THE WAGE DISTRIBUTION IN PORTUGAL: 1982-1994*

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1. INTRODUCTION

In the last decade, Portugal has devoted very substantial resources to modernise its industrial structure, both by subsidising investment in modern technologies and by creating training programmes. In addition, educational levels of labour force have been continuously increased, largely as a result of increases in the number of years of mandatory schooling, which led to a shift in the supply of labour towards more skilled workers.

It comes therefore natural that the impact of this effort on the structure of wages and wage inequality should be under scrutiny. Our goal is to know if, as in many other countries, inequality increased in Portugal in the 1980's; and if Portuguese data are consistent with the hypothesis that the eventual increase in wage inequality can be due to a shift in labour demand favouring high-skilled labour at the expense of low-skilled labour, primarily caused by changes in the technology.

This paper summarises the main findings of an analysis of the wage distribution and of its evolution in the 1980's and the first half of the 1990's, focusing on the role played in the process by human capital accumulation[1].

Analysts of the determinants of wages have acknowledged the leading role of heterogeneity among both work places and individuals. As a consequence, for instance, the returns to education may vary across individuals with the same observed human capital. In our analysis, we use quantile regression techniques. Unlike the usual least squares (mean) regression, these techniques allow the study of the efforts of each of the covariates along the whole distribution. Therefore, our methodology allows us to account for this heterogeneity, and to extract useful information from it.

The paper is structured as follows: Section 2 describes briefly the samples employed and provides an overview of the evolution of the Portuguese labour market. Section 3 gives a non-technical introduction to the quantile regression methodology employed in the analysis. Regression results are presented and discussed in Section 4. Finally, Section 5 offers concluding remarks.

2. DATA AND MAIN FACTS

This paper analyses the relevance of covariates representing gender, human capital (as measured by education, experience and tenure), firm attributes (size and ownership status) and industry attributes in explaining wage distribution[2].

(2) Note that we analyse wages, and not total earnings. Wages include all salaries paid between March 1982 and September 1994. Nor payments in kind neither eventual annual bonus which were not paid over the referred months are included. The relative importance of these items is expected to be greater at the top of the wage distribution, and increasing over the period under review.

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Table 1

REAL GROWTH OF WAGES 1982-1994

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Mean	2.8
Quantiles	
10	1.6
25	1.5
50	1.7
75	2.5
90	3.6

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Table 2

LABOUR FORCE ATTRIBUTES

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	1982	1994
Sex (% of females)	0.29	0.39
Years of schooling	5.05	6.33
Schooling classes		
(% in each class)		
less than 4 years	10	3
4 years.	59	45
6 years.	14	26
9 years.	15	28
14 years.	2	4
Experience.	23.84	22.70
Tenure	8.50	7.79

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The data employed were obtained from a survey (*Quadros de Pessoal*) conducted by the Portuguese Ministry of Employment, covering the work force of all firms employing paid labour in Portugal. We use data from 1982 and 1994, respectively the first and the last year for which information was available. For each year, we selected random samples of about 5,000 full-time wage earners employed by firms located in mainland Portugal.

Tables 1, 2 and 3 provide a brief description of the data, and document with clarity a number of relevant changes that have occurred in the labour market. Real wages increased significantly over the period. Indeed, the average wage increased by 2.8 per cent in annual average real terms. However, this wage increase was very unevenly distributed. While wages at the bottom of the distribution (first decile, first quartile and median) increased by about 1.5 per cent per year, the salaries at the third quartile and at the ninth decile increased by 2.5 and 3.6 per cent per year, respectively. Obviously, this pattern of growth led to an increase in the relative dispersion of the wage distribution. The increase in dispersion was particularly evident at the top of the distribution, where the differences between the ninth decile and the third quartile widened from 50 to 73 per cent, which contrasts with a virtual stability of the distance between the first quartile and the first decile.

The composition of the labour force also exhibited important changes in the period. Women represent an increasing proportion of the labour force, from about 30 per cent in 1982 up to 40 per cent in 1994. During this period, the education level of the labour force also increased quite substantially, from an average of five years of schooling to an average of six, reflecting the increased years of mandatory schooling. This evolution is also visible in the distribution of the working population across the schooling classes. There is a marked increase in the percentage of workers with 6 years of education or more. For instance, individuals with 4 years of education or less, which accounted for almost 70 per cent of total working population in 1982, were no longer the majority in 1994.

"Experience" is defined as age minus the number of years of schooling minus 6 (the age of entrance in primary schooling). The evolution of this variable reflects the combined evolution of age and schooling. As the average age of individuals in the sample remain virtually constant around 35 years, experience displays a decrease over time. Unlike experience, the database contains direct information on tenure within a firm. The data shows that average tenure also decreased during this period. This evolution chiefly reflects the significant flows of entry and exit of firms experience during this period, leading to a reduction in the average age of firms, and hence in the average tenure.

Regarding labour demand, the data contains observation on the firm size (represented by the number of employees per firm), main activity and ownership status (whether the firm for which the individual works has a majority of state/private and domestic/foreign capital). The referred firm turnover is also associated to the decrease of average firm size. Table 3 indicates that foreign-owned

Table 3

FIRM ATTRIBUTES

	1982	1994
Size (average of log of number of employees)	5.14	4.50
Foreign (% total).	0.06	0.07
State (% total)	0.12	0.09

Chart 1

WAGE DISTRIBUTION FOR MEN AND WOMEN

firms increased their importance, while state-owned firms became less important over time.

3. QUANTILE REGRESSION

Our econometric analysis uses quantile regression techniques. Whilst the interpretation of results requires previous knowledge of the methodology, this section gives a simple graphic illustration of the concept underlying quantile regression.

Consider the distribution of wages (y) for men and women. In this context, we have a single regressor (x), which can only take two values, *0* for women and *1* for men. A wage distribution is defined for each gender, as shows chart 1.

Point *A* represents the mean of y given $x = 0$, $E(y|x=0)$ and, analogously, $A' = E(y|x=1)$. Connecting these points one gets the (population) mean or least squares regression. The usual approach to earning functions is to estimate regressions of this form. This type of estimation is useful in that it measures the impact of gender on mean wage. Of course, these models do not imply that all the individuals of a given gender earn the same wage: the remaining variability (i.e., the deviations from the mean), however, is treated as nuisance and disregarded in the analysis.

Points *B* and *B'* represent the 75-th quantile of the distribution of *y* for men and women, respectively ($B = Q_{75}(y|x = 0)$ and ($B' = Q_{75}(y|x = 1)$). For instance, 75 per cent of women earn less than the wage corresponding to *B*. Quite in the same way as done with the mean, one may connect *B* and *B'*, so we get a line representing the 75-th quantile of the conditional distribution of *y* for different values of *x* — that is, the 75-th quantile regression. Of
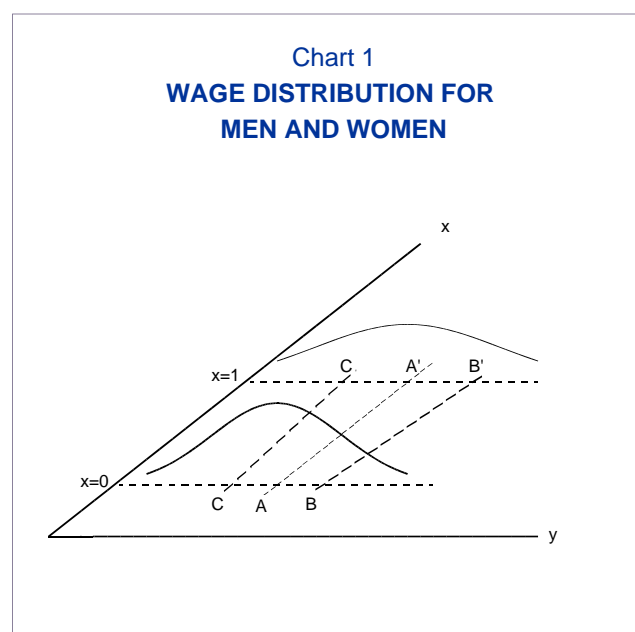
course, the same can be done for other quantiles yielding a whole set of quantile regressions. These are functions of *x* of the type $Q_p(y|x)$ for *p* in (0,1) (in chart 1 CC' stands for ($Q_{25}(y|x)$)). As chart 1 shows, the different regressions do not necessarily convey the same information on the way covariates (x) impact the variable analysed (y) — which means regression lines are not necessarily parallel. On average, men can be paid 13 per cent more than women, at the same time a man in the 25-th quantile of the men's wage distribution only earns 10 per cent more than a woman in the same place of women's wage distribution. Just in the same way, the wage spread between gender may reach 16 per cent when measured at the 75-th quantile of each distribution. Therefore, wage differences between men and women can be proportionally greater at the top of the distributions. Unlike a simple mean regression, the quantile regression conveys this information.

4. RESULTS

4.1 Wage determinants

This section discusses the impact of some of the covariates presented in section 2 upon the probability distribution of the log of hourly wages. We will present both the quantile regressions and some global characterisation of the wage distributions and their evolution over time.

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Table 4

QUANTIL REGRESSION - SEX

	Average	Quantiles				
		10	25	50	75	90
1982	-14.546	-10.679	-10.434	-13.191	-15.846	-19.909
1994	-15.614	-8.629	-11.926	-14.321	-16.844	-17.183

Tables 4 and 5 exhibit the estimated coefficients of covariates "sex" and "education" at different points of the distribution of the log of wages. To allow a comparison with the effects upon the mean, the tables also present the OLS estimates [3].

Sex

The first column in table 4 shows that, on average, women make 15 per cent less than otherwise comparable men (i.e., with the same human capital and employed at the same firm) and that this figure has experienced a slight increase from 1982 to 1994. The information retrieved from the remaining columns confirm that, *ceteris paribus*, the distribution of women's wages is clearly to the left of men's (all the coefficients are negative). It also indicates that the estimate of an average 15 per cent pay penalty is not an accurate description of the differences between the wage distributions for men and women. In fact, in 1994 the first decile of women's wages is only 9 per cent lower than the corresponding decile of men's wages, but the median is already 14 per cent lower and, at the 9-th decile, the difference reaches 17 per cent. The fact that wage differentials are wider at the top than at

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(3) Although estimates for these two variables are the only presented, our regressions included all regressors referred in section 2, plus 26 industry dummies. We focus on the variables for which coefficients varied the most from 1982 to 1994. All estimates were obtained from linear specifications of the quantile regression,

$$Qp(y|x) = \alpha(p) + \sum_{j=1}^{k} x_j \beta_j(p), \; p \in (0,1)$$

where x_j denote the covariates and β represent the corresponding coefficients, which are quantile-specific. Detailed results are presented in the Working Paper version.

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Quadro 5

**RETURNS TO ONE ADDITIONAL
YEAR OF SCHOOLING**

Edu-cation	Average	Quantiles				
		10	25	50	75	90
Years 1982						
4	1.282	0.447	1.081	1.752	2.552	1.854
6	7.056	5.129	6.235	6.318	7.895	8.773
9	9.152	8.721	8.056	7.808	8.827	9.688
14	8.763	6.308	8.857	10.123	10.062	9.144
1994						
4	0.418	0.315	1.161	1.336	1.907	-0.662
6	5.066	2.188	3.391	4.786	5.758	8.013
9	8.239	4.54	5.443	7.409	9.826	12.359
14	11.254	7.449	10.251	11.986	12.863	13.845

the bottom of wage distribution translates into men having a relatively more dispersed wage distribution than women. Although the same qualitative results also hold for 1982, some quantitative changes have occurred over the 12 years period under scrutiny. Indeed, while sex differentials increased (though slightly) for individuals earning wages at the middle of the distribution, they are smaller for the top and the bottom of the pay scale.

All "human capital" covariates — years of schooling, tenure and experience — have positive returns at every point of the wage distribution. Table 5 presents the results for education.

Education

The results indicate a clear change in the wage distribution. The return to an additional year of education observed in 1982 was basically independent of the educational class (except for the 4-year class). However, return is clearly an increasing function of schooling. Moreover, schooling has an evident positive impact on the wage dispersion in 1994.

The returns of having just the "primary education" have dramatically decreased from 1982 to 1994 at all quantiles. Moreover, at the bottom of the formal education scale, the number of years in school does not have much bearing on the reasons why an individual has a relatively high pay job.

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Apparently, the return from having 9 years of schooling has declined somewhat on the left tail but has increased at the 75-th and 90-th quantiles. Finally, the returns of holding a university degree (14 years of schooling) are the only ones which increased at all quantiles from 1982 to 1994.

One may conclude that returns to education are not necessarily positive: it makes virtually no difference to have no formal education or just 4 or even 6 years of schooling, at least for those individuals which are at the top of the wage distribution. Only after a certain degree does education pay off. When it does, education is more valued for high-paid jobs.

Experience and tenure

We now briefly discuss the results for experience and tenure. It is very clear that the effect of either variable is positive over the entire wage distribution. In 1982 the returns to experience are roughly constant all over the distribution, but in 1994 they are higher for the highest quantiles. Tenure, on the other hand, exhibits both in 1982 and 1994 approximately constant returns on the midpart and left tail of the wage distribution but with a significant reduction at the top quantiles. Tenure is thus more valued at relatively low-paid jobs.

Firm effects

Our regressions also include covariates to control for employers' heterogeneity, namely as regards size and ownership status. Larger firms pay more to workers with the same attributes. Notably in 1982, larger firms tend to have a larger wage spread.

The impact of the covariates reflecting the type of firm ownership — "state" and "foreign" — is quite diverse. State ownership is much more relevant at the lower tail of the wage distribution: relatively low-paid workers earn more in state-owned firms, but the impact of this attribute dies out as one moves along the wage distribution and is statistically insignificant for higher wages. Therefore, state ownership tends to compress the wage spread, even controlling for workers' observed characteristics. On the contrary, the presence of foreign capital not only shifts the whole distribu-

tion to the right — hence increasing wages at all levels — but increases proportionately more relatively high-paid jobs.

4.2 The wage distribution

We are now in a good position to analyse the conditional wage distribution. It should be stressed that the conditional distribution refers to individuals with the average observed attributes, employed in an "average" firm — thus contrasting with the distribution analysed in section 2, which provided an estimate for the marginal wage distribution.

The estimates in the first column of table 6 will be obtained using the 1982 regression coefficient and the 1982 regressions sample averages. Analogously, the second column presents estimates evaluated at the 1994 averages and coefficients. The last column presents the estimates obtained using the coefficients from the 1994 regressions but the 1982 average values of the covariates. The estimates in the first two columns refer to the distribution of wages observed in each year, in samples of individuals that are identical with respect to the attributes considered in the models. The estimates in the last column attempt to provide a counterfactual depiction of what would be the 1994 wage distribution if the amounts of human capital, firm size and other covariates would have remained constant at their 1982 average value[4].

Comparison of the two last columns in table 6 enables to disentangle two types of factor that may have caused the changes in the conditional wage distribution: changes in the average level of the covariates and changes in the coefficients associated to these inputs. For instance, consider the change in the average amount of human capital on one side, and the changes in the returns to this capital on the other. What comes out very clearly from

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(4) Analytically, the first column yields the estimates for $Qp(y_{82}|\bar{x}_{82})$ — obtained using the β coefficients estimated with 1982 data and the regressors estimated on the 1982 sample average (see footnote 1). The second column gives the estimates for $Qp(y_{94}|\bar{x}_{94})$ — using the 1994 β coefficients and the 1994 regressors sample averages. In the third column we estimated $Qp(y_{94}|\bar{x}_{82})$ — obtained using the β coefficients estimated with 1994 data and the regressors estimated on the 1982 sample average.

Table 6

THE CONDITIONAL WAGE DISTRIBUTION

	1982	1994	1994
			At 1982 covariates
Dispersion			
log(q90)-log(q10)	0.73	0.82	0.75
log(q75)-log(q25)	0.36	0.40	0.37

this exercise is that both changes contribute towards increasing inequality. However, the overall contribution of changes in returns (or more generally, in the coefficients) is relatively modest, as compared with changes in the average quantity of inputs. Indeed, the inequality indices in table 6 clearly reveal that most of the estimated change in the wage inequality was due to changes in the distribution of the workers' attributes, rather than to an increase inequality within workers with the same attributes.

5. CONCLUSION

This paper analysed the wage distribution for Portugal and its evolution from 1982 to 1994. The role of education in this evolution was given particular evidence. Results show that the returns of having just the "primary education" have dramatically decreased over the 12 years under scrutiny at

all quantiles, and are no longer significant in 1994. On the other end of the educational spectrum, the incremental returns of having a university degree have increased at every point of the wage distribution, but with a much sharper rise for the top quantiles. Education is proportionally more valued for better (high-paid) jobs.

The observed increase in returns to education goes alongside with an increase in the average level of education of the working population. Unlike in the USA, for instance, where the increase in returns to may have been induced by a reduction in the number of college graduates, in Portugal we had an increase in returns to university education, despite the remarkable increase in the number of college graduates. What this necessarily suggests is a significant shift in labour demand towards more skilled workers, which probably reflect changes in the underlying technology.

Wage dispersion increased over the period under scrutiny. Results suggest that the bulk of wage inequality was due to changes in the distribution of the workers' attributes, rather than to changes in the returns to those characteristics. Take education for example. As seen, and notwithstanding an overall positive impact on wages, education is relatively more valued at the upper quantiles of the distribution, therefore increasing wage dispersion. The outstanding increase in the average educational level of the labour force is, therefore, estimated to have contributed to the increase in wage inequality observed from 1982 to 1994.