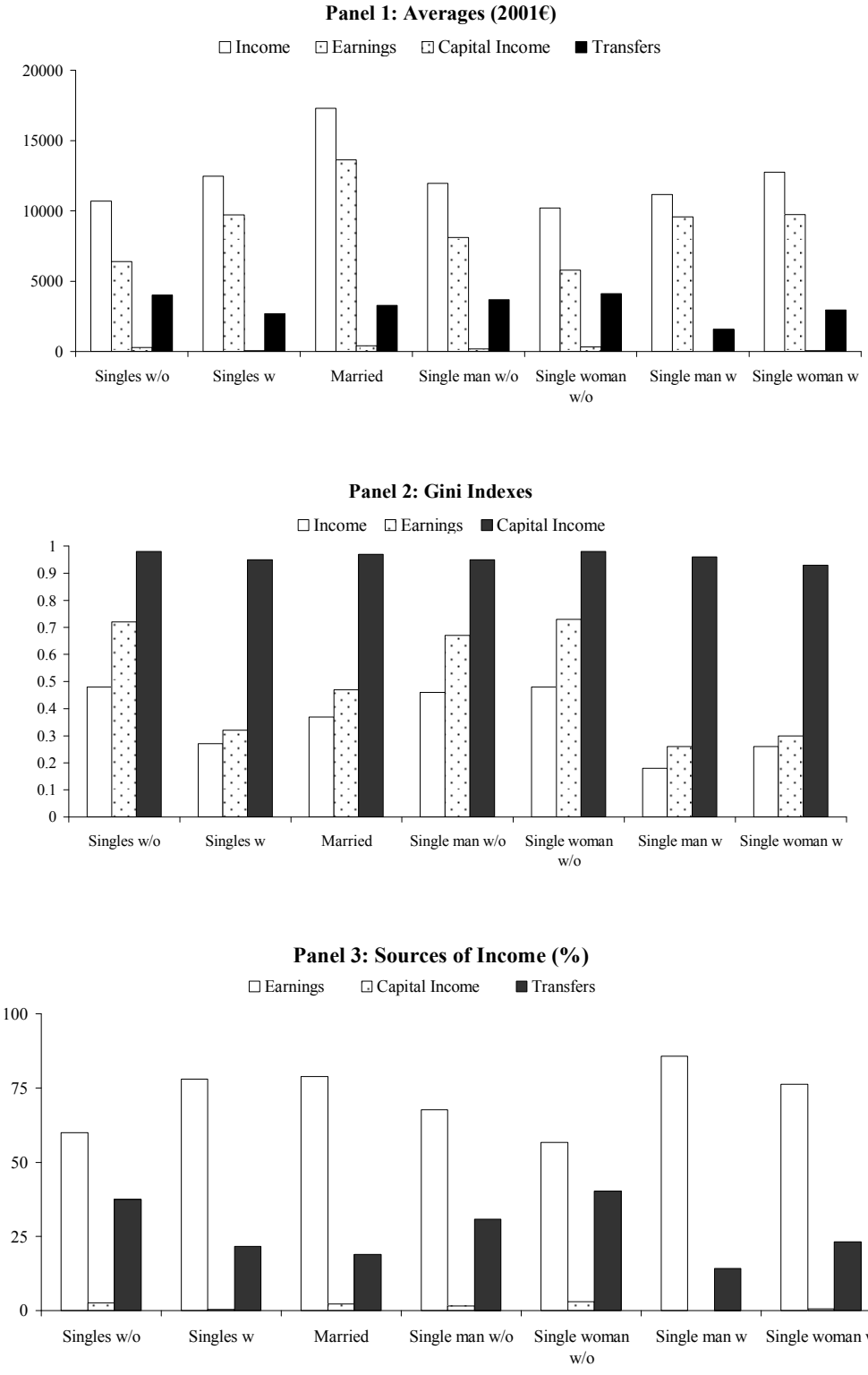


Fig. 8 Portuguese households partitioned by marital status. *Panel 1:* Averages (in euros), *Panel 2:* Gini indexes, *Panel 3:* Sources of income (%). *Source*: Portuguese Survey of the 2001 European Community Household Panel.

We find that married households are the largest group (71.8% of the sample), single households without dependents come next (21.9%), and the number of single households with dependents is very small (6.3%). As is apprarent, married households make substantially higher income, earnings, and capital income than their single counterparts. However, this is not the case if we divide the income of married households by two to account for double-income households. When we compare singles with and without dependents, we find that singles with dependents are somewhat better off than singles without dependents, due to higher earnings and despite the latter receive a larger amount of capital income and transfers. Specifically, the average income of singles with dependents is 16.6% larger than that of singles without dependents, their average earnings are 51.7% larger, and their average capital income and transfers are 81.3% and 67.3% smaller, respectively.

We also find that income and earnings are most unequally distributed amongst single households without dependents, particularly among those headed by women. In contrast, the concentrations of capital income are fairly similar across all the marital status groups.

As far as the sources of income are concerned, we find that the share of income accounted for by earnings is very similar for married households and for those headed by singles with dependents. On the other hand, this share is significantly smaller for households headed by singles without dependents. The opposite happens in the case of transfers. Specifically, we find that transfers account for 37.5% of the income of singles without dependents, and only for 21.7% of the income of singles with dependents. This is not surprising since retired widows are mostly singles without dependents, in general they do not work, and they receive a significant share of retirement pensions and other social security transfers.

Next, we consider the partition of single households according to the sex of the household heads. Not surprisingly, the households headed by single females outnumber those headed by single males (21.2% against 6.9%). The average earnings of single females without dependents are 28.5% lower than the average earnings of single males, but their average capital income and transfers are 73.9% and 11.8% larger, respectively. Altogether, single females without dependents end up earning 17.0% less income than their male counterparts. This is not the case of single households with dependents. In this group, the average income earned by women is 14.1% higher than the average income earned by men. This is mostly due to the fact that women with dependents receive an amount of transfers that is 86.8% higher than the amount of transfers obtained by their male counterparts.

Furthermore, the data shows that income, earnings and capital income are more unequally distributed amongst households without dependents, and that differences between men and women are small for both the group with dependents and the group without dependents.

Finally, as Fig. 8 illustrates, households headed by single females, both with and without dependents, earn smaller shares of their income from earnings and larger shares from transfers than the corresponding groups headed by single males.

9. Income mobility

People move up and down the economic scale; they do not stay in the same income, earnings, and capital income groups forever. Aging is perhaps the main cause for this type of economic mobility, but it is certainly not the only one. Mobility is also affected by the results of business projects and other ventures that can bring about significant changes in earnings to lucky or unlucky entrepreneurs. There can also be some other radical expressions of good luck (such as gambling), or bad luck (such as accidents). Furthermore, other changes in economic groups are a consequence of the conscious effort of households to smooth their consumption over time. Whatever its cause, economic mobility makes inequality an essentially dynamic phenomenon.

The ECHP allows for the possibility of continuously monitoring the same group of families and individuals over the years. In this section, we take advantage of this feature to compute the 1994-2001 income mobility matrix of the Portuguese households[5]. Table 11 contains the results. For example, the first entry in the mobility matrix reports that 72.0% of the households in the bottom income quintile in 1994 were also in the bottom income quintile in 2001. The table also shows that 2.1% of the households that were in the first quantile in 1994 were in the top quantile in 2001. Reversely, 5.0% of the households that were in the highest quantile in 1994 fell to the lowest quantile in 2001[6].

[5] The mobility matrices of the earnings and capital income variables are available upon request.
[6] In the 1994 wave income is given in the Portuguese national currency, the *escudo*. We have transformed this variable into euros using the entry exchange rate 200.482 escudos = 1 euro.

Table 11. Income Mobility of Portuguese households (1994 - 2001)

From 1994	To 2001				
	0-20	20-40	40-60	60-80	80-100
0-20	72.0	16.0	6.4	3.5	2.1
20-40	34.2	33.2	17.1	13.2	2.4
40-60	12.0	24.0	37.7	19.3	7.1
60-80	6.4	15.2	22.2	33.8	22.4
80-100	5.0	5.4	8.5	21.0	60.0

Source: 1994 and 2001 Portuguese Surveys of the European Community Household Panel

For some purposes, the mobility statistics reported in Table 11 might still contain too much information, and it might be useful to have a simpler, one-dimensional summary statistic for each variable. One such statistic is a simple arithmetic transformation of the second-highest eigenvalue of the mobility matrix[7]. The closer this eigenvalue is to 1, the more persistent is the variable under study. Consequently, the closer one minus the second-highest eigenvalue is to 1, the more mobile is the variable under study. We report this statistic in the first column of Table 12. In the remaining columns, we report the fractions of the households of the quintiles of the income distribution that have moved to a different quintile during the seven years lapsed between 1994 and 2001. We call these fractions the mobility statistics[8]. To evaluate the roles played by age and employment status in shaping economic mobility, in the second row of that same table we report the mobility statistics for the sample households whose head had not retired in 2001, and in the third row those for the sample households whose head was between 25 and 45 years old in 1994.

Table 12. Mobility statistics of Portuguese households (1994 - 2001)

	f[a]	1st Q	2nd Q	3rd Q	4th Q	5th Q
All[b]	0.31	28.0	66.8	62.3	66.2	40.0
Non-retired[c]	0.36	39.1	69.1	66.7	67.2	36.9
Age 25-45[d]	0.35	47.7	54.7	65.9	66.9	37.8

Source: 1994 and 2001 Portuguese Surveys of the European Community Household Panel
a This column reports one minus the second highest eigenvalue of the corresponding mobility matrices
b The last five columns of this table report the fraction of the households of each quintile that moved to a different quintile from 1994 to 2001
c This row reports the mobility statistics of earnings for households whose head had not retired in 2001
d This row reports the mobility statistic of earnings for households whose heads were between 25 and 45 years old in 1994

To facilitate the analysis, in Fig. 9 we represent the mobility statistics by income quintiles. In all three cases, the profiles are clearly hump-shaped. In general, the bottom and the top quintiles should be the least mobile, since the households in those quintiles can only move either up or down the economic scale, while the households in the middle quintiles can move

[7] Note that the highest eigenvalue of probability transition matrices is always 1.
[8] Note that the shares reported in the last five columns of Table 12 are one minus the shares reported in the diagonal of Table 11.

both up and down. In the 1994-2001 period this was indeed the case and the households in the three middle quintiles were clearly the most mobile

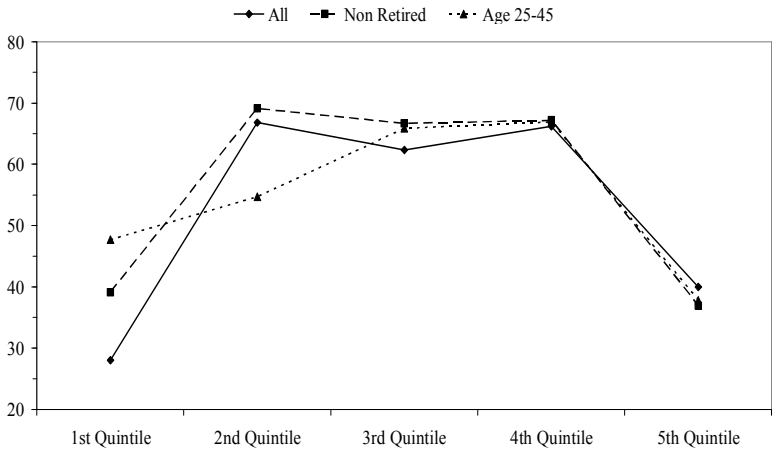


Fig. 9 Mobility by income quintiles (1994–2001). *Source*: Portuguese Surveys of the 1994-2001 European Community Household Panel.

As Fig. 9 illustrates, the households in the bottom quantile are by far the least mobile. This lack of income mobility is partly due to age-related issues, as for both the sample of non-retired households and the 25-45 cohort the mobility statistic is sensitively higher: if we consider the second-highest eigen values of the mobility matrices (Table 12), we find that retired households are less mobile than average. In turn, households in the 25-45 age cohort are more mobile than average. This might be due to the fact that labour earnings growth among individuals in the 25-45 age group is relatively high as compared to younger and older individuals. Accordingly, we find that while only 28.0% of the households that were in the first quantile moved to a different quantile in 2001, among the households whose head was non-retired this rate rises to 39.1%. If we consider the households whose head was between 25 and 45 years old this number increases further to 47.7%.

10. Changes in income, earnings and capital income inequality (1994-2001)

The Portuguese economy has shown a rather striking evolution in the last ten years. In the late 1990s, Portugal posted impressive results in both the real and monetary areas. Its GDP per capita grew faster than the EU average and met the Maastricht criteria for EMU in good times. However, from 1999 the economy started to slow down and in early 2002 entered

recession. In this section, we will examine changes in income, earnings and capital income inequality that took place over the expansion years.

Before presenting the results, it must be noted that when comparing distributions (either across countries or across time) it is important to assess the statistical significance of the observed differences. As Moran (2006, p. 226) puts it, "given that statistics such as the Gini index are widely used to make normative evaluations of a nation's capacity for distributive justice, statistical inference can become an important mechanism for evaluating which movements in the index are likely to represent 'real' and substantively important distributional change and which might be better attributed to error or random variation in the samples". With this in mind, the analysis that follows builds up on bootstrap methodology. Specifically, we present the results of a set of non-parametric tests based on the bootstrapped means of the difference between the inequality statistics in 2001 and 1994. To make the statistical inference more robust, we use three alternative bootstrap methods: the standard normal, the percentile and the bias-corrected method. These methods are described in Appendix B.

10.1 Changes in the income distribution

Table 13 reports the evolution of the concentration and skewness statistics of the income distribution. The overall picture is one of decreasing inequality. While in 1994 the Gini index, the coefficient of variation and the top10%/bottom90% ratio were, respectively, 0.44, 0.91 and 3.91, in 2001 these statistics were 0.40, 0.85 and 3.76. The bottom half of Table 13 assesses the significance of these changes. The first row ('Sample') summarizes the total variation between 1994 and 2001 as measured by the difference between the sample moments. The next two rows report the mean ('Bootstrapped mean') and the standard deviation ('Bootstrapped standard error') of the 2001-1994 differential across bootstrap replications. The last three rows test whether the total change is statistically different from zero using, alternatively, the standard normal, the percentile, and the bias-corrected method. The results show that income inequality, as measured by the Gini index, was significantly higher in 1994 than in 2001. In turn, the total changes in the coefficient of variation, the top10%/bottom90% ratio and the skewness coefficients fail to be statistically significant.

Table 13. Changes in the concentration and skewness of the income distribution

	Gini	CV	Top 10%/ Bottom90%	Location of Mean%	Mean/ Median	Skewness
1994	0.436	0.91	3.91	63.6	1.27	2.88
1995	0.421	0.85	3.71	62.4	1.25	2.47
1996	0.409	0.84	3.63	62.4	1.24	2.66
1997	0.409	0.82	3.64	62.5	1.24	2.01
1998	0.410	0.84	3.70	63.4	1.24	2.43
1999	0.403	0.85	3.71	63.9	1.24	2.97
2000	0.397	0.80	3.57	62.2	1.24	2.14
2001	0.400	0.85	3.76	64.4	1.26	3.00
Δ(2001-1994)						
Sample	-0.04	-0.06	-0.15	0.80	-0.01	0.12
Bootstrapped mean	-0.03	-0.06	-0.15	0.72	-0.01	0.13
Bootstrapped standard error	0.01	0.05	0.20	1.34	0.03	0.77
Normal test	***					
Percentile test	***					
Bias-Corrected test	***					

*** denotes significant at the 1% confidence level. Bootstrap tests based on 500 random replications of sample size equal to the number of households in the dataset (4,614). *Source*: Portuguese Surveys of the 1994-2001 European Community Household Panel.

Next, in Table 14 we look at the evolution of the shares earned by households in different parts of the distribution. For illustrative purposes, the shares of the different quantiles are depicted in Fig. 10, where each series has been normalized by its value in 1994.

Table 14. Changes in the income distribution – shares of the sample totals (%)

Year	The Poor			Quintiles					The Rich		
	1	1-5	5-10	1st	2nd	3rd	4th	5th	10-5	5-1	1
1994	0.017	0.377	0.835	3.87	9.27	15.65	23.53	47.67	11.59	12.88	5.91
1995	0.029	0.412	0.903	4.12	9.78	16.00	23.68	46.48	11.51	12.40	5.35
1996	0.027	0.500	0.983	4.50	10.17	16.11	23.52	45.69	11.17	12.36	5.26
1997	0.033	0.512	0.988	4.54	10.08	16.17	23.51	45.70	11.34	12.75	4.81
1998	0.026	0.472	0.949	4.41	10.36	16.17	23.20	45.86	11.33	12.23	5.58
1999	0.031	0.561	1.053	4.81	10.63	16.00	22.86	45.70	11.04	12.54	5.65
2000	0.040	0.553	1.100	4.89	10.58	16.22	23.31	45.00	10.95	12.58	4.92
2001	0.050	0.600	1.120	5.09	10.32	15.86	22.68	45.88	10.88	12.45	6.20
Δ(2001-1994)	0.033	0.223	0.285	1.22	1.05	0.21	-0.85	-1.79	-0.71	-0.43	0.29

Source: Portuguese Surveys of the 1994-2001 European Community Household Panel.

We find that households in the lower tail of the income distribution improved their economic position. Specifically, the share of total income earned by the income-poorest more than doubled, going from 0.02% in 1994 up to 0.05% in 2001. Similarly, the income share earned by households in the first quantile was about 1.3 times larger in 2001 than in 1994 (5.09% against 3.87%). At the same time, income receipts among the income-rich tended to diminish. The share of income earned by the households located in the top quantile decreased from 47.7% to 45.9%. This change is qualitatively similar among the households that belong to the

top 10% of the income distribution, with the exception of those in the top 1%. Among this group, we cannot detect any discernible trend

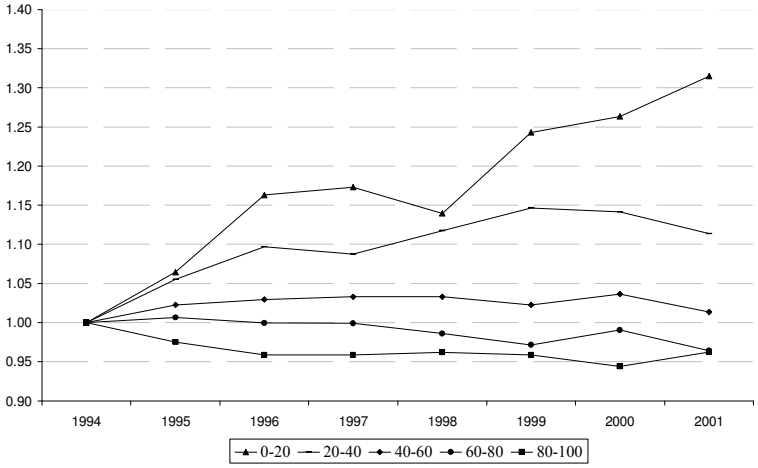
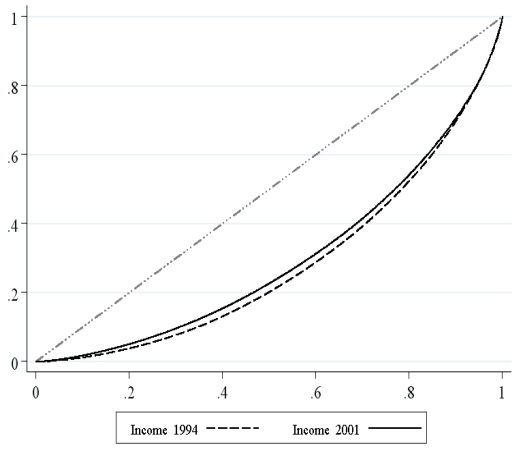


Fig. 10 Shares of the sample totals, by income quintiles. Series normalized by the 1994 values. *Source*: Portuguese Surveys of the 1994-2001 European Community Household Panel.

In Panel 1 of Fig. 11 we plot the Lorenz curves of the income distributions in 1994 and 2001. A frequently used criterion to asses the welfare implications of a given distribution is the concept of Lorenz dominance (Atkinson, 1970): distribution A Lorenz dominates distribution B if the Lorenz curve of distribution A is always above the Lorenz curve of distribution B[9]. This is the case in Fig. 11. Specifically, we find that the shares of income earned by families in the lowest 20%, 40%, 60% and 80% of the income distribution were, respectively, 1.22, 2.27, 2.48 and 1.78 percentage points higher in 2001 than in 1994. As the bootstrap results show, such differences are statistically significant at the 1% confidence level, indicating that the income distribution in 2001 Lorenz dominates that in 1994.

[9] Lorenz dominance is a powerful concept. If the Lorenz curve for a distribution *f* lies everywhere above that for another distribution *g*, then any aggregate inequality measure *M*, such as the Gini coefficient, that satisfies symmetry, mean independence, population homogeneity, and the Dalton-Pigou principle of transfers, will rank the income inequality of the distribution *f* lower than that of *g*: $M(f) < M(g)$ (Jenkins, 1991). Thus, if one distribution Lorenz dominates another, all aggregate inequality measures satisfying the above properties will agree in their ranking of the two distributions.

Panel 1: Lorenz Curves



Panel 2: Bootstrap tests

Δ(2001-1994)	Income			
	0-20	0-40	0-60	0-80
Sample	1.22	2.27	2.48	1.78
Bootstrapped mean	1.24	2.28	2.48	1.79
Bootstrapped standard error	0.18	0.47	0.79	0.11
Normal test	***	***	***	***
Percentile test	***	***	***	***
Bias-Corrected test	***	***	***	***

Fig. 11 Changes in the income Lorenz curve. *** denotes significant at the 1% confidence level. Bootstrap tests based on 500 random replications of sample size equal to the number of households in the dataset (4,614). *Source*: Portuguese Surveys of the 1994-2001 European Community Household Panel.

10.2 Changes in the earnings distribution

According to the data, earnings inequality tended to decrease over the sample period. As Table 15 shows, the Gini index, the coefficient of variation and the top10%/bottom90% ratio decreased, respectively, from 0.56, 1.14 and 4.93 in 1994 to 0.53, 1.06 and 4.64 in 2001. Still, only the variation of the Gini coefficient appears to be statistically significant. As regards the skewness of the distribution, the results show small and non-significant changes over the sample period.

Table 15. Changes in the concentration and skewness of the earnings distribution

	Gini	CV	Top 10%/ Bottom 90%	Location of Mean%	Mean/ Median	Skewness
1994	0.558	1.14	4.93	60.9	1.27	2.47
1995	0.547	1.08	4.66	59.3	1.27	2.06
1996	0.540	1.06	4.59	58.5	1.29	1.91
1997	0.541	1.06	4.63	58.5	1.26	1.73
1998	0.534	1.07	4.62	59.4	1.21	2.15
1999	0.534	1.07	4.62	58.6	1.25	2.08
2000	0.525	1.04	4.48	58.0	1.21	2.00
2001	0.530	1.06	4.64	61.00	1.23	2.07
Δ(2001-1994)						
Sample	-0.03	-0.08	-0.29	0.10	-0.04	-0.40
Bootstrapped mean	-0.03	0.08	-0.29	0.14	-0.04	-0.41
Bootstrapped standard error	0.01	0.05	0.29	1.47	0.05	0.39
Normal test	***					
Percentile test	**					
Bias-Corrected test	**					

** denotes significant at the 5% confidence level, *** denotes significant at the 1% confidence level. Bootstrap tests based on 500 random replications of sample size equal to the number of households in the dataset (4,614). Source: Portuguese Surveys of the 1994-2001 European Community Household Panel.

Table 16 reports the evolution of the shares earned by households in different parts of the distribution. The normalized figures are depicted in Fig. 12. The trends are similar to those documented for the income variable: the poor tended to improve their economic position. Specifically, the share of earnings obtained by families in the bottom 30% of the earnings distribution rose from 0.45% to 1.84%, while the share of earnings obtained by families in the 30-40 decile rose from 3.87% to 4.87%. Again, this trend was parallel to decreasing shares earned by the rich. Specifically, the top quantile accounted for 52.48% of the total earnings in 2001, against a 54.84% in 1994. Similarly, the share obtained by the earnings-richest fell from 6.76% to 6.15%.

Table 16. Changes in the earnings distribution – shares of the sample totals (%)

Year	The Poor		Quintiles			The Rich		
	0-30	30-40	3rd	4th	5th	10-5	5-1	1
1994	0.446	3.874	15.35	25.49	54.84	13.38	15.24	6.76
1995	0.450	4.160	15.66	26.08	53.65	13.33	14.71	6.12
1996	0.714	4.442	15.73	26.00	53.12	13.14	14.98	5.82
1997	0.744	4.382	15.97	25.53	53.37	13.38	15.13	5.76
1998	1.051	4.594	16.22	25.31	52.82	12.75	15.00	6.16
1999	1.116	4.571	15.94	25.57	52.80	12.76	15.13	6.10
2000	1.306	4.740	16.35	25.79	51.81	12.55	14.38	6.38
2001	1.840	4.870	15.84	24.96	52.48	12.47	15.43	6.15
Δ(2001-1994)	1.394	0.996	0.49	-0.53	-2.36	-0.91	0.19	-0.61

Source: Portuguese Surveys of the 1994-2001 European Community Household Panel.

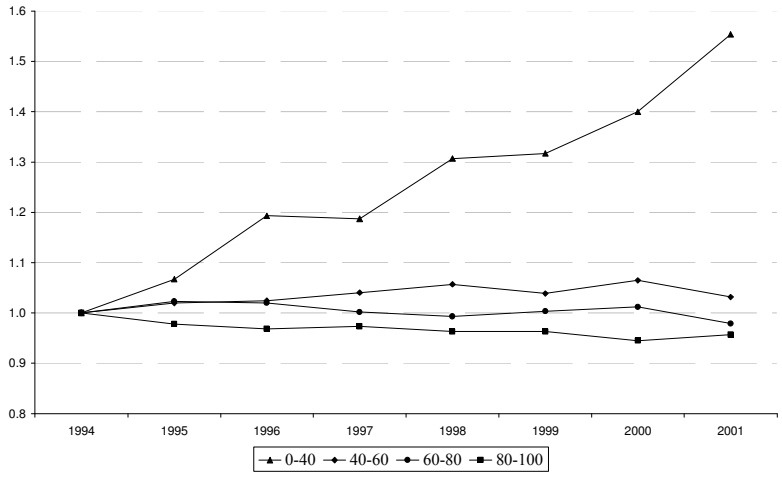
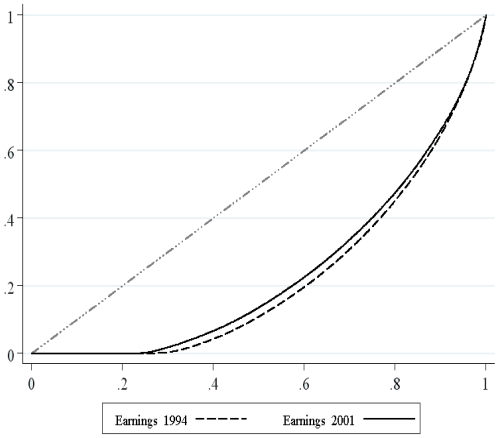


Fig. 12 Shares of the sample totals, by earnings quintiles. Series normalized by the 1994 values. *Source*: Portuguese Surveys of the 1994-2001 European Community Household Panel.

The trend towards lower earnings inequality resulted into a Lorenz curve at the end of the period that Lorenz dominates that in the beginning of the period (Panel 1 of Fig. 13). Specifically, the shares of earnings earned by families in the lowest 40%, 60% and 80% of the

earnings distribution were, respectively, 2.39, 2.88 and 2.35 percentage points higher in 2001 than in 1994, and such differences are statistically significant (Panel 2 of Fig. 13).

Panel 1: Lorenz Curves



Panel 2: Bootstrap tests

Δ(2001-1994)	Earnings		
	0-40	0-60	0-80
Sample	2.39	2.88	2.35
Bootstrapped mean	2.40	2.85	2.37
Bootstrapped standard error	0.61	0.91	1.23
Normal test	***	***	*
Percentile test	***	***	*
Bias-Corrected test	***	***	**

Fig. 13 Changes in the earnings Lorenz curve. * denotes significant at the 10% confidence level, ** denotes significant at the 5% confidence level, *** denotes significant at the 1% confidence level. Bootstrap tests based on 500 random replications of sample size equal to the number of households in the dataset (4,614). *Source*: Portuguese Surveys of the 1994-2001 European Community Household Panel.

10.3 Changes in the capital income distribution

While the concentration of income and earnings tended to decrease over the sample period, capital income became increasingly compressed. Table 17 illustrates this trend.

Table 17. Changes in the concentration and the skewness of the capital income distribution

	Gini	CV	Top 10%/ Bottom 90%	Location of Mean%	Mean/ Median
1994	0.963	7.17	515.25	92.1	16.43
1995	0.957	5.63	381.46	91.7	10.26
1996	0.963	8.58	428.12	92.5	28.35
1997	0.965	7.47	548.47	92.8	17.52
1998	0.968	7.96	483.69	93.4	21.81
1999	0.972	8.19	701.43	94.0	18.73
2000	0.967	6.89	615.58	93.8	15.29
2001	0.970	11.98	706.52	94.2	35.17
Δ(2001-1994)					
Sample	0.01	4.81	191.27	2.10	18.74
Bootstrapped mean	0.01	4.81	191.26	2.09	18.74
Bootstrapped standard error	0.01	2.95	258.08	0.75	10.11
Normal test	*			***	*
Percentile test				***	
Bias-Corrected test	*			**	**

* denotes significant at the 10% confidence level, ** denotes significant at the 5% confidence level, *** denotes significant at the 1% confidence level. Bootstrap tests based on 500 random replications of sample size equal to the number of households in the dataset (4,614). The mean-to-median ratio is not reported: in all years the modal value of capital income is zero and, thus, this statistic is not well defined. *Source*: Portuguese Surveys of the 1994-2001 European Community Household Panel

We find that the Gini index, the coefficient of variation and the top10%/bottom 90% ratio rose from, respectively, 0.96, 7.17 and 515.25 in 1994 to 0.97, 11.98 and 706.52 in 2001. The statistical significance of these changes is however limited. In turn, changes in the skewness of the distribution turn out to be significant, with the location of the mean and the skewness coefficient being significantly higher in 2001 than in 1994.

Table 18 tracks the evolution of the capital income distribution over the sample years. Two things are worth noting. First, the share of capital income earned by the bottom 90% of the distribution did not change by much. This is due to an overhelming majority of households reporting zero capital income in all surveyed years. Second, changes in the top tail of the distribution were heterogeneous. On the one hand, the share earned by those households in the top 10-5% and 5-1% of the distribution show a decreasing trend, from 7.1% in 1994 to 2.8% in 2001 in the former case and from 38.1% to 31.1% in the later case. On the other hand, the share obtained by the households in the top 1% of the capital income distribution exhibits an upward trend, going from 53.1% to 64.8%. The evolution of these shares is depicted in Fig. 14.

Table 18. Changes in the capital income distribution
Shares of the sample totals (%)

Year	The Poor	The Rich		
	0-90	10-5	5-1	1
1994	1.712	7.14	38.06	53.08
1995	2.304	9.67	39.51	48.51
1996	2.057	8.02	36.21	53.71
1997	1.614	6.57	35.77	56.05
1998	1.826	4.23	37.43	56.52
1999	1.262	3.51	33.72	61.51
2000	1.429	4.17	40.74	53.66
2001	1.250	2.84	31.08	64.83
Δ(2001-1994)	-0.462	-4.30	-6.98	11.75

Source: Portuguese Surveys of the 1994-2001 European Community Household Panel.

Finally, in Fig. 15 we depict the 1994 and 2001 Lorenz curves. Even though differences in the ordinates of the curve fail to be significant at the 90th and the 99th percentiles, they are significant at the 1% confidence level in the 95th percentile[10]. All in all, this evidence suggests that over the sample period changes in the capital income distribution were non-trivial and leaded towards higher concentration.

[10] This significance extends to the 93th, 94th, 96th and 97th percentiles, according to computations not reported here.

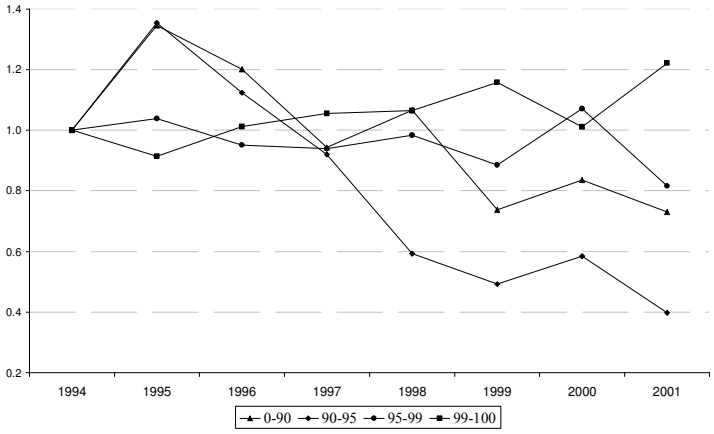
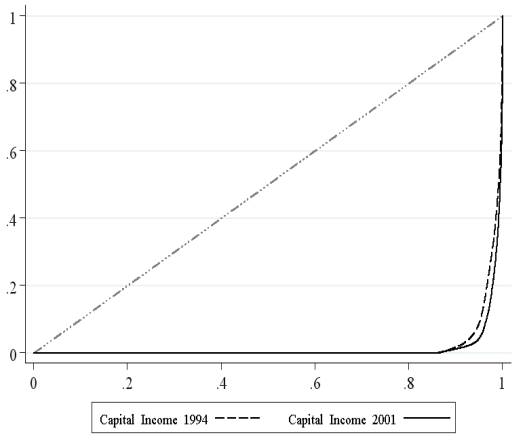


Fig. 14 Shares of the sample totals, by selected intervals. Series normalized by the 1994 values. *Source*: Portuguese Surveys of the 1994-2001 European Community Household Panel.

Panel 1: Lorenz Curves



Panel 2: Bootstrap tests

Δ(2001-1994)	Capital income		
	0-90	0-95	0-99
Sample	-0.01	-0.05	-0.12
Bootstrapped mean	-0.01	-0.05	-0.11
Bootstrapped standard error	0.01	0.02	0.09
Normal test		***	
Percentile test		***	
Bias-Corrected test		***	

Fig. 15 Changes in the capital income Lorenz curve. *** denotes significant at the 1% confidence level. Bootstrap tests based on 500 random replications of sample size equal to the number of households in the dataset (4,614). *Source:* Portuguese Surveys of the 1994-2001 European Community Household Panel.

11. Conclusions

Understanding and explaining economic inequality within a country and over time crucially depends on the information that we have at our disposal. In this paper, we gathered detailed and up-to-date information to characterize economic inequality along a variety of dimensions. This was done for Portugal, a country placed high in the international rankings of inequality.

Data on the income, earnings and capital income earned by the Portuguese households was collected to describe the range, shape, concentration and skewness of the resulting distributions. The simultaneous analysis of these distributions allowed us to differentiate between the income-, earnings- and capital income-rich and the income-, earnings- and capital income-poor. These groups were found to differ significantly along a variety of socioeconomic dimensions, including age, employment status, education and marital status. These socioeconomic factors were explored further to describe their connection with economic inequality.

The data was taken from the European Community Household Panel dataset (ECHP), a standardized survey carried out in the European Union from 1994 to 2001. This dataset presented two main advantages. The first one was comparability. This was an appealing feature, insofar as most international comparisons of inequality are based on different datasets and sampling periods, diverging sample of individuals, and differently defined variables. The calculations reported in this paper can be easily extended to any of the other 14 countries included in the ECHP[11]. This task, which is beyond the present paper, would allow for straight comparisons between European countries. As a second advantage, the ECHP monitors the same group of families and individuals over time. This allowed us to analyze the dynamics of economic mobility in Portugal. Furthermore, the paper documented changes in inequality from 1994 to 2001, a period of economic expansion in Portugal. During these years, income and earnings inequality tended to decrease, while capital income inequality tended to increase. Using bootstrap techniques, we found statistical evidence that these changes were significant. This conclusion is fairly robust to the choice of the bootstrap test.

As a limitation, we did not provide explanations for the observed patterns. Establishing the causal relation between demographic characteristics, the unequal opportunities that individuals face, the functioning of labour markets, the role of institutions, and the scope of the public system of transfers, on the one hand, and overall inequality and its evolution over time, on the other hand, is a task for further research. Similarly, a theory of inequality that is consistent with most of the facts reported in this paper is still in the waits.

[11] See Budria and Díaz-Giménez (2007) for an analysis of the Spanish economic inequality using the 1998 Spanish survey of the ECHP.

Appendix A. Definitions of variables

The definitions of income, labour earnings, capital income, and transfers used in this article are the following:

- Income: defined as the sum of labour earnings, capital income and transfers (ECHP variable: HI100).
- Labour earnings: defined as the sum of net labour income from both paid employment and from self-employment (ECHP variable: HI111).
- Capital income: defined as the sum of net capital income and net property income (ECHP variables: HI121+HI122).
- Transfers: defined as the sum of both private and public transfers. Private transfers include both inter-vivos transfers and bequests. Public transfers include retirement pensions and old-age benefits, unemployment compensation and other work-related transfers, survivors benefits, illness and disability benefits, family benefits, education grants, social aid, housing subsidies, and other public transfers (ECHP variables: HI123+HI130+HI132+HI133+HI134+ HI135+HI136+HI137+HI138).

Appendix B. The Bootstrap Method

Let $X = \{x_1, x_2, ..., x_N\}$ be the vector of observations included in the ECHP and let $\hat{M}$ be the point estimate of an unknown population parameter M computed from the set of observations X (ex: the Gini coefficient). The bootstrap technique consists on estimating the variance of the parameter $\hat{M}$ through repeated simulations using the original set X. The procedure is as follows:

1) Extract a random set $R_j = \{x_1^j, x_2^j, ..., x_N^j\}$ of size N with replacement from the original sample X.
2) Estimate the population parameter M using the random set R_j. This statistic, which we will denote by $\hat{M}_j$, is the bootstrap replication of $\hat{M}$ computed from the j*th* bootstrap sample.
3) Repeat steeps 1) and 2) a large number of J times.

The α confidence interval for the sample moment $\hat{M}$ is then given by $\left[C^L(N,\alpha,J), C^U(N,\alpha,J)\right]$ where the lower bound $C^L(N,\alpha,J)$ and the upper bound $C^U(N,\alpha,J)$ vary across methods.

With the *Standard Normal Approach*, $C^L(N,\alpha,J)=\hat{M}-t_{\alpha/2,J-1}\cdot std(\hat{M})$, and $C^U(N,\alpha,J)=\hat{M}+t_{\alpha/2,J-1}\cdot std(\hat{M})$, where $t_{\alpha/2,J-1}$ is the $\alpha/2$ critical value from a Student's *t*-distribution with *J-1* degrees of freedom and $std(\hat{M})$ is the standard error of $\hat{M}$,

$$std(\hat{M})=\sqrt{\frac{\sum_J\left(\hat{M}_j-\overline{\hat{M}}\right)^2}{J-1}}$$

where $\overline{\hat{M}}=\frac{1}{J}\sum_J\hat{M}_j$.

With the *Percentile Method*, the vector of bootstrap replications $\{\hat{M}_1,\hat{M}_2,\ldots,\hat{M}_J\}$ is ranked in ascending order and then $C^L(N,\alpha,J)$ and $C^U(N,\alpha,J)$ are calculated as, respectively, the α*th* and (1-α)*th* percentiles in the ordered distribution. Finally, the *Bias-corrected Method* takes into account the asymmetry of the bootstrap distribution. Specifically, define

$$z_0=\Phi^{-1}\left(\frac{Q(\hat{M}_i\le\hat{M})}{J}\right)$$

where Φ is the standard cumulative normal and $Q(\hat{M}_i\le\hat{M})$ is the number of elements in the bootstrap distribution that are less or equal than the sample estimate $\hat{M}$. Let $L=\Phi\left(2z_0-z_{1-\alpha/2}\right)$ and $U=\Phi\left(2z_0+z_{1-\alpha/2}\right)$, where $z_{1-\alpha/2}$ is the (1-α/2)*th* percentile of the normal distribution. Then $C^L(N,\alpha,J)$ and $C^U(N,\alpha,J)$ are, respectively, the L*th* and U*th* percentile of the distribution of parameters $\{\hat{M}_1,\hat{M}_2,\ldots,\hat{M}_J\}$. For a more detailed description and applications of these methods, see Efron and Tibshirani (1993) or, more recently, Moran (2006).

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