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THE DISTRIBUTION OF HOUSEHOLD INCOME AND EXPENDITURE IN PORTUGAL: 1980 AND 1990

BY MIGUEL GOUVEIA

University of Pennsylvania

AND

JOSÉ TAVARES

Harvard University

From 1980 to 1990 Portugal experienced a generalized liberalization of economic activity, due in large part to its 1986 integration in the European Union. This paper studies the changes in the Portuguese distribution of household income and expenditure during this period, using micro-data on household budgets and applying recent developments in statistical inference for Lorenz curves. We find a significant increase in six measures of welfare and an unambiguous decrease in the inequality of the respective distributions. Different explanations for the findings of decreased inequality are discussed.

1. INTRODUCTION

The distribution of personal income has long been a central concern of economists and policy-makers. After a post-war period of stability, countries such as the U.S. and the U.K. have been experiencing an increase in income inequality. Economists are still unsure whether this is a worldwide trend or a feature specific to a few countries.[1] This paper provides additional evidence on the issue by studying the case of Portugal, an European country classified as "upper middle income" by the World Bank (World Bank, 1993).

In trying to explain why income inequality is on the rise in countries such as the U.S., the effect of international trade on the distribution of income is often mentioned. This discussion has gained momentum in the last decade, as international trade expanded, competition intensified and regional free-trade areas gained relevance. In some countries, including the U.S., observers worry that the changing international division of labor might be causing an increase in the domestic earnings' inequality.

Another trend we have been witnessing in many countries is a shift away from government control of economic activity.[2] Countries moving towards more

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[1]Two examples of recent work on international comparisons of inequality changes are Gottschalk (1993) and Bourguignon and Morrisson (1992). The first finds a generalized tendency towards greater inequality in the countries included in the Luxembourg Income Study, with Germany being an exception. The second work finds clear trends towards greater inequality only in the U.S. and in the U.K.

[2]We are thinking not only of Eastern European countries, but also of Latin American countries where privatizations are either planned or in the making.

market oriented economies fear the effects on income distribution of both added international competitiveness and the liberalization of economic activity.

Against this background, Portugal from 1980 to 1990 is an interesting case-study. During that period, the main forces driving the economy and the distribution of income were precisely those outlined above. The integration in the European Union (EU) in 1986 intensified the internationalization of the economy. At the same time, governments began liberalizing internal markets. This liberalization came after two periods of heavy government intervention. During five decades (1926–74) Portugal was under a "dirigiste" right-wing dictatorship that distrusted competitive markets and adopted protectionist policies (Opello, 1985).

The politically unstable period that followed the 1974 revolution saw the nationalization of the entire banking system and the largest industrial firms. The reversal of these nationalizations began more than a decade later (Bermeo, 1990) and it was still far from complete in 1993. Even though some aspects of the Portuguese experience may be unique, there is something to be learned by studying the Portuguese case. The results will be of general interest to countries currently undergoing liberalization programs.

With this motivation in mind, we now state our goals. The main objective of this paper is to analyze and compare the distribution of income and expenditure in Portugal for the years 1980 and 1990. We use non-parametric statistics to estimate income and expenditure density functions. We construct rank curves (Saposnik, 1981) and examine the changes that occurred in the decade under study.[3]

We also focus on the issue of inequality by comparing Lorenz curves and computing inequality indexes.

Our results are obtained using micro-data on household budgets collected in 1980 and 1990. The use of micro-data is crucial on several grounds. An obvious gain is that we can estimate inequality indices without having to resort to approximations that aim at correcting for the grouping of the data.[4] A more important advantage is that by relying on micro-data we are able to apply the new developments in statistical inference for Lorenz, rank and generalized Lorenz curves. As Bishop *et al.* (1991) argue, the study of the distribution of income was too often conducted using only descriptive statistics. Since these studies invariably use sample data, this means that researchers ignored sampling variability and implicitly assigned a variance of zero to parameter estimates. The use of statistical inference provides a sounder methodological basis for comparisons of statistics such as income quantiles or income shares. These comparisons are necessary to establish either Lorenz dominance or crossing. Atkinson (1970) established that Lorenz dominance is a sufficient condition for ranking inequality in income distributions, but the fact that Lorenz curves often cross each other frequently limited the empirical relevance of Atkinson's result. However, by using the tools of statistical inference one finds that these crossings are often statistically insignificant.

[3]The rank curve is the same device as the well-known "Pen's Parade." See Pen (1971) and the updating in Jenkins and Cowell (1994). We keep the less evocative name of rank for convenience and also to conform with its current use in the literature.

[4]Cowell (1977) gives numerical examples showing how the grouping of observations can introduce large error margins.

Statistical inference thus effectively increases the number of cases where Lorenz domination is empirically relevant. An example of this situation will arise later in our analysis of the Portuguese data.

A brief account of our main findings follows. We consider six indicators of household welfare: total, per capita and equivalent household income and expenditure.

The results are essentially the same for the six concepts. They indicate a significant increase in the level of incomes and expenditure throughout the population. Did this arise at the cost of generating higher inequality? The answer is no. We found an unambiguous decrease in the inequality of the income and expenditure distributions.[5]

Having ruled out demographic changes as the origin for the drop in income inequality we then discuss alternative interpretations, such as changes in the quality composition of the work force, the likely effects of increased international trade, and a growth of the importance of transfer policies.

2. Data and Concepts

Data for this study come from the Survey of Family Budgets conducted by the Portuguese National Statistical Institute (INE) for the years 1980–81 and 1989–90.[6]

Some of the concepts used in these surveys are worth mentioning here. A household is a group of persons with the same residence and a common budget. Household income is the sum of net resources received by all household members, including earnings and capital income. It also includes income in-kind such as imputed rents or in-kind salaries. Finally, income is measured net of social security and income taxes and includes government transfers. Expenditures include all purchases of goods and services as well as the in-kind items above. We report all values at 1990 prices, using a thousand "escudos" as the unit of measurement.[7] Only data for mainland Portugal was considered. The entire population was covered with the exception of personnel in military installations.

In the following analysis we will present results for income and expenditure, in total, per capita, and equivalent terms. There are good reasons to consider all six variables. Most economists believe that expenditure is a better measure of

[5]After a first draft of this paper was completed, Rodrigues (1993) was made public. This work analyzes the same data sets and also finds a decrease in inequality. The two papers are, however, quite different: while Rodrigues concentrates on income inequality index decompositions for a variety of sample partitions, we emphasize dominance tests for rank, Lorenz, and generalized Lorenz curves and cover both income and expenditure.

[6]These two surveys provide the most recent available data on household income distribution. Their timing is significant. The first was conducted as the country was coming out of a transitional phase to complete civilian political control, after the 1974 revolution. It also follows a 1977 IMF sponsored stabilization program and predates the late arrival of the macroeconomic conditions caused by the second oil shock. The second survey was initiated 3 years after integration in the EU, during a period of governmental stability. Thus a comparison of 1980 to 1990 will be presentative of the changes occurring during the decade.

[7]We used the consumer price index to scale up 1980 values. Alternative indices like the national accounts' consumption deflator yielded similar results.

welfare than income.[8] Measurement error in income reporting provides an additional reason for using the expenditure concept: survey respondents tend to underreport income relative to expenditures.[9] On the other hand, the existence of capital market imperfections and liquidity constrained households limits the empirical relevance of consumption as a proxy for life-cycle welfare. Also, Atkinson (1983) presents ethical arguments for using income. Since no measure is likely to be perfect, either on measurement or conceptual grounds, we will report results for both income and expenditures. The inclusion of income will also facilitate international comparisons, since that is the variable most frequently available and used in the literature.

We will report on total and per capita variables. We also computed results accounting for the returns to scale in household consumption by using euqivalence scales. Equivalence scales are generally considered to be a better measure of the "needs" of a household than per capita values.[10] Following Buhmann *et al.* (1988), equivalent incomes y^* are obtained from income y as

$$y_i^* = \frac{y_i}{N_i^{\delta}},$$

where N_i and y_i are respectively the number of individuals and the income of household i. The parameter δ is the equivalence elasticity. Calculations presented use $\delta = 0.6$.[11] Note that total and per capita income also correspond to measures of equivalent income, when δ above is respectively 0 and 1.

As in the previous case of the choice between income and expenditure, it turns out that the qualitative results are the same regardless of which variable is chosen. Notice that when dealing with total household income or expenditure we consider the number of observations to be the number of households. However, when studying per capita or equivalent values we followed Danziger and Taussig (1979) and considered the number of observations to be the number of individuals: a household with four individuals provides four observations of per capita or equivalent values.

[8]An example of a household welfare distribution study focusing on expenditure is Cutler and Katz (1992). Theoretically, using a life-cycle model and assuming perfect capital markets it is possible to define restrictions on preferences such that one period consumption is a reliable indicator of lifetime welfare. In general no similar conditions can be found for income (Blundell and Preston, 1990). Slesnick (1993) illustrates how a consumption based analysis can yield results that substantially differ from those based on income.

[9]Mean household expenditure is often greater than mean household income. See our Table 1. INE (1986) reports that survey workers notice greater resistance to income than to expenditure reporting. An additional problem is the extent to which the underground economy affects the data. However, even though we ignore the importance of the so-called informal sector, there are no reasons whatsoever to suspect its relative importance changed substantially during the 1980s. The comparison between 1980 and 1990 distribution data should thus be relatively immune to measurement problems.

[10]See, v.g. Cowell (1984).

[11]Coulter *et al.* (1992) study the sensitivity of inequality measures to choosing different scales. Rodrigues (1993) documents the robustness of inequality results for our data with respect to the choice of equivalence elasticities.

TABLE 1

MEANS AND STANDARD DEVIATIONS

	1980			1990		
	N	Mean	St. Dev.	*N*	Mean	St. Dev.
Total expenditure	8,035	1,109.86	1,019.58	9,640	1,323.19	1,116.84
Per capita expenditure	26,606	335.18	305.02	29,662	430.61	357.60
Equivalent expenditure	26,606	557.18	469.47	29,662	696.69	529.70
Total income	8,035	1,038.36	779.62	9,640	1,277.86	964.61
Per capita income	26,606	313.58	229.18	29,662	415.86	294.46
Equivalent income	26,606	522.73	345.69	29,662	673.89	444.86

Definitions: "total"—unequivalized household distribution, household weighted; "per capita"—household income per capita, person weighted; "equivalent"— household income/(household size), person weighted. See text for details.

Table 1 presents summary statistics for the income and expenditure variables. Figures 1 and 2 show the results of non-parametric estimates of the density functions for total household income and expenditure, respectively. To restrict density estimates to positive values, the sole type in our samples, we estimated the density function for the logarithms instead of the levels and then performed a change of variable. Estimates were obtained by using a normal kernel with window widths determined by the cross-validation method.[12]

It is apparent from these figures that the 1990 distributions approximately correspond to rightward shifts of the 1980 distributions. In other words, 1990 distributions seem to exhibit first degree stochastic dominance over the 1980 distributions.[13]

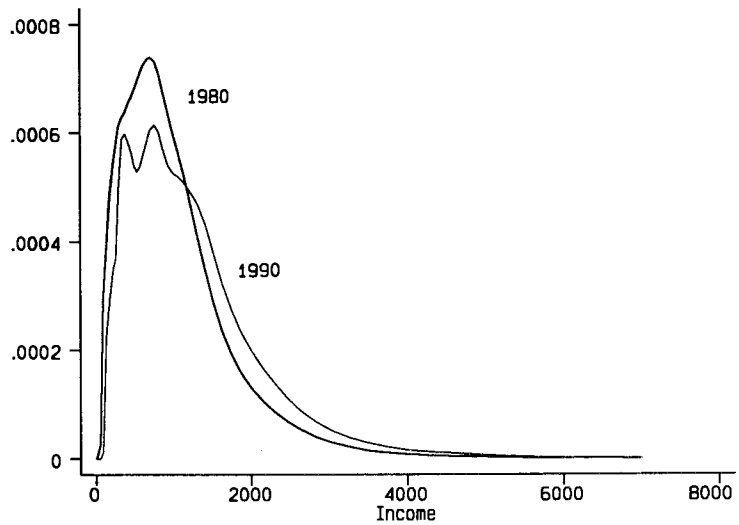

Figure 1. Household Income Density

[12]See Silverman (1986, Chap. 3) or Härdle (1990, Chap. 5) for details.
[13]See Rothschild and Stiglitz (1970) for definitions of stochastic dominance.

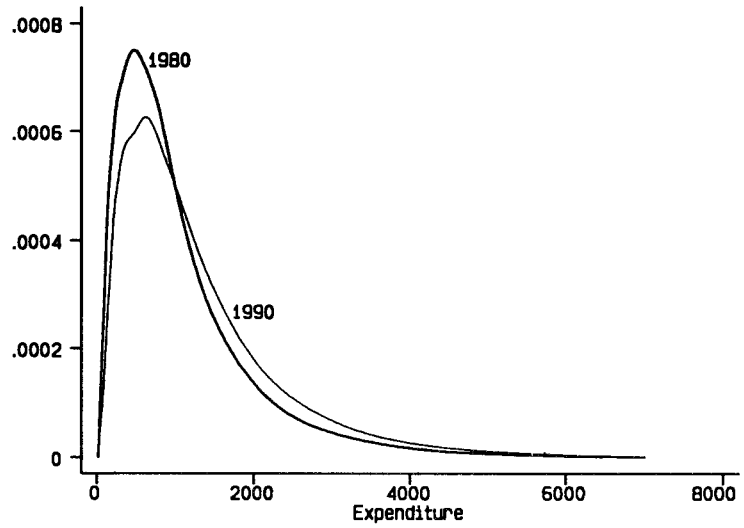

Figure 2. Household Expenditure Density

In the next section we present a formal test of this hypothesis, the results of which confirm the visual suggestion of dominance. However, the effect of income growth on inequality is less clear: for example, the distribution of total household income becomes bimodal.[14] Clearly a visual appreciation is insufficient to evaluate the changes. Section 3 will provide the quantitative information necessary for that evaluation.

3. Income and Expenditure Distributions

3.1. *Dominance Concepts*

The welfare economics literature includes references to three different dominance concepts that allow the ranking of income distributions: rank, Lorenz and generalized Lorenz dominance. These three concepts correspond to different ethical judgments and it is helpful to think of these judgments as properties of social welfare functions.

The rank curve associates population deciles to their conditional mean incomes. Income distribution *a* rank dominates income distribution *b* if the rank curve for *a* is always above the rank curve for *b*. This notion corresponds to first-degree stochastic dominance.[15]

Of the three dominance concepts that we will use, rank dominance is the one that relies on the weakest assumptions: the strong Pareto principle and anonymity. The strong Pareto principle means that an increase in the income of any household increases social welfare. The principle of anonymity requires that all households

[14]Cowell *et al.* (1993) report a similar finding of bimodality for the U.K. income distribution. We will return to this topic in our concluding section.

[15]See Saposnik (1981). Bishop *et al.* (1992) contains an empirical application of the concept.

be identically considered in the social welfare function. We also need the assumption of population invariance to apply the dominance concepts to income distributions of populations differing in size (Cowell, 1977). Not surprisingly, since rank dominance embodies the weakest assumptions its verification is the hardest one to obtain empirically.

Rank dominance implies (but it is not implied by) Generalized Lorenz dominance, which corresponds to second-degree stochastic dominance.[16] In addition to the assumptions required for rank dominance, it values equality in the income distribution by satisfying Dalton's principle: transfers from rich to poor always generate a better income distribution. Generalized Lorenz dominance is equivalent to preference measured by any increasing and strictly concave social welfare function. Graphically this dominance concept corresponds to non-intersecting generalized Lorenz curves, defined below.

The third concept, Lorenz dominance (Atkinson, 1970), focuses on inequality only and ignores income or welfare levels. Graphically it corresponds to non-intersecting concentration or Lorenz curves. It coincides with generalized Lorenz dominance if the means of the two distributions being compared are equal: the generalized Lorenz curve of a distribution simply corresponds to scaling up the respective Lorenz curve by its mean.

3.2. *Statistical Inference*

Two preliminary steps precede testing for any type of dominance. The first is to find the sampling distributions of the parameter estimates in which we are interested. The second is choosing the tools appropriate to the simultaneous statistical inference problem we will be facing.

The traditional empirical use of these dominance concepts, in particular Lorenz dominance, neglected the role of sampling variability. The ordinates for the Lorenz curve were calculated from the data and the resulting values were treated as the true population values rather than mere sample estimates. Beach and Davidson (1983), among others, filled this methodological vacuum by deriving the variance-covariance matrix for the *sample* Lorenz and Generalized Lorenz curves' ordinates. Beach *et al.* (1994) extended these results to the rank curve.

The results listed above allow us to compute the appropriate covariance matrices, but we still have the problem that a statement of dominance involves the *simultaneous* comparison of the deciles. In order for that comparison to be valid we will use the SMM—Studentized Maximum Modulus—distribution.[17]

We can now test for the existence of any of the three types of dominance.

3.3. *Testing for Rank Dominance*

The curves we are about to present are built after ranking the observations by increasing income or expenditure.[18]

[16]See Shorrocks (1983). Lambert (1989) contains a detailed study of the concept.

[17]See the Appendix for more details on the covariance matrices and the SMM.

[18]In each of the six cases presented we rank the observations according to the variable being studied. This means the ranking of households changes with the concept used.

TABLE 2A

RANK DOMINANCE—EXPENDITURE

Decile	Total			Per capita			Equivalent		
	80	90	t-ratio	80	90	t-ratio	80	90	t-ratio
1	180.02	229.13	−9.07	85.84	119.47	−17.55	142.80	190.84	−27.43
	(3.64)	(4.00)		(1.19)	(1.50)		(1.11)	(1.36)	
2	342.95	422.51	−10.01	134.09	182.40	−22.35	222.01	292.04	−35.92
	(5.37)	(5.86)		(1.46)	(1.60)		(1.21)	(1.52)	
3	480.78	591.09	−12.10	170.95	227.74	−22.56	276.84	368.15	−41.67
	(6.19)	(6.69)		(1.64)	(1.91)		(1.36)	(1.72)	
4	615.96	749.83	−12.57	207.89	273.56	−22.46	332.48	437.85	−43.94
	(7.23)	(7.82)		(1.97)	(2.16)		(1.56)	(1.82)	
5	760.06	926.84	−13.72	248.06	321.18	−21.90	391.88	510.21	−41.31
	(7.72)	(9.39)		(2.28)	(2.44)		(1.85)	(2.19)	
6	917.01	1,125.43	−14.89	293.18	376.22	−20.05	461.27	592.88	−37.51
	(9.51)	(10.27)		(2.68)	(3.15)		(2.41)	(2.55)	
7	1,120.17	1,375.99	−14.48	354.11	450.49	−18.64	556.76	705.90	−31.93
	(11.67)	(13.26)		(3.54)	(3.77)		(3.07)	(3.52)	
8	1,404.09	1,709.65	−12.85	437.64	552.29	−15.99	684.39	864.64	−30.46
	(16.43)	(17.18)		(4.79)	(5.33)		(3.82)	(4.52)	
9	1,867.89	2,252.92	−11.33	584.05	722.22	−12.42	894.68	1,110.61	−24.37
	(23.07)	(24.95)		(7.66)	(8.06)		(5.88)	(6.63)	
10	3,408.75	3,848.55	−5.09	1,122.75	1,339.55	−5.61	1,608.03	1,893.28	−11.95
	(64.84)	(57.15)		(25.32)	(29.18)		(17.11)	(16.63)	

Note: Definitions as in Table 1. Standard errors in parentheses.

TABLE 2B

RANK DOMINANCE—INCOME

Decile	Total			Per capita			Equivalent		
	80	90	t-ratio	80	90	t-ratio	80	90	t-ratio
1	199.97	266.73	−12.24	101.93	146.22	−23.47	164.32	223.58	−33.16
	(3.83)	(3.89)		(1.23)	(1.43)		(1.14)	(1.38)	
2	374.22	454.91	−9.57	151.54	203.90	−25.36	249.33	326.42	−38.27
	(5.82)	(6.10)		(1.47)	(1.45)		(1.37)	(1.48)	
3	527.38	638.71	−11.12	187.83	245.84	−24.41	308.57	398.20	−40.79
	(6.87)	(7.28)		(1.57)	(1.79)		(1.39)	(1.70)	
4	668.01	803.59	−12.91	222.18	289.99	−24.43	362.46	467.64	−43.98
	(7.02)	(7.81)		(1.81)	(2.10)		(1.52)	(1.84)	
5	801.93	983.71	−15.50	257.12	334.94	−26.80	417.64	539.18	−47.47
	(7.12)	(9.31)		(1.86)	(2.23)		(1.64)	(1.97)	
6	950.05	1,176.85	−17.32	296.46	385.19	−24.32	475.73	613.14	−46.74
	(8.65)	(9.84)		(2.46)	(2.70)		(1.89)	(2.25)	
7	1,120.59	1,383.60	−18.77	346.43	445.07	−23.35	544.53	701.11	−45.94
	(9.60)	(10.21)		(2.82)	(3.15)		(1.13)	(2.63)	
8	1,330.06	1,645.85	−17.93	411.35	526.86	−21.11	640.84	821.14	−40.90
	(11.30)	(13.51)		(3.46)	(4.24)		(2.86)	(3.36)	
9	1,669.17	2,070.59	−15.94	514.32	670.17	−18.23	788.60	1,010.24	−33.32
	(17.12)	(18.46)		(5.45)	(6.58)		(4.14)	(5.20)	
10	2,741.84	3,354.05	−8.92	906.16	1,145.11	−8.60	1,274.47	1,637.28	−19.29
	(44.93)	(51.89)		(18.71)	(20.54)		(11.79)	(14.65)	

Note: Definitions as in Table 1. Standard errors in parentheses.

TABLE 3A

LORENZ CURVES—EXPENDITURE

Decile	Total			Per capita			Equivalent		
	80	90	t-ratio	80	90	t-ratio	80	90	t-ratio
1	0.01621	0.01732	−2.50	0.02358	0.02617	−5.02	0.0256	0.0274	−6.08
	(0.0003)	(0.0003)		(0.0004)	(0.0004)		(0.0002)	(0.0002)	
2	0.04710	0.04925	−2.19	0.06042	0.06612	−5.38	0.0655	0.0693	−6.74
	(0.0007)	(0.0007)		(0.0008)	(0.0007)		(0.0004)	(0.0004)	
3	0.09039	0.09392	−2.28	0.10738	0.11601	−5.17	0.1152	0.1222	−8.07
	(0.0012)	(0.0010)		(0.0012)	(0.0011)		(0.0006)	(0.0006)	
4	0.14588	0.15059	−2.19	0.16450	0.17594	−4.87	0.1749	0.1850	−8.61
	(0.0016)	(0.0014)		(0.0017)	(0.0016)		(0.0009)	(0.0008)	
5	0.21433	0.22063	−2.28	0.23264	0.24632	−4.44	0.2452	0.2582	−8.67
	(0.0021)	(0.0018)		(0.0023)	(0.0021)		(0.0011)	(0.0010)	
6	0.29697	0.30578	−2.60	0.31322	0.32870	−4.01	0.3279	0.3434	−8.40
	(0.0026)	(0.0022)		(0.0028)	(0.0026)		(0.0014)	(0.0012)	
7	0.39787	0.40979	−2.99	0.41051	0.42738	−3.59	0.4279	0.4447	−7.74
	(0.003)	(0.0025)		(0.0034)	(0.0032)		(0.0016)	(0.0014)	
8	0.52445	0.53888	−3.20	0.53092	0.54843	−3.17	0.5507	0.5688	−7.36
	(0.0035)	(0.0028)		(0.0040)	(0.0038)		(0.0019)	(0.0016)	
9	0.69272	0.70915	−3.49	0.69146	0.70657	−2.44	0.7114	0.7282	−6.53
	(0.0037)	(0.0029)		(0.0045)	(0.0043)		(0.0020)	(0.0016)	

Note: Definitions as in Table 1. Standard errors in parentheses.

TABLE 3B

LORENZ CURVES—INCOME

Decile	Total			Per capita			Equivalent		
	80	90	t-ratio	80	90	t-ratio	80	90	t-ratio
1	0.01925	0.02087	−3.52	0.03001	0.03328	−6.18	0.0314	0.0332	−5.80
	(0.0004)	(0.0003)		(0.0004)	(0.0004)		(0.0002)	(0.0002)	
2	0.05528	0.05647	−1.16	0.07463	0.07969	−4.85	0.0791	0.0816	−4.27
	(0.0008)	(0.0007)		(0.0008)	(0.0007)		(0.0004)	(0.0004)	
3	0.10603	0.10646	−0.26	0.12993	0.13565	−3.59	0.1382	0.1407	−3.00
	(0.0012)	(0.0011)		(0.0012)	(0.0011)		(0.0006)	(0.0006)	
4	0.17036	0.16940	0.44	0.19535	0.20166	−2.89	0.2075	0.2101	−2.30
	(0.0016)	(0.0014)		(0.0016)	(0.0014)		(0.0008)	(0.0008)	
5	0.24755	0.24632	0.46	0.27105	0.27795	−2.48	0.2874	0.2901	−1.92
	(0.0020)	(0.0018)		(0.0021)	(0.0018)		(0.0010)	(0.0010)	
6	0.33907	0.33842	0.20	0.35837	0.36558	−2.11	0.3784	0.3811	−1.59
	(0.0024)	(0.0022)		(0.0026)	(0.0023)		(0.0012)	(0.0012)	
7	0.44696	0.44669	0.07	0.46037	0.46688	−1.61	0.4826	0.4852	−1.31
	(0.0027)	(0.0025)		(0.0030)	(0.0027)		(0.0014)	(0.0013)	
8	0.57511	0.57549	−0.10	0.58157	0.58681	−1.13	0.6051	0.6070	−0.86
	(0.0029)	(0.0027)		(0.0035)	(0.0030)		(0.0015)	(0.0015)	
9	0.73583	0.73753	−0.41	0.73302	0.73935	−1.27	0.7561	0.7569	−0.38
	(0.0030)	(0.0028)		(0.0038)	(0.0032)		(0.0016)	(0.0015)	

Note: Definitions as in Table 1. Standard errors in parentheses.

We first study rank dominance. The empirical rank curve graphs the mean income or expenditure of each decile against the cumulative relative frequency of the sample (the p_i's). Tables 2A and 2B show the estimates of the decile means for 1980 and 1990 and their respective standard errors. The tables also include the vector of the t–statistics that are used to test for the significance of the differences.

The t–statistics lead to the conclusion that 1990 rank dominates 1980 for any reasonable confidence level, that is, all deciles have significantly higher means in 1990.

This means that the distribution of welfare was unambiguously "better" in 1990 as measured by all increasing social welfare functions. The presumption of first-degree stochastic dominance motivated by Figures 1 and 2 is thus verified. Finally, since first-degree stochastic dominance holds, this implies that the income distribution in 1990 also exhibits Generalized Lorenz dominance over 1980.

We interpret these results as evidence supporting that between 1980 and 1990 real incomes increased significantly. They also indicate that income growth was spread across all income levels and did not benefit just a particular income class or classes. These findings are somewhat unexpected if we consider that growth in real wages was negative in the early 1980s. In other countries increasing labor force participation rates have made up for weak (sometimes negative) real wages' growth (Levy, 1988) but additional work is needed to ascertain whether that explanation also applies to Portugal. At any rate, the high growth of real wages in the late 1980s is probably the main explanation for our findings.

3.4. *Testing for Lorenz Dominance*

The previous section established that any reasonable measure of social welfare would indicate a positive change in the decade under study. However, one might make the case that equality by itself constitutes an important political and ethical value. There is also the possibility that household welfare is determined not only by absolute income levels but also by relative position in society.[19] In both instances, inequality becomes an issue deserving a separate treatment. Was it the case that the welfare gains were obtained at the cost of increasing inequality? In fact, the opposite is true since we obtained the strong result that 1990 Lorenz dominates 1980.

Tables 3A and 3B present the ordinates and their standard errors for the 1980 and the 1990 Lorenz curves.

A conventional analysis using descriptive statistics would find that 1990 Lorenz dominates 1980 if the welfare indicators used are: (i) total, per capita or equivalent expenditure; (ii) per capita or equivalent income. This conclusion is correct, even though some 1990 ordinates present values not significantly greater than 1980 counterparts.[20]

[19]Sen (1982), among others, and others has made this point.

[20]Distribution a Lorenz dominates distribution b if all a ordinates are greater or equal than b ordinates and at least one strict inequality holds.

One case appears to be the exception: the empirical Lorenz curves for total income cross. Apparently, this indicates that a comparison of the income distributions for both years requires the use of subjective judgments.[21] This is one instance where the use of statistical inference pays off. If we look at the t-statistics reported in Table 3B for total income we notice that they are all insignificant, with the exception of the first. For the first decile we find a difference that is significant at the 1-percent level. We thus obtain the result that for total household income distributions, 1990 statistically Lorenz dominates 1980. With this additional piece of evidence we achieve unanimity of the qualitative results obtained for the six variables measuring welfare, all pointing in the direction of decreasing inequality.[22]

4. Discussion and Conclusions

We begin by restating the main findings of our work. First, all the six measures studied (total, per capita and equivalent income and expenditure) indicate that there was a significant increase in household welfare during the period from 1980 to 1990, spread across all income or expenditure levels. The second finding is that there was a statistically significant decrease in the inequality of the distribution of these welfare measures.

The results obtained are quite strong but the decrease in inequality has only been exposed, not explained. Explanation is an entirely different task, one we do not undertake in this paper. There are, however, preliminary questions we can raise and try to answer with the data at our disposal.

A simple explanation could be a shift in the demographic composition of the population. Portugal experienced demographic changes that are common to other European countries, in particular an aging of the population and a reduction in household size. We conducted a shift-share analysis of the 1980 and 1990 data to evaluate the quantitative importance of these two demographic trends and found that their influence was negligible.[23] Rodrigues (1993) investigates these and other compositional shifts (sex of household head, rural/urban, employment status, etc.) and finds that they also fail to explain the inequality results.[24]

Since demographic variables lack explanatory power, we are left with a basic question: why did inequality decrease in Portugal at the same time it increased in most other OECD countries? We believe that there are three possible explanations for the empirical findings. The first hypothesis relies on the changes in the

[21]Not to mention the need to take a stance on the worth of total income as a household welfare measure.

[22]Given that Lorenz dominance prevails, all reasonable inequality indices must reveal a decline in inequality. We list below the results for the Gini index. The first value of each pair corresponds to 1980 and the second to 1990: Total Income (0.3680, 0.3676), Per Capita Income (0.3305, 0.3200), Equivalent Income (0.3132, 3092), Total Expenditure (0.4238, 0.4090), Per Capita Expenditure (0.3956, 0.3682), and Equivalent Expenditure (0.3796, 0.3578). Rodrigues (1993) reports a wider range of indices and their standard errors.

[23]These results are available on request.

[24]Returning to our Figure 1, Cowell *et al.* (1993) explain their findings of a bimodal distribution for the U.K. as reflecting the dichotomy between households with members working v. not working. Rodrigues' findings indicate that dichotomy is unimportant in explaining Portugese inequality changes. Another possible interpretation for bimodality is that of a "vanishing" middle class. Again, this interpretation may be hard to accept in a context of decreasing inequality.

quality composition of the work force.[25] During the period covered in our study the average schooling level of the population increased. More importantly, there was a reduction in the variance of the distribution of years of schooling in the work force.[26] If the functions relating earnings to the characteristics of workers such as schooling are stable across periods, a reduction in the variance of schooling leads to lower earnings (and income) inequality. Of course, the same factors that increased inequality in other countries, such as technological changes in production and information processing, may also have been operating. However, maybe because of delays in technology adoption relative to wealthier countries, these factors did not determine the overall evolution of inequality. It is an open question whether, as the country catches up technologically, the trends dominating other OECD countries will also drive the evolution of inequality in Portugal.

The second hypothesis relies on the increasing importance of international trade and the comparative advantage characteristics of the Portuguese economy. Within the EU, Portugal has comparative advantage in labor-intensive sectors requiring a low-skilled work force (Courakis, 1991). Integration in the EU might have increased the relative demand for low-skill labor, giving those at the bottom of the earnings distribution the greatest gains from expanded trade.

It is interesting to note here that the argument in the U.S. has been that international trade increases inequality by decreasing the domestic demand for low-skilled workers and shifting this demand to other countries. Portugal, within Europe, is an example of the other end of this demand shift, since its comparative advantage is in sectors using those low-skills. The same trade-induced specialization that increases inequality in the U.S., has the potential to decrease inequality in countries like Portugal.

The third hypothesis is that of an increase in the importance of redistribution policies.[27] This is plausible because while in other OECD countries the welfare state had already "matured," it was still growing in Portugal during the 1980s, through either higher income-support levels for poor households or more generous public pensions for retired workers.[28] This increase in redistribution outlays was probably facilitated by the inflow of "structural adjustment" funds from the EU.

At this stage of our research we ignore the quantitative importance of these alternative explanations. However, we believe they can provide motivation for future research. It seems clear that we must examine income sources separately (earnings and government transfers in particular) to be able to gain an understanding of the mechanisms generating lower inequality. Also, earnings should be studied in such a way as to disentangle the effects of international trade.

The results reported in this paper are good news to countries embarking on a liberalization path. The Portuguese experience in the 1980s stands as testimony

[25]In contrast to the situation in the 1960s and 1970s, migration was unimportant in the 80s.

[26]Using individual data for full-time workers in our data sets we estimate that the average years of schooling increased from 5.7 in 1980 to 6.3 in 1990, but the standard deviation decreased from 4.0 to 3.9.

[27]The results for the first decile of the household income Lorenz curve suggest that the decrease in inequality was due in large part to improvements at the bottom of the distribution. This is consistent with improvements in redistribution policies targeted at the poor.

[28]According to Banco de Portugal (1992, pg. 92), domestic transfers (not including interest payments) increased from 10.9 percent of Personal Income in 1980 to 15.6 percent in 1990.

to the possibility of internal and external liberalization coinciding with both income growth and falling inequality.[29] The challenge is now to explain how this result came about and whether it is a fortunate exception or the result of replicable and sustainable policies. In particular we would like to explore the roles played by international trade and economic policy in achieving this inequality reduction.

Appendix

Statistical Inference for Lorenz, Generalized Lorenz and Rank Curves

This appendix summarizes the basic statistical inference tools used in the paper.

The main contribution to the literature on statistical inference for Lorenz curves is Beach and Davidson (1983) (BD). To state their results, let us start by defining Y to be income, distributed according to a c.d.f. $F(y)$ and with mean μ. Given the vector $p_i = i/10$, $i = 1, \ldots, 10$, the population deciles ξ_i are defined by $F(\xi_i) = p_i$. The vector of conditional means is Γ, with $\gamma_i = E(Y \mid Y \leq \xi_{p_i})$.

Θ, with $\theta_i = p_i \gamma_i$ is the decile vector of a generalized Lorenz curve and $\hat{\Theta}$ its sample counterpart. Theorem 1 of BD states that if F is strictly monotonic, twice differentiable and has a finite mean and variance, then $\sqrt{n}(\hat{\Theta} - \Theta)$ follows asymptotically a multivariate normal distribution, with mean zero and covariance matrix Ω, with

$$\omega_{ij} = p_i[\lambda_i^2 + (1 - p_j)(\xi_{p_i} - \gamma_i)(\xi_{p_j} - \gamma_j) + (\xi_{p_i} - \gamma_i)(\gamma_j - \gamma_i)] \text{ for } i \leq j,$$

where λ_i^2 is defined as the variance of Y conditional on $Y \leq \xi_{p_i}$.

Theorem 2 of BD establishes a similar result for the vector of Lorenz curve ordinates.[30]

Beach *et al* (1994) studied the rank curve.[31] Define the vector of decile means M, with $\mu_i = E(Y \mid \xi_{p_{i-1}} < Y \leq \xi_{p_i})$. Then, the results in Beach *et al.* state that $\hat{M}$ is also asymptotically normal in that $\sqrt{N}(\hat{M} - M)$ has a limiting multivariate normal distribution with zero mean and covariance matrix $V = R\Omega R'$, where

$$R = \begin{pmatrix} (p_1/(p_1 - p_0)) & 0 & \cdots & \cdots & 0 \\ -(1/(p_2 - p_1)) & (1/(p_2 - p_1)) & \cdots & \cdots & 0 \\ \vdots & \vdots & \ddots & \ddots & \vdots \\ 0 & \cdots & 0 & -(1/(p_{10} - p_9)) & (1/(p_{10} - p_9)) \end{pmatrix},$$

and where $p_0 = 0$.

Given asymptotic normality and independence, one can test for the equality of a single Lorenz curve ordinate in two different income distributions by comparing the t-statistic with the tables for the standard normal distribution. However,

[29] Using aggregate data Rodrigues (1986) found an increase in inequality from 1973 to 1980. Maybe Portugal fits the Kuznets (1953) hypothesis that establishes a u-shaped relationship between development and equality.

[30] Note that to use the theorems we need to replace the parameters by consistent estimates.

[31] See also Jäntti (1992).

since when we investigate curve dominance we are performing a *simultaneous* comparison of the 10 decile ordinates, we cannot use the standard distributions to determine the critical values for the t–statistics.

In all the above cases, we can test the null hypothesis of the equality of two curves by comparing the appropriate statistic with the critical values of a χ^2. However, that is not the concern we have in mind when testing for dominance since we are interested in testing each decile.[32] To accomplish that, in the case of rank dominance, we compute the following t–statistics:

$$T_i = \frac{\hat{\mu}_i^a - \hat{\mu}_i^b}{[(\hat{\sigma}_{ii}^a/N^a) + (\hat{\sigma}_{ii}^b/N^b)]^{1/2}},$$

where N_a and N_b are the number of observations in the sample income distributions a and b, and σ_{ii} are the diagonal elements of the respective V matrices. We can construct the t–statistics for the Lorenz and generalized Lorenz dominance cases in a similar way.

Since we are performing a *simultaneous* comparison of the 10 decile ordinates, we cannot use the standard distributions to determine the critical values for the t–statistics. Instead, we use the SMM—Studentized Maximum Modulus distribution for the reasons discussed by Bishop *et al.* (1992).

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[32]In most cases the null hypothesis of equality will be rejected. The question is how to go beyond that result.

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