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**The impact of EU integration on the
Portuguese distribution of employees'
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Abstract

The accession of Portugal to the EU resulted in several important and different shocks to the Portuguese economy, imposing among others a real positive and lasting effect on employees' earnings. This paper analyses the impact of Portugal's accession to the EU in terms of employees' earnings inequality using data for the years 1985 and 1991 at the *Concelhos* level from the *Quadros de Pessoal* database. The two earnings distributions are compared using cardinal measures of inequality and the Lorenz stochastic dominance approach (Araar Abelkrim and Jean-Ives Duclos). The Relative Distribution approach (Mark S. Handcock and Martina Morris) is applied in order to inspect the overall differences of the two distributions and split the overall relative distribution into location and shape shift effects. The technique of covariate decomposition is used to assess the importance of the human capital/education distribution for the explanation of the evolution of the employees' earnings distribution from 1985 to 1991. This paper contributes to the literature on inequality by focusing on country specific data at the regional and sectoral level and by applying distinct empirical methodologies that clarify the nature of inequality at the aggregate level. During the period under analysis employees' median and average earnings registered a strong growth pointing to a sort of honeymoon effect of EU integration on Portuguese employees' earnings. The paper also contributes to the literature by sorting out this kind of honeymoon effect and emphasizing it as a case to be analyzed in other countries since, in the absence of appropriate country policies, it can jeopardize future growth.

Keywords: Portugal, EU integration, earnings inequality, human capital/education inequality, relative distribution

JEL classification: O12, D33

1. INTRODUCTION

The accession of Portugal to the EU resulted in several important and different shocks to the Portuguese economy, imposing among others a real positive and lasting effect on employees' earnings. This paper analyses the impact of the Portuguese accession to the EU in terms of employees' earnings inequality using data for the years 1985 and 1991 at the *Concelhos* level from the *Quadros de Pessoal* database. The two earnings distributions are compared using cardinal measures of inequality and the Lorenz stochastic dominance approach (Araar (2006)). The Relative Distribution approach

(Handcock and Morris (1999)) is applied in order to inspect the overall differences of the two distributions and split the overall relative distribution into location and shape shift effects. The technique of covariate decomposition is used to assess the importance of the human capital/education distribution for the explanation of the evolution of the employees' earnings distribution from 1985 to 1991. This paper contributes to the literature on inequality by focusing on country specific data at the regional and sectoral level and applying distinct empirical methodologies that clarify the nature of inequality at the aggregate level. During the period under analysis employees' median and average earnings registered a strong growth pointing to a sort of honeymoon effect of EU integration on employees' earnings. The paper also contributes to the literature by sorting out this kind of honeymoon effect, corresponding to very high earnings at the top of different earnings distributions. Moreover, we stress the importance of the Portuguese honeymoon effect as a case to be analyzed in other countries since, in the absence of appropriate country policies, it can jeopardize future growth. For instance, in economies with a highly unequal initial wealth distribution and credit market imperfections, individuals that are not at the top of the distribution underinvest in human capital because borrowing is costly, which, in turn jeopardizes future growth. Another possible explanation for this negative impact come from the fiscal approach: the median voter of a society with a highly unequal initial wealth distribution is more prone to vote for redistribution policies, which in turn implies higher levels of taxation and government expenditure, causing distortions that disincentive private investments.

Rodrigues (1996), Rodrigues (1999) and Rodrigues (2007) analyses at deep extent the main characteristics of inequality and poverty in the Portuguese economy during the

1990's. 1989-2000 was a period of vigorous growth for the Portuguese economy, with growth accelerating in the last five years of the period under analysis[1]. In this period, the increase in real income occurred at all levels of income translating into a decrease in absolute poverty[2]. But the increase in income was uneven, with inequality rising strongly in the first half of the period.

Since the 1980's there was a resurgence of interest on the subject of income inequality in the research agenda (see e.g. Silber (1999)), moreover the progress achieved in the field of applied methodologies constitutes a challenge for us to inspect, from a new view, the so-called Portuguese miracle in the first years of European integration. For instance, the literature on the relationship between inequality and economic growth has been carefully and thoroughly surveyed by Aghion et al. (1999), Perotti (1994), Alesina and Perotti (1994), Bénabou (1996), and Deininger and Squire (1998), among others. This literature has, among other things, challenged key predictions from a former literature on the subject, namely those derived from the Kuznets inverted-U curve relating economic growth to income inequality. The inverted U-curve or Kuznets curve for the developed world is very well documented for the 19th and part of the 20th centuries (see Williamson and Lindert (1980), Lindert (2000) and Margo (1999)). After the 1980's we witnessed what is known by the "Great U-Turn", which corresponds to a subsequent growth of inequality (Bennett and Bluestone (1988), Alderson and Nielsen (2002)). A similar pattern was found for wages (Freeman and Katz (1995), Levy (1992)) in the USA and also for the other developed countries (Gottschalk (1997)).

As already stated, we examine the evolution of the Portuguese earnings distribution for 1985-1991 period emphasizing the influence upon it of education, based on a nonparametric, full information methodology. This Relative Distribution (RD) analysis is specially appropriate (Nielsen et al. (2005)) when inequality is associated with polarization rather than median shifts and, frequently, we witness the growth of polarization associated with a rise in incomes. This methodology performs better than the usual empirical summary measures of inequality because, even in the case of an identical pattern of evolution (Morris et al. (1994)), it makes it possible to identify very different patterns of distribution associated with the same evolution. The idea of a

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[1] The real GDP per capita average annual growth rate was 2.8% for the whole period, 2.6% in 1989-1995 and 3.7% in 1995-2000.
[2] The poverty line is 6500 Euros per year.

unified theory[3] that can explain the recent increase in inequality, even if it can explain the change in those empirical measures, also implies an evolution in terms of different patterns of distribution (Nielsen, Alderson and Jason (2005))[4].

There are other promising parametric methodologies that extend the Blinder-Oaxaca methodology (Blinder (1973) and Oaxaca (1973))[5]. Machado and Mata proposed, recently, a method centered on the estimation of marginal wage distributions consistent with a conditional distribution estimated by quantile regression and concluded (Machado (2005)) that education levels contributed to the increase of wage inequality over the period 1986-1995. The data base for their study is the same as ours except for the fact that they used samples of 5000 employees while we use all the information from Quadros de Pessoal database, and this is why we prefer to implement RD analysis[6]. The authors used several covariates for the explanation of wages - sex, education, age and tenure - but concluded that the only covariate with an unequivocal contribution to the wage distribution is education[7]. These conclusions allow us to use education, total and by schooling levels as the only covariate for earnings.

The remainder of the paper is organized as follows. In section 2, we undertake a bird's view eye of the macroeconomic characteristics of the Portuguese economy for the period 1985-1991. In section 3, we examine the main features of the evolution of Portuguese earnings for the period 1985-1991 at the overall level, as well as for some parts of the relative distribution. Additionally, the location shift and the shape of the distribution are taken into account in order to be able to distinguish their impact on the evolution of earnings. In section 4, we deepen our investigation on the evolution of Portuguese earnings by focusing on one of the main factors explaining earnings, education. The relative earnings distribution built on the previous section is then modified to allow for education as a covariate. We examine the effect of education, total and by schooling levels, on the relative distribution. Finally, in section 5 we conclude.

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[3] See Table 1 for an overview of explanations for the case of the USA (Nielsen, Alderson and Jason (2005)).
[4] We used the following packages: Zeileis (2009) and Handcock (2009) for R and also Jann (2008) for Stata.
[5] See Deutsch and Silber (2007)
[6] They also use hourly wages and we use total monthly earnings.
[7] Machado e Mata, 2005, p. 458, 461 and Table II.

2. THE PERFORMANCE OF THE PORTUGUESE ECONOMY OVER THE PERIOD 1985-1991: A MACROECONOMIC SUMMING UP

There is some literature that documents the economic miracle experienced by Portugal in the first years of European Integration. For instance, Portugal (2005) claims that the exchange rate and disinflation policies conducted by the Portuguese authorities since the entrance of Portugal to the ERM were successful and supportive of European integration. Duarte and Simões (2002), on the contrary, analyze the main factors responsible for economic growth in the Portuguese economy and conclude that the high positive growth differential of the Portuguese economy is explained mainly by adverse initial conditions in terms of inputs stocks.

The macroeconomic indicators %RGDPPE, % RGDP and U[8]: in Table 1 below show the extraordinary performance of the Portuguese economy between 1985 and 1991 when compared, for instance, with Spain, that became a member of the European Community at the same time as Portugal. Notice however that the Portuguese %CPI performs badly when compared to that of the other countries.

Table 1. Macroeconomic Indicators for 1985-1991

|	% RGDPPE	% RGDP	% CPI	U
Germany	2.2	3.6	1.7	7.4
France	2.0	2.9	3.1	9.2
Portugal	4.3	5.7	11.3	6.4
Spain	1.0	4.2	6.4	15.4

It is widely acknowledged that a conjunction of factors and economic policies were behind the Portuguese miracle. This was a period of optimistic expectations about European Integration and of liberalization reforms in the Portuguese economy. The process of liberalization undertook concerned privatizations, investment, prices, development of the capital market and international flows of capital. At the same time, institutional reforms were implemented to back up those policies. Anti-inflationary policies were implemented, for instance, and new wage bargaining practices started to

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[8] %RDGPPE, average annual growth rate of real domestic gross product per person employed in percentage ; %RGDP, average annual growth rate of real domestic gross product in percentage; %CPI, growth rate of national CPI in percentage; U, unemployment rate.

be followed by unions. By the end of 1993, the Minister of Finance Braga de Macedo put an end to the wage bargaining practice of wage indexation to past inflation, convincing unions to accept wage indexation to expected inflation. It is also worth mentioning the European Community net transfer funds that Portugal benefitted from: in 1988, 1.4%; in 1989, 1.4%; in 1990, 1.2%; and in 1991, 1.5%[9]. Finally, the most important European trade patterns exhibited synchronized business cycles with the Portuguese economy (see Figure 1 below) in this expansionary period.

Figure 1. Real Output Gap in Portugal, France, Germany and Spain
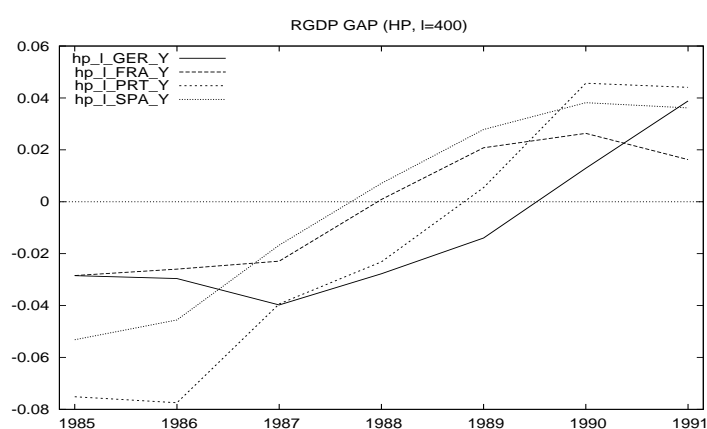
3. EVOLUTION OF THE PORTUGUESE EARNINGS DISTRIBUTION OVER THE PERIOD 1985-1991: A RELATIVE DISTRIBUTION ANALYSIS

We study two distributions corresponding to two different points in time, 1985 and 1991. Although this type of analysis is usually conducted based on the statistical summary indicators of the distributions, such as moments or empirical inequality concepts, we will apply the relative distribution (RD) analysis proposed by Handcock and Morris (1999). For this purpose, we use data for the years 1985 and 1991 from the *Quadros de Pessoal* database[10], which is the result of an annual compulsory survey conducted by the *Ministério do Trabalho e da Solidariedade Social (MTSS)* where firms are required to provide information about their workers on items such as monthly compensation, highest schooling level attained, age, and monthly hours worked. The

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[9] GDP percentages.

[10] The *Quadros de Pessoal* database is provided by Gabinete de Estratégia e Planeamento do Ministério do Trabalho e da Solidariedade Social (GEP – MTSS).

data is available for the 1985-2007 period (with the exception of the years 1990 and 2001). We consider average full earnings of the employees that performed complete working hours during the month of October. For the year 1985, 10708 cells of employees, levels of education and industries for a total of 1426264 employees were used. As for the year 1991, 12104 cells and 1769520 employees were considered. Earnings values were deflated by the HCPI, reference year 2000, for Portugal.

For the weighted distributions of earnings we compute several measures of relative inequality: the Lorenz curve (Lorenz M. O. (1905)) and measures of relative inequality (Fields (2001)) that are strongly Lorenz-consistent, such as the Gini coefficient (Xu (2004)), Theil's entropy measure (Theil (1967)) and Atkinson's measure[11] (Atkinson (1970)). Based on these data we started by computing cardinal inequality measures and distribution moments (see Table 2 below).

Table 2. Earnings Evolution

	Gini	Atkinson	Theil	Median (€)	Average (€)
1985	0.225	0.042	0.089	662.1	739.8
1991	0.256	0.052	0.112	833.9	970.1

From 1985 to 1991, allthree inequality measures have risen and the average annual growth rate of median earnings was 3.9% (total growth for the period, 25.9%), while the average annual growth rate of average earnings was 4.6% (total growth 31%). Median and average earnings values indicate a heavy right tail for both distributions.
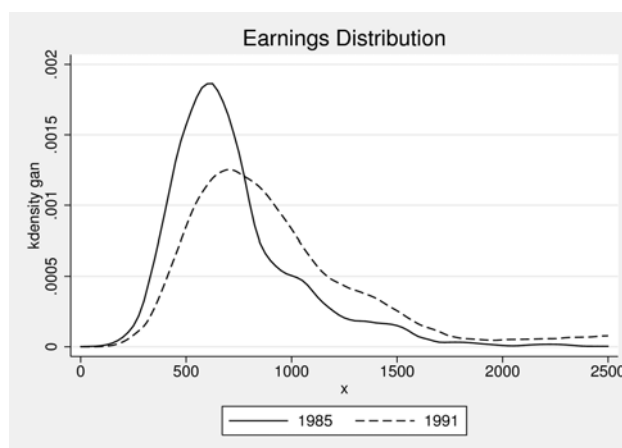
From the earnings distributions, (see Figure 2 below) we can observe that from 1985 to 1991 earnings are less concentrated on the interval 200€ to 750€ and the frequency of earnings higher than 800€is higher for the year 1991.

[11] With the coefficient of risk aversion to inequality equal to 0.5.

Figure 2: Earnings Density

The inequality measures above point to an increase in overall inequality over the period, suggesting Lorenz dominance[12] of the 1991 curve over the 1985 curve. This hypothesis is confirmed by applying the stochastic dominance approach (Davidson (2008)). For the CI[13] of the estimated Lorenz difference curve (1985 curve - 1991 curve) we use an asymptotic approach by taking into account the information about the data of the two curves. We plot in Figure 3 below the estimated Lorenz difference where the gray area indicates the confidence interval at the level of 95%. The fact that the estimated difference curve lays, simultaneously, in the 4th quadrant and the upper CI slighted cuts the zero curve indicates that the 1991 LC is dominated by the 1985 LC curve. We can thus conclude for an increase in inequality between the two years.

Figure 3: Portugal LC 1985 &1991

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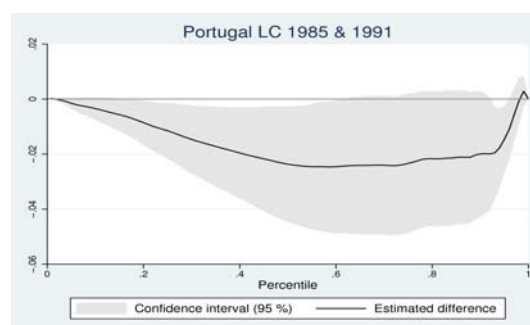
[12] Using Araar and Duclos (2007).
[13] CI - Confidence intervals; LC – Lorenz curve.

Next we apply the relative distribution (RD) analysis (see Handcock and Morris (1999)) in order to study the Portuguese earnings distribution for the period 1985-1991. This is a non-parametric approach specially suited to the analysis of differences among distributions[14]. One advantage of this methodology comes from the fact that its results are independent of monotonic transformations of the variables under study. Suppose that we have real euro earnings of firm's employees for 1985 and 1991. Using this methodology it is indifferent to study earnings or the log of earnings.

Our reference is the data generated in 1985 (Y_0). $F_0(y)$ denotes the cumulative distribution function (CDF) of Y_0 and $f_0(y)$ denotes the density function (PDF). This data will be compared with data for 1991, based on CDF, F(y), PDF, and f(y). The relative distribution of Y to Y_0 is the distribution defined as $R=F_0(Y)$. R is simply the grade transformation of Y into Y_0 (Cwik and Jan). With this transformation R measures the relative rank of Y compared to Y_0. The CDF of R is defined by $G(r)=F(F_0^{-1}(r))=F(Q_0(r))$, where r represents relative data, the proportion of values, with $0 <= r =< 1$ and $Q_0(r)$ the quantile function of F_0. The PDF of R, the derivative of G(r), is

given by $g(r) = \dfrac{f\left(F_0^{-1}(r)\right)}{f\left(F_0^{-1}(r)\right)}$.

As stated previously, f and f_0 are the densities functions, consequently PDF (G(r)) is also a density ratio. CDF and PDF are easily interpreted: the relative CDF, G(r), is the proportion of the 1991 earnings that is below the level of proportion r of the 1985 earnings; and the relative PDF is the ratio of the frequency of 1991 earnings to the frequency of the 1985 earnings at the rth quantile for the 1985 earnings. If the 1985 and 1991 earnings distributions are identical then the relative distribution is uniform on [0,1]. When the PDF of RD is greater than 1 there is a greater frequency of observations in the 1991 distribution. In terms of the CDF relative distribution if, for the median of 1985 earnings (r=0.5), we get the value 0.3 this means that only 30% of 1991 employees earn less than the 1985 median earnings. In the case of coincidence of the CDF with the bisector the two distributions are equal. The confidence intervals of the PDF are obtained using a normal approximation to produce the distribution of the estimates.

The CDF relative distribution plotted below in Figure 4 gives us a clear image of what happened in terms of the evolution of earnings for different parts of the

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[14] We stick closely to the authors' explanation.

distribution. To the median of 1985 earnings distribution (r=0.50) corresponds the value G(r)=0.278 meaning that only 27.8% of the employees in 1991 earn less than the 1985median of earnings. The corresponding values associated with the 1st quartile (r=0.25) and the 3rd quartile (r=0.75) of the 1991 distribution are, respectively, 7.7% and 50% of that distribution. We thus conclude that, for the year 1991, there is a smaller proportion of employees earning less or the same than the proportion of employees for 1985.

Figure 4. CDF (RD)
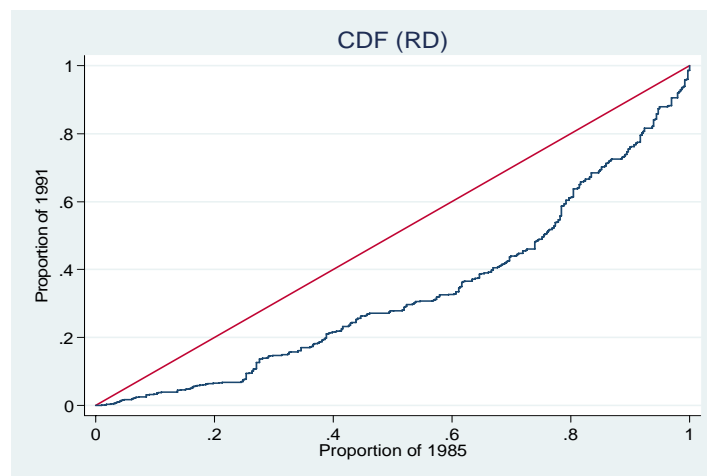
Next we deal with possible differences in the distributional shape in order to clarify changes in earnings inequality during the 1985-1991 period by testing for relative polarization (RP)[15] (see Table 3 below).

Table 3. Relative Polarization (RP)

	Coefficient	Bootstrap S.E.	95% CI (Normal-based)	
Median RP	0.246	0.053	0.140	0.351
Lower RP	0.265	0.074	0.116	0.414
Upper RP	0.226	0.067	0.091	0.361

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[15] Handcock and Morris (1999), pp. 69-73.

The RP values confirm the increase in inequality during the period. The standard errors calculated with 50 replications have very small values compared to the coefficients. A zero value of RP means no differences in distributional shape. A positive value means an increase in the tails of the distribution, which is equivalent to more polarization. Comparing 1991 to 1985, we have a 24.6%[16] shift in employees from the centre of the distribution to the upper and lower quartiles. All the coefficient values have minimum significance levels of probability. These results confirm the fact that inequality increased due to polarization in the period 1985-1991, and they are more informative than Figure 2.

Our investigation of the changes in earnings distribution is extended to account for changes due to the location shift (LS) and to the shape shift (SS). The relative distribution can be decomposed into a location and a shape component. Suppose we represent by Y_{0L} a variable that describes the 1985 distribution location-adjusted, in such a way that it has the same median as the 1991 earnings distribution. This new variable corresponds to a counterfactual distribution with the location of the 1991 distribution and the shape of the 1985 distribution. We have now three distributions, Y_0, Y and Y_{0L}, based on which we can construct two relative distributions that represent the effects of changes in location and shape. For the location shift we have the RD of Y_{0L} to Y_0 and for the shape shift the RD of Y to Y_{0L}.

In Figure 5 below we plot the RD for the overall distribution (ORD), the RD for the location shift (LS) and, finally, the RD for the shape shift (SS).

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[16] From 14% to 35.1% at the 95% confidence level.

Figure 5. Location shape decomposition for the ORD
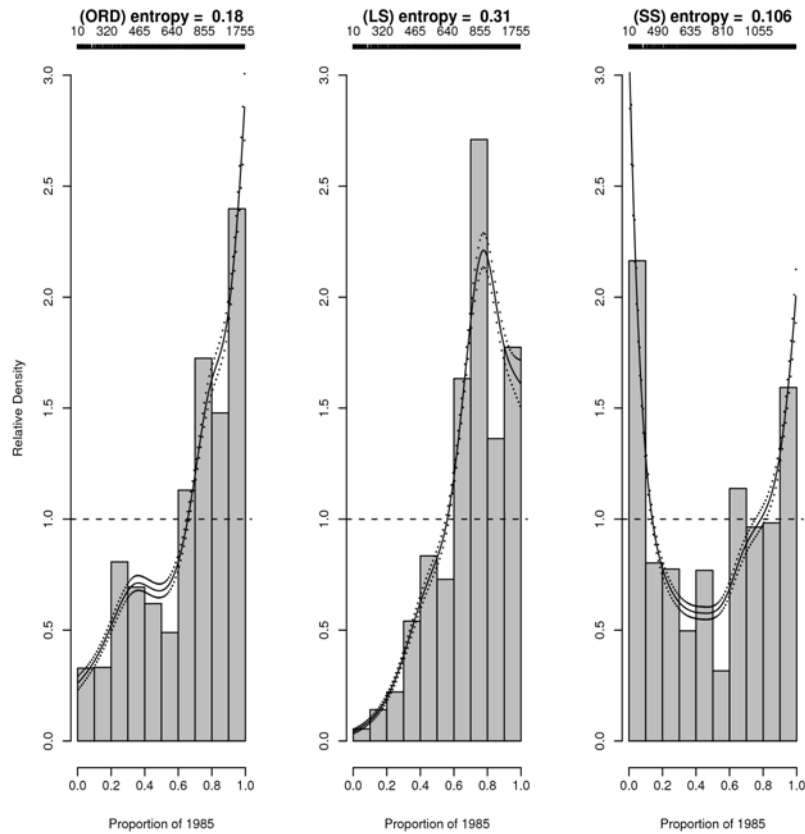
In what concerns the ORD, we can observe that, for percentile 19% of the 1985 cohort, the relative density value is 0.5 meaning that half of the 1991 employees received the level of 1985 earnings associated to percentile 19%. For percentiles equal or higher than percentile 66% of 1985, the relative density value is higher than one, which means that the proportion of 1991 employees is greater than that of 1985. The difference in average earnings over the period was due to the increase in high level earnings, or equivalently, it was explained by the difference at the top of the distribution. For example, the relative density at the 97.5% percentile of 1985 cohort is 2.6, which means that, at the top of the distribution, the proportion of 1991 employees with the corresponding earnings is three times higher in terms of 1985 employees. We can conclude that the employees at the bottom of the earnings distribution are, in 1991, less than those in 1985, and the inverse applies to the top of the earnings distribution.

The LS relative density represents the effect of the median shift in earnings between the two years in terms of the relative density, under the assumption of no change in the distribution shape. LS entropy value is 0.31, almost three times the one

associated with de SS curve, which corresponds to an important effect of the location shift associated to the 1991 earnings distribution. At percentile 50% for the 1985 cohort, the proportion of 1991 employees is 84% of 1985 employees, which illustrates the strong location shift mentioned above. The bottom deciles are very small compared to those of the ORD and, on the contrary, the deciles 0.7 to 0.8 are substantially higher. For an invariant distribution shape, we can conclude that we have fewer 1991 employees with very low earnings and more 1991 employees with high earnings.

Finally, the SS represents the effect of the shape shift in earnings between the two years, with the exclusion of the median effects in the relative density function. If we look at the deciles from 10% to 65% (and from deciles 76.5% to 87.5%), we conclude that considerably more than a half of the distribution located at the middle represents a proportion of 1991 employees less than 1985 employees. Moreover, we observe high values at the bottom 2.73 (1.5%) and at the top 2.0 (99.5%). This means that large differences at low and high deciles were registered. We have relatively more 1991 employees at the bottom (for percentile 1.5% the relative density value is 2.73) and at the top of the distribution (for percentile 98.5% the relative density value is 1.9).

4. THE IMPACT OF EDUCATION ON THE EVOLUTION OF PORTUGUESE EARNINGS DISTRIBUTION OVER THE PERIOD 1985-1991: A RELATIVE DISTRIBUTION ANALYSIS

Up until now, we analyzed the earnings distributions for two time periods. But we can also admit that the two series of values are different as a result of the presence of a variable Z, known as a covariate, which we will consider to be the level of education of employees. We can adjust the relative distribution of earnings with the changing distribution of years of education. We thus consider (Y_0, Z_0) as our reference data, corresponding to the 1985 employees' earnings, and (Y, Z) as our comparison data, corresponding to the 1991 employees' earnings. Following closely Handcock and Morris (1999), we build a virtual population for the reference data with the same covariate as the comparison data. What would the 1985 earnings have looked like if the 1985 employees had the same years of education as the 1991 employees?

We represent the marginal density of Y_0 by,

$$f_0(y) = f_{Y_0}(y) = \int f_{Y_0|Z_0}(y \mid z) \cdot f_{Z_0}(z) \cdot dz \tag{1}$$

If Y_A is the expression of Y_0 for the virtual reference distribution, its density distribution can take the form,

$$f_A(y) = \int f_{Y_0|Z_0}(y \mid z) \cdot f_Z(z) \cdot dz \tag{2}$$

where Y_A is a random variable describing Y_0 composition-adjusted to Z, which can be also expressed as,

$$f_A(y) = \int g_Z(r) \cdot f_{Y_0|Z_0}(y \mid Q_{Z_0}(r)) \cdot dr \tag{3}$$

where $g_Z(r)$ is the relative density of Z to Z_0 and $Q_{Z_0}(r)$ is the quantile function of Z_0.

With the composition-adjusted response distribution, the overall relative distribution is decomposed into a component that represents the effect of changes in the marginal distribution of the covariate (composition effect) and a component that represents the residual changes. In terms of density ratios we have:

$$\frac{f(y_r)}{f_0(y_r)} = \frac{f_A(y_r)}{f_0(y_r)} \cdot \frac{f(y_r)}{f_A(y_r)} \tag{4}$$

where the overall relative density is equal to the product of the density ratio for the composition effect by the density ratio of the residual effect.

In what follows we start with the study of the relative distribution of education for the two years, 1985 and 1991. After that we will evaluate two distributional impacts. The first one will be a compositional shift and the second one the change of relation between the response and the covariate variable. The first effect quantifies the impact of changes in the levels of education upon the earnings distribution. Even under the strong hypothesis of no change in the composition of the education of employees, the conditional distribution of earnings by education level has changed from 1985 to 1991, which is the target of the second covariate effect. Empirically these effects are obtained by counterfactual computations. We consider that the reference population of employees has the same covariate composition as the comparison population, so we can build the distribution of earnings neglecting changes on education levels. Finally, the

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residual differences in the relative distribution will be interpreted as a change in the covariate-response relation.

Before addressing the question raised above, we will characterize, first, the evolution of education in terms of the summary inequality and location measures, as well as through the inspection of education density figures. The situation for the period 1985-1991, in terms of years of education, is portrayed in the Table 4 below.

Table 4. Education Evolution

	Gini	Atkinson	Theil	Median (€)	Average (€)
1985	0.280	0.076	0.152	4	5.410
1991	0.304	0.079	0.159	6	6.720

Education inequality is undoubtedly higher in 1991 relative to 1985 based on the information of the Gini coefficient, but based on the information from the Atkinson and Theil coefficients the picture is not so clear. The location values have also increased, with an average growth rate of the median of 6.9% (total growth 50%), which is quite impressive. In Figure 6 below we can observe important differences for the lowest and highest levels of education.

Figure 6. Education Densities
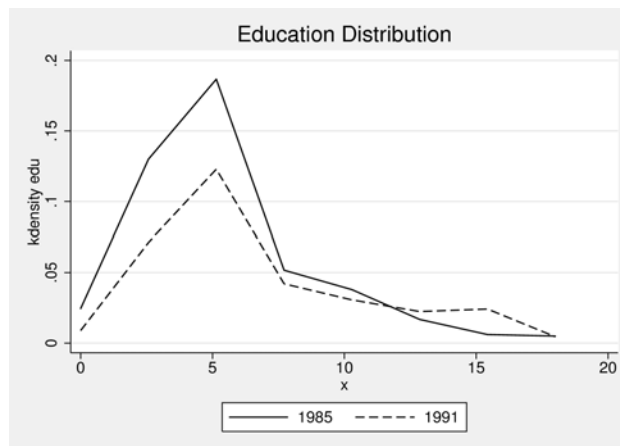
The relative distribution (see Figure 7 below) shows a 20% reduction in 1991 in employees with average years of schooling not higher than 7 years of schooling; and between 7 to 10 years of schooling, there are, in 1991, 32% more employees than in

1985. Finally, we have a disproportionate and high concentration on the top level of education in 1991, compared to 1985.

Figure 7. Education RD
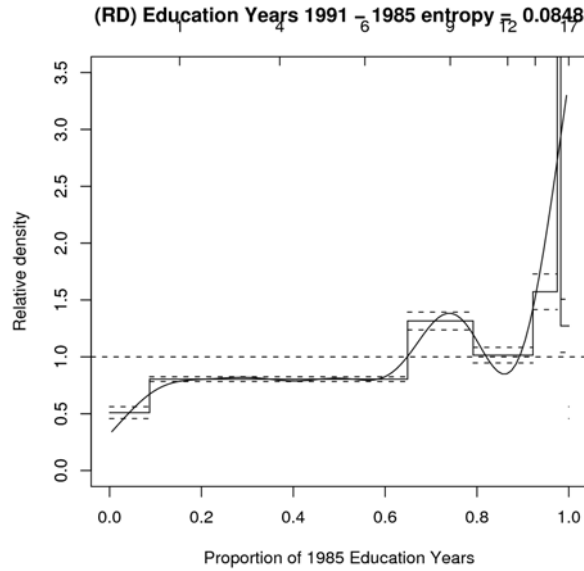
In Figure 8 below, we plot the overall relative distribution of earnings, which is the same as the one plotted in Figure 5. Additionally, we compute, in the education effect figure, the composition education effect on earnings. As can be seen, differences in education composition from 1985 to 1991 had a small impact on the relative distribution of earnings (see the low level of entropy 0.03). The fact that we had, in 1991, more "educated" employees, produced considerable effects on some parts of the distribution. Above percentile 72.5% of the 1985 cohort, we observe that relative density is greater than one, achieving the value 2 at the top of the relative distribution. This means that the number of employees with the highest level of education doubled in 1991 relative to 1985. Below percentile 72.5% of the 1985 cohort, 1991 employees receive lower earnings than 1985 employees.

Figure.8 Education Covariate decomposition of earnings
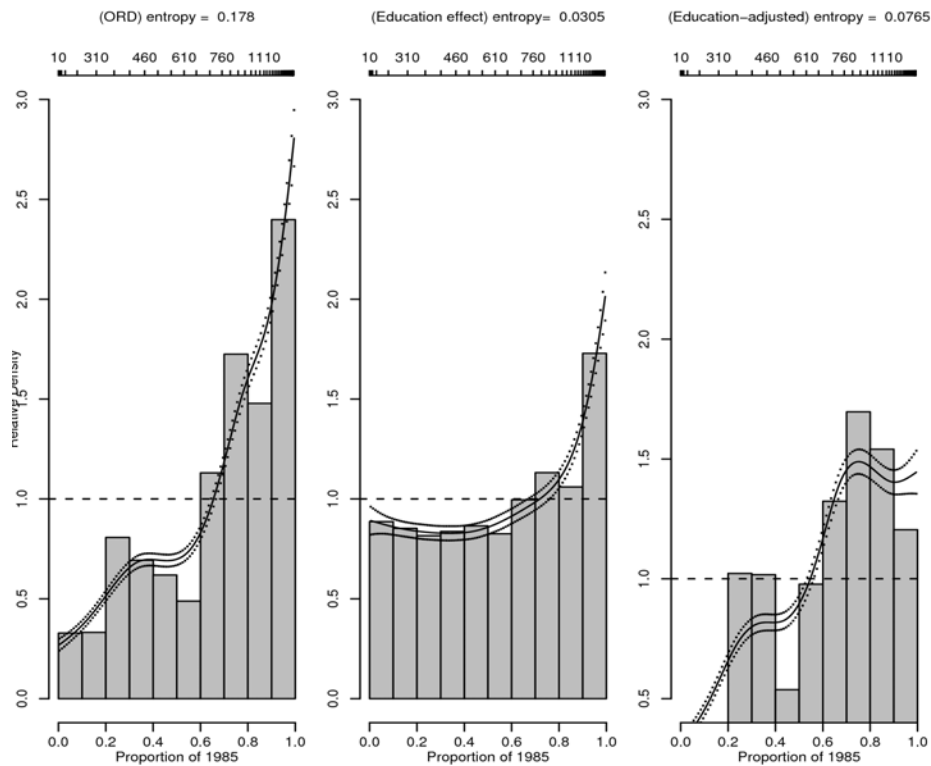
The conditional distribution of earnings by years of education would change even if we had the same distribution of employees by years of education, so the overall relative distribution would change. This aspect is represented in Figure 8 through the education-adjusted relative distribution of earnings. Until percentile 55% of the 1985 cohort, the 1991 distribution has values below those of 1985. Above that, more specifically from percentiles 67.5% to 72.5% and again near the top of the 1985 distribution, the values of the relative distribution are 40% to 50% larger. The entropy value is in this case 50% of the overall entropy value and 2.5 times higher than the one associated with the education effect. This result points to an increase in the returns to education over the period 1985-1991, which is in accordance with the literature on returns to education for the Portuguese economy (see e.g. Budria and Nunes (2005), Portugal (2004) and Hartog et al. (1999)). As can be observed in Table 5 below, MRP for the education-composition effect is negligible. On the contrary, for the composition-adjusted effect polarization increased 20%.

Table 5. Median Relative Polarization for Education Composition

	Estimate	p-value	95% CI (Normal-based)	
Education-composition effect	0.072	0.000	0.042	0.103
Composition-adjusted effect	0.196	0.000	0.167	0.225

A more accurate description of what happened due to different levels of education can be observed through the Relative Distributions associated with the levels of this covariate variable. The levels considered are: "<=4", representing the interval [0, 4] schooling years; "4<ed<=9" for the interval]4, 9]; "12" representing exactly 12 years of schooling; and ">12" for more than 12 years of schooling. In the histograms below (see Figure 9) we can identify a change in the shape of the distributions, smaller for the 2nd distribution. In what concerns the location, with the exception of the 1st and 2nd distributions, it is evident the shift to the left from 1985 to 1991. In Figure 9 below there is clear evidence that in Portugal more educated employees increased their earnings during this period, a conclusion based on the shift to the right of the respective densities.

Figure 9. RD by levels of education
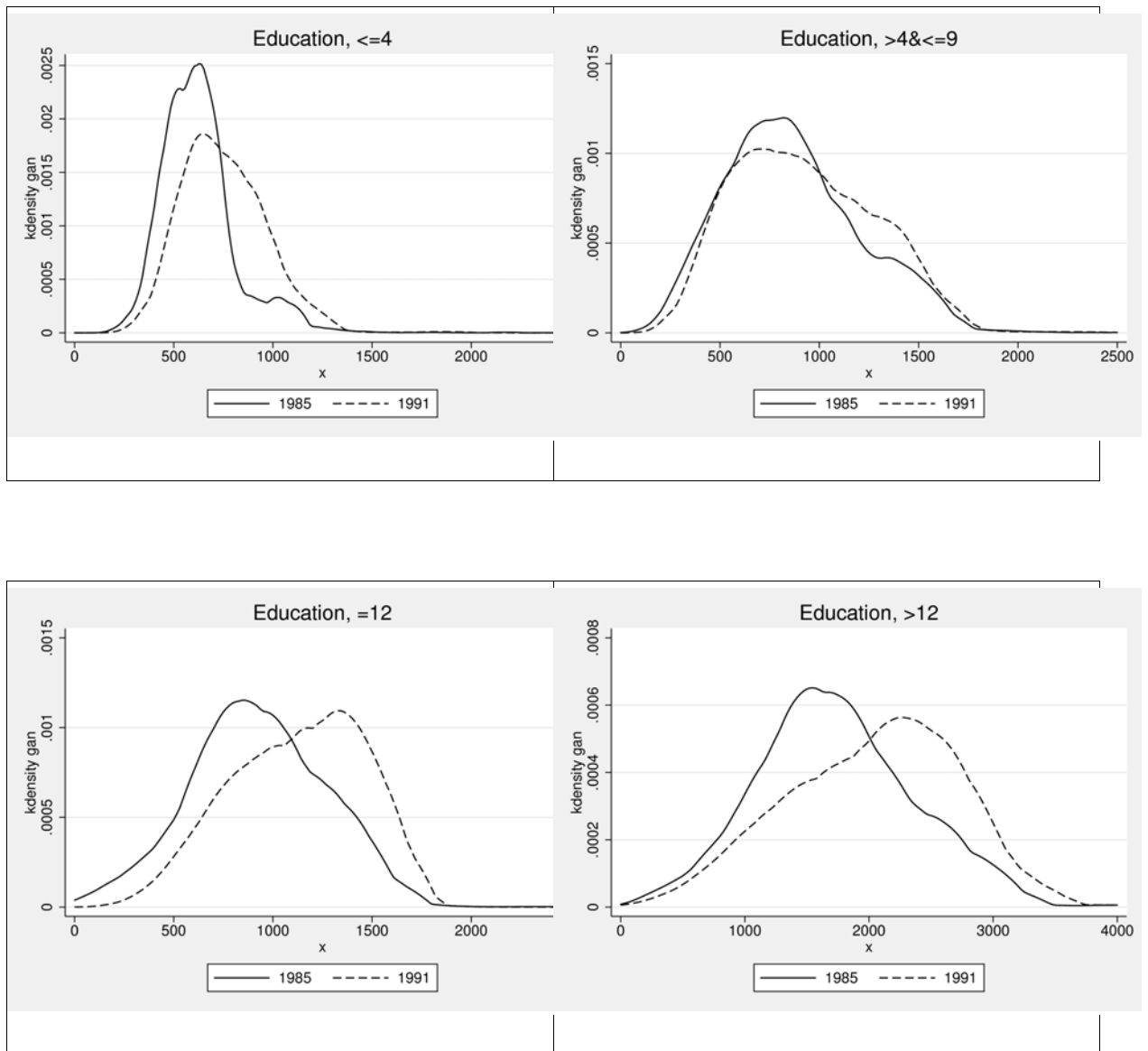
Figures 10 and 11 below for the relative distributions by levels of education confirm the above results. The low level of entropy coefficient (0.02) associated with years of education between 4 and 9 confirms the small overall divergence between the 1985 and 1991 distributions. For the first group, ("<=4), up to 72% of the 1985 cohort the 1991 proportion of employees is less than in 1985, meaning that fewer employees are receiving low-earnings. The relative difference is substantial at the top right of the distribution, reaching a maximum of 3.06 at percentile 99.5%. A greater proportion of 1991 employees earn the highest earnings (for this level of education). The distribution of earnings has not changed much for the second group of employees, even if at same points of the distribution there are considerable differences. The differences in the two

period distributions are higher for the first and third group (with 12 years of schooling), which is expressed by the entropy values. For the third group, until percentile 67% of the 1985 cohort, less 1991 employees are negatively affected in terms of earnings. The substantial differences are located again at the top right, from percentiles 96.5% to 99.5%, with a relative value higher than 3, meaning that three times more 1991 employees have the top earnings of this level of education. The differences for the most educated employees, (>12), between 1985 and 1991 are less important than for the other two groups previously analyzed, but are still important. After percentile 65.5% of the reference distribution, the relative density value is higher than one, reaching a maximum value of 2.3 at the top right of the 1985 distribution. The overall result is interesting: for all levels of education, except for the second group, the proportion of 1991 employees receiving "top" earnings is greater than for the original cohort.
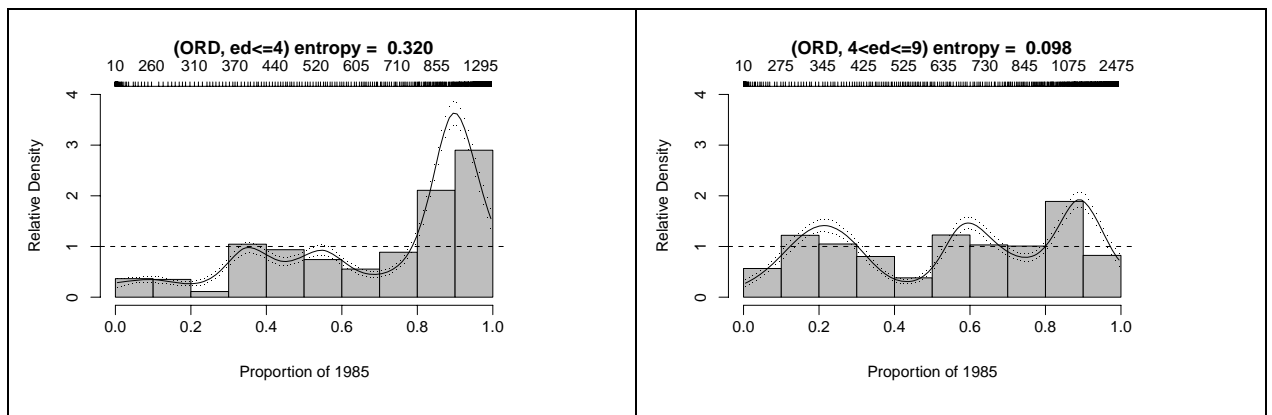
Figure 10. ORD with covariate "4<=ed" and "4<ed<=9"

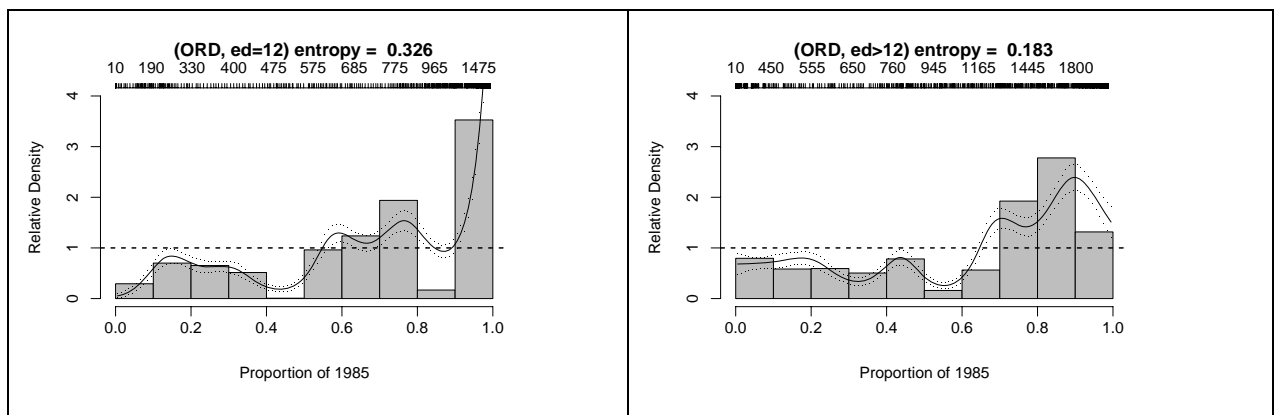Table 11. ORD with covariate "12<=ed" and "12<ed"

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Table 6 below is a summing up of the polarization measures associated with the relative distribution for the different levels of education. In the first column we have years of education.

Table 6. Relative Polarization Index

	Coefficient	Bootstrap S.E.	95% CI (Normal-based)	
<=4				
Median RP	.1654987	.0757557	.0132618	.3177355
Lower RP	.0921373	.1442686	-.1977813	.3820559
Upper RP	.23886	.1234109	-.0091435	.4868636
4<edu<=9				
Median RP	.2457626	.0497472	.1457919	.3457333
Lower RP	.265137	.0748555	.1147091	.4155648
Upper RP	.2263882	.0604085	.1049928	.3477837
=12				
Median RP	.0627228	.1519906	-.2427138	.3681594
Lower RP	.4012125	.1611833	.0773025	.7251225
Upper RP	-.2757669	.2750156	-.8284314	.2768976
>12				
Median RP	.1104747	.141691	-.174264	.3952133
Lower RP	.3289205	.1562023	.0150203	.6428208
Upper RP	-.1079712	.2818873	-.674445	.4585026

Recall that a positive value of the median relative polarization index (MRP) indicates an increase in the tails of the distribution while a negative value indicates convergence towards the center. A zero value represents no differences in the shape of the distribution. Notice that the upper RP for a number of years of education non inferior to 12 years is negative. This means that the contribution to the median index of the relative distribution above its median represents a process of convergence towards the median. But a more accurate inspection shows that, for these two cases, the CI is sufficiently large to prevent a clear interpretation of the results. Additionally, the S.E. are sufficient large to conclude we can't reject the nullity of any movement in terms of the polarization for the last two groups. For the first group (until 4 years of schooling)

we have a polarization, increase in the tail of the distribution, of 16%, with a value of 24% for the distribution above its median. In the case of the second group, from 4 to 9 years of schooling, we have a polarization of 24%, more or less equally distributed in terms of values above and below the median. The results confirm the growth of earnings inequality based on the increase of the tails in the case of these two groups and by figures of considerable importance.

5. CONCLUSION

In this study, we analyzed the impact of Portugal's accession to the EU in terms of employees' earnings inequality using data for the years 1985 and 1991 at the *Concelhos* level from the *Quadros de Pessoal* database. The period under analysis corresponds to a sort of honeymoon of Portuguese European integration. We investigate the evolution of the Portuguese earnings distribution over the period 1985-1991 emphasizing the influence of education on that distribution, using on a nonparametric, full information methodology, known as the Relative Distribution analysis. This methodology performs better than the usual empirical summary measures of inequality, or even parametric methods, allowing for the characterization of overall differences in distributions.

We confirm the increase in earnings inequality for the period under analysis through usual inequality measures (Gini, Atkinson and Theil coefficients), by using the stochastic dominance Lorenz curve, and also by the inspection of the CDF relative distribution figure. Relative polarization analysis shows evidence of an increase in polarization. From 1985 to 1991, 25% of employees moved from the center to the upper and lower quartiles. Based on the ORD we confirm that the employees at the bottom of earnings distribution are in 1991 less than those in 1985 and the inverse applies to the top of the earnings distribution. In terms of LS relative density, there are fewer 1991 employees with very low earnings and more 1991 employees with high earnings. As for the SS, we have relatively more 1991 employees at the bottom and at the top of the distribution.

The evolution of earnings distribution was further inspected by adding a covariate variable, the employees' level of education. The relative distribution for education shows a reduction of 20% of 1991 employees with average years of schooling not superior to 7; from 7 to 10 years, we have in 1991, 32% more employees than in 1985;

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and, finally, we have a disproportionate and high concentration on the top level of education in 1991, compared to 1985. In terms of the composition education effect, we confirm that the composition from 1985 to 1991 had a small impact on the relative distribution of earnings. Nevertheless, the number of 1991 employees doubled in terms of 1985 employees with the highest level of education and, below percentile 72.5% of the 1985 cohort, 1991 employees received fewer earnings than 1985 employees. The education-adjusted relative distribution seems to endorse the thesis that for Portugal, over the period 1985-1991, returns to education have increased. Additionally, an increase in polarization (20%) associated with this last distribution manifests itself for different levels of education. We confirm that for the group "<=4", fewer employees are receiving low-earnings and a greater proportion of 1991 employees earn the highest earnings. Differences for the second group, with more than 4 years of schooling and a maximum of 9 years of schooling were not detected. For the third group, substantial differences are identified, again at the top right of the distribution, from percentiles 96.5% to 99.5%. The difference for the most educated employees (>12) between 1985 and 1995 are less important: after the percentile 65.5% of the reference distribution the relative density value is greater than one (2.3 at the top). Summing up, for all levels of education, except for the second group, the proportion of 1991 employees receiving "top" earnings is greater than for the original 1985 cohort.

A major contribution of this paper is that it provides a complete and thorough picture of the differences in terms of employee's earnings distribution in the Portuguese economy between 1985 and 1991. This was possible due to a large extent to the use of the Relative Distribution methodology.

In future research, the consequences of the evolution of Portuguese employees' earnings distribution for Portuguese external competitiveness and economic growth should deserve our attention but are beyond the scope of this paper. For instance, regarding the consequences of the evolution of the Portuguese employees' earnings in terms of economic growth, it would be interesting to identify the theories that are best suited to explain the nexus for the Portuguese economy, the classical theories that predict a positive sign or, the more recent theories such as the borrowing constraints in human capital investment or the fiscal approach theories that predict a negative sign.

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