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Intra-Regional Regional Wage Inequality In Portugal: A Quantile Based Decomposition Analysis

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**INTRA-REGIONAL WAGE INEQUALITY IN PORTUGAL: A QUANTILE BASED
DECOMPOSITION ANALYSIS**

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ABSTRACT

Studies on intra-regional inequality are scarce, particularly for European countries. This paper aims at further investigating inequality by focusing on wage differences within regions. We consider the case of Portugal which is referred as one of the countries with highest economic inequality. In particular, we analyse the evolution of intra-regional wage inequality between 1995 and 2005, employing the quantile-based decomposition method suggested by Melly (2005). Our results show that wage inequality evolution has been different for the several regions in Portugal, as it increased in some regions and decreased in others. Different changes in the work force composition explain these diverse developments.

Keywords: Inequality, regions, quantile-based decomposition

JEL Classification:

1. INTRODUCTION

Economic inequality is a major concern for governments but also for academics around the world. Studies report that economic inequality remained relatively stable since the second world war until the 1980s (Blinder, 1980; Lemieux, 2008). However, in the 1980s and 1990s several studies reveal an upward trend in economic inequality in many countries, namely in Anglo-Saxonic countries such as USA, UK and Canada (Lemieux, 2008). Other countries, such as France, Japan and Germany did not experience such upward trend in inequality. There is also evidence that the upward trend in inequality continued in the 2000s in the USA and other countries but at a slower pace (Autor et al., 2008; Centeno and Novo, 2009; Dustmann, 2009; OECD, 2011).

The vast majority of studies analyse inequality at national level or differences among countries. There are as well several studies that have considered inter-regional wage differences (Blackaby and Murphy, 1995; Garcia and Molina, 2002; Motellón et al., 2011; Pereira and Galego, 2011; Pereira and Galego, forthcoming). However, research at intra-regional level, rising issues of potential spatial heterogeneity on wage inequality, is very scarce, particularly about Europe (Monastiriotis, 2002; Taylor, 2006; Dickey, 2007 for UK; Goerlich and Mas, 2001 for Spain or Perugini and Martino, 2008 for the European regions). Yet, in order to better understand the causes of wage inequalities it is important not only to investigate inequalities at national level and even inter-regional differences, but also to study intra-regional inequality. Indeed, regional inequality may have important economic consequences, namely it may reduce economic growth in the long run (Goerlich and Mas, 2001; Perugini and Martino, 2008). Therefore, a full knowledge

of this labour market feature is important in order to improve the effectiveness of policies and to design inequality correction programs.

This paper aims at further investigating inequality by focusing on wage differences within regions. We consider the case of Portugal which is referred as one of the countries with highest economic inequality (OECD, 2005, Cardoso, 1998; Centeno and Novo, 2009). Although Portugal shares most institutional features of Continental Europe, it displays inequality levels similar to those of the Anglo-Saxonic countries (Centeno and Novo, 2009; Cardoso, 1998). There are as well important and persistent inter-regional wage differentials in Portugal, which are documented by several studies (Vieira et al., 2006; Pereira and Galego, 2011, Pereira and Galego, forthcoming). Nevertheless, as for the rest of Europe, empirical research focusing on earnings inequality within regions is missing in Portugal.

The evolution of intra-regional wage inequality in Portugal between 1995 and 2005 is analysed. We consider data from the Portuguese Ministry of Employment – *Quadros de Pessoal* - and employ a quantile-based decomposition method suggested by Melly (2005). To the best of our knowledge, this is the first application of this methodology to the issue of intra-regional wage inequality. This approach has several advantages in relation to the usual single index measures (Gini, Theil, etc.) commonly used in economic inequality analysis. First, it allows analysing economic inequality along the entire wage distribution. Secondly, single index measures can yield different rankings of inequality, as they weight differently distinct parts of the wage distribution (Melly, 2005). Finally, and in the spirit of the Blinder (1973) and Oaxaca (1973) and Juhn et al. (1993) decompositions, Melly (2005) method decomposes changes in inequality into components

explained by changes in characteristics, returns to characteristics and residuals, allowing for a better understanding of the causes for changes in inequality.

Our results show that wage inequality evolution has been heterogeneous in the several regions of Portugal, as inequality increased in some regions, but decreased in others. In general, there was a trend towards lower wage inequalities between and within specific groups of workers in the regions (due to coefficients and residuals). Hence, the increase in wage inequality in some regions is explained by substantial improvements in the work-force composition (due to changes in characteristics). These findings confirm that it is important to consider the analysis of inequality inside regions, besides national inequality and inter-regional inequality, in order to better understand the patterns of inequality in each country.

The paper is organised as follows. In section 2 there is a summary of the empirical literature on inequality. In section 3, the methodology used in this study is presented. Section 4 provides a preliminary analysis of the data. In section 5 we present and discuss our findings. Section 6 concludes.

2. BRIEF REVIEW OF EMPIRICAL EVIDENCE ON INEQUALITY

Investigation on economic inequality regained strong interest as several studies for Anglo-Saxonic countries documented an increase in inequality since the 1980s to at least the middle of the 2000s (Autor et al., 2008; Lemieux, 2008; OECD, 2011). However, the pattern followed by economic inequality along these decades was not equal. While in the eighties inequality increased along the entire wage distribution, in the following decades the increase was concentrated in the upper-tail of the wage distribution (Autor et al., 2008; Lemieux, 2008).

A field of the literature has suggested that skill biased technological change, driven by the computer revolution, raised the relative demand for skilled workers leading to an increase in inequality (Acemoglu, 2002; Krueger, 1993). However, analyses for other countries (like France, Germany and Japan) reveal that inequality did not follow the same trend as in English-speaking countries. Therefore, other complementary explanations emerged stressing the role of wage-setting institutions to justify these different developments. First, in continental Europe the wage-setting process is more centralised and unions have a stronger influence than in USA. Second, the decline in the real minimum wage in the USA accounts for most of the increase in wage inequality at the lower end of the wage distribution (Dinnardo et al., 1996). Third, Piketty and Saez (2006) point out performance pay schemes of executive and top executives as responsible for the increased of the top-end inequality in the nineties. Finally, de-unionization may also have contributed to increase top-end inequality (Card, 1992; Freeman, 1993).

Within continental Europe, Portugal is one of the countries with highest economic inequality in the private sector (Cardoso, 1998; OECD, 2005; Centeno and Novo, 2009). Cardoso (1998) reports a very high level of wage inequality in Portugal as compared to other labour markets by mid-eighties. At that time, overall wage inequality (measured by the Gini index) was higher in Portugal than in Canada, Sweden, Australia and West-Germany, but similar to that of UK (which was slightly lower than that of USA, the paradigm of an unequal labour market). Since the beginning of the eighties Portugal has been continuously displaying high levels of inequality, although with some fluctuations, with inequality levels by mid-2000s being higher than in the eighties (Centeno and Novo, 2009). In 2006 wage inequality in the upper tail of the wage distribution was even higher in Portugal than in USA (Centeno and Novo, 2009).

Studies on wage inequality in Portugal have identified differences in education (Andini, 2010; Carneiro, 2008; Centeno and Novo, 2009; Machado and Mata, 2005), differences in skills as well as changes in the relative demand for very qualified workers within industries (Cardoso, 1998) as the most important factors explaining inequality. Since the beginning of the eighties to mid-nineties, inequality increased both due to the rise in the returns to education and to compositional changes in the work force, mainly concerning education (Machado and Mata, 2005; Centeno and Novo, 2009). After this period, compositional changes in the work force had a stronger role on inequality change, reflecting a greater supply of educated workers (Centeno and Novo, 2009).

Research focusing on intra-regional inequalities is much less common and mainly analyse the case of UK: Monastiriotis (2002), Taylor (2006) and Dickey (2007). There is as well a study for Spain (Goerlich and Mas, 2001) and another for European regions (Perugini and Martino, 2008). Studies for UK conclude that there are significant regional differences in inequality and that the causes differ across regions. Monastiriotis (2002) studies both inter and intra-regional inequality between 1982 and 1997, concluding that most of the increased inequality in the UK in this period was due to within regions differences. The author further concludes that the main determinant of wage inequality was the evolution of the returns to occupations. The focus of Taylor (2006) is on within-group wage inequality across UK regions, its causes and how they evolved along a 15 year period. Dickey (2007), in turn, investigates inequality at different points of the earnings distribution, concluding that increasing returns to occupation, age and skills were responsible for the widening of all regional earnings distributions. Moreover, this author identifies the factors that shape inequality differences across regions, like differences in wage premium for high-skilled workers and on the impact of migration.

Goerlich and Mas (2001) employ several inequality indicators for analysing inequality in the provinces and regions of Spain, concluding that there are marked differences in income inequality in the country. They also found evidence of a negative correlation between regional inequality, per capita income and growth. In fact, the richest (poorest) regions of the country are those more egalitarian (unequal). The negative association between inequality and growth is not confirmed in the study of Perugini and Martino (2008) for European regions, as the results indicate that regional inequality promotes growth in the short and medium-terms. However, the negative link between inequality and growth is not rejected in the long term.

For Portugal, the analysis of earnings inequality within regions has been neglected. However, at inter-regional level the literature reports important, persistent, and increasing differences along the wage distribution, partially explained by regional differences in education, occupational structure and the firm size (Vieira et al., 2006; Pereira and Galego, 2011a, Pereira and Galego, forthcoming).

3. METHODOLOGY

We base our empirical analysis on Melly (2005) quantile based decomposition. Melly (2005) uses a similar framework as Juhn et al. (1993) to decompose differences in wage distributions between two time periods (years). The methodology takes as a starting point quantile estimations for $t=0$ (1995) and $t=1$ (2005) for Mincerian type wage equations:

$$\ln w_i^t = x_i^t \beta^t(\theta) + u_i^t, \quad t = 1, 0 \quad (1)$$

where $\ln w_i^t$ represents the hourly real wage (in logs) $i=1, \dots, n$ is the number of observations in each year t , θ is the quantile being analysed, u_i^t is an idiosyncratic error term, and x_i represents a set of explanatory variables.

In the spirit of Juhn et al. (1993), the objective is to decompose changes in wage inequality along the time into three components: changes in characteristics, changes in coefficients and changes in residuals. First, Melly (2005) notes that taking the median as a measure of central tendency of the distribution, the wage equation for each time period can be written as:

$$\ln w_i^t = x_i^t \beta^t(0,5) + u_i^t, \quad t = 1, 0 \quad (2)$$

Where $\beta^t(0,5)$ is the coefficient vector of the median regression in year t .

Next, the counterfactual wage distribution, that is the distribution that would have prevailed in period 0 if the distribution of individual characteristics had been the same as in period 1, has to be estimated. This can be calculated by minimizing the following expression, over the distribution of x_i in year 1 and using the coefficient estimates for period 0.

$$\hat{q}(\hat{\beta}, x) = \inf \left\{ q : \frac{1}{N} \sum_{i=1}^N \sum_{j=1}^J (\tau_j - \tau_{j-1}) \mathbf{1}(x_i \hat{\beta}(\tau_j) \leq q) \geq \theta \right\} \quad (3)$$

Hence,

$$\hat{q}(\hat{\beta}^0, x^1) = \inf \left\{ q : \frac{1}{N} \sum_{i=1}^N \sum_{j=1}^J (\tau_j - \tau_{j-1}) \mathbf{1}(x_i^1 \hat{\beta}^0(\tau_j) \leq q) \geq \theta \right\} \quad (4)$$

is the θ th quantile of the counterfactual wage distribution. The difference between $\hat{q}(\hat{\beta}^0, x^1)$ and $\hat{q}(\hat{\beta}^0, x^0)$ is explained by changes in characteristics. In turn, to separate the coefficients effect from the residual effect we consistently estimate the τ th quantile of the residuals distribution conditional on x by $x(\hat{\beta}(\tau) - \hat{\beta}(0.5))$. The wage distribution that would exist if the median return to characteristics had been equal to that of period 1 but the residuals had been distributed as in period 0 is estimated by $\hat{q}(\hat{\beta}^{m1,r0}, x^1)$, where $\hat{\beta}^{m1,r0}$ is a vector with the j element equal to $\hat{\beta}^{m1,r0}(\tau_j) = \hat{\beta}^1(0.5) + \hat{\beta}^0(\tau_j) - \hat{\beta}^0(0.5)$. Consequently, the difference between $\hat{q}(\hat{\beta}^{m1,r0}, x^1)$ and $\hat{q}(\hat{\beta}^0, x^1)$ results from changes in (median) coefficients as characteristics and residuals remain at the same level. Finally, the difference between $\hat{q}(\hat{\beta}^1, x^1)$ and $\hat{q}(\hat{\beta}^{m1,r0}, x^1)$ represents the variation due to residuals.

The following expression summarizes the three effects (residuals, coefficients and characteristics) responsible for the wage change between period 1 and period 0.

$$\begin{aligned} \hat{q}(\hat{\beta}^1, x^1) - \hat{q}(\hat{\beta}^0, x^0) &= \underbrace{\left[\hat{q}(\hat{\beta}^1, x^1) - \hat{q}(\hat{\beta}^{m1,r0}, x^1) \right]}_{\text{residuals: within-group component}} + \underbrace{\left[\hat{q}(\hat{\beta}^{m1,r0}, x^1) - \hat{q}(\hat{\beta}^0, x^1) \right]}_{\text{coefficients: between-group component}} + \\ &= + \underbrace{\left[\hat{q}(\hat{\beta}^0, x^1) - \hat{q}(\hat{\beta}^0, x^0) \right]}_{\text{characteristics}} \end{aligned} \quad (5)$$

The residuals or within-group component represents the part of the wage change explained by changes in wages within a specific group; the between-group component represents the part of the wage differential explained by changing wage premiums of specific groups; finally, the

characteristics effect represents the part of the wage variation explained by changes in the composition of the work force (Melly, 2005; Autor et al., 2005).

In a similar way we can decompose the wage changes at several inequality indexes. Like in other studies (Autor et al., 2008; Dustman, 2009), we base our analysis on the following inequality indexes and their decomposition: changes in the 90/10 log wage differential as measure of change in overall inequality; changes in the 90/50 and the 50/10 log wage differentials as measures of change of inequality in the upper-tail and lower-tail of the wage distribution, respectively.

4. THE DATA

In this study we use individual data from *Quadros de Pessoal* for 1995 and 2005. This is a matched employer-employee dataset produced by the Portuguese Ministry of Employment. The survey provides information about all workers and firms in the private sector. It does not include data about the unemployed, those employed in public administration, the self-employed or the armed forces. The available data contains information about earnings, hours of work, age, education, tenure, firm size, industry affiliation, occupation and the region where firms are located.

In our sample, we considered only workers between 16 and 65 years of age and excluded those working in agriculture and fisheries sectors, as well as unpaid family workers and apprentices. We investigated the five regions in mainland Portugal, considering level two of regional aggregation – NUTS-2). Therefore, individuals working in the Madeira and the Açores regions

were not included¹. In addition, given the huge amount of data available in *Quadros de Pessoal* and due to the timing-consuming methods used in this study, we randomly selected a sample of 10% individuals per region from the raw data. The final data set includes 406100 observations (234873 males and 171227 females).

[Table 1, about here]

Table 1 presents the descriptive statistics of the main variables for mainland Portugal and for the several regions. Referring to national data, it is possible to conclude that there is an increase in wage levels between 1995 and 2005, for both genders. There is also an obvious upgrading in the workers education and occupations. On the contrary, there is in general a decline on the average workers experience and tenure as well as on the average size of firms.

At regional level, there is a wage increase from 1995 to 2005 in all regions and for both genders as well as an improvement in the workers' educational levels. There are, however, important differences among the regions. Indeed, Lisboa is the region which displays the highest average wages for both 1995 and 2005, but also the region which presents the highest percentage of workers with university degree and secondary education. Another important structural characteristic of the Lisboa region is that it shows the highest percentages of *Senior officials and Managers, Professionals, Technicians and Associate professionals*. Moreover, the percentage of workers performing these occupations (men and women) increased along the period under analysis. The same trend occurred in general in other regions (apart from Alentejo and Algarve in the case of *Technicians and Associate professionals* for men). This indicates the increasing role of high skilled jobs in the regions' economy.

¹ These regions are made up of islands and therefore present a quite different situation to those located on mainland Portugal.

Regional differences are not so evident in the workers' experience and tenure levels. Apart from the Norte, the general level of experience decreased in the males case from 1995 to 2005; for women, it decreased in some regions (Lisboa, Algarve), but increased in other cases (Norte, Centro and Alentejo). As regard to tenure, there is a general decrease in the period indicating higher labour market turnover. Furthermore, in general, Lisboa also presents firms with higher average size in both years and genders. Nevertheless, the average firm size has decreased in every region between 1995 and 2005.

5. RESULTS

5.1 WAGE EQUATIONS

To implement the wage decomposition proposed by Melly (2005), regional wage equations by gender and for several quantiles were estimated. The logarithm of the real hourly wage is the dependent variable. In order to take into account regional differences in the cost of living, wages were deflated by the *Instituto Nacional de Estatística* (INE) regional consumer price index² and are at 1995 constant prices. As explanatory variables we used, worker experience, tenure, 15 control dummies for industry affiliation, 9 occupational dummies, dummies for education and the logarithm of firm size³.

² This is the only data source available that allows correcting price differentials among regions.

³ A definition of variables is given in Appendix A.

We should also refer a possible problem which might have some impact on our results. In fact, when estimating wage equations selection bias is an issue to consider. This problem may be mainly a consequence of unobserved differences between unemployed and employed or between migrant and non-migrant workers. Due to the lack of suitable information in our dataset we cannot take selectivity into account in the analysis. Nevertheless, as previous studies have stated (Pereira, 2003; Pereira and Galego, 2011; Pereira and Galego, forthcoming) there are reasons to believe that this problem does not significantly affect our conclusions. First, we are not considering gender wage differences and previous evidence has showed that there are no significant sample selection effects in regional wage equations estimates for both genders (Pereira, 2003). Second, internal migration in Portugal is very low and therefore it is unlikely that the results are affected by migration issues (OECD, 2000; ECB et al., 2011).

[Tables 2 and 3, about here]

Tables 2 and 3 present the median regression coefficients for the wage equations⁴, estimated for mainland Portugal and for the several regions by gender. The coefficient estimates are in general statistically significant and display the expected signs. There are, however, some differences between 1995 and 2005 estimates, as well as among regions and genders. In particular, for men there is a generalised decrease in the wage premiums related with education (secondary education and university degree) from 1995 to 2005. Similar evolution occurs in the case of high skilled occupations, mainly for *Senior officials and Managers and Professionals*. This trend is less evident in the region of Lisboa. In the case of women, there is a general decrease in the wage premiums associated with high skilled occupations, both at national and regional levels. Education wage premiums, on the contrary, increased, in spite of some regional heterogeneity,

⁴ Due to the huge number of regressions for the several quantiles only the median coefficients are presented.

namely in the case of Algarve and Lisboa. All in all, this pattern may indicate a decrease in the returns to workers characteristics and therefore a reduction of wage inequality between groups. The decomposition of the wage change in the next subsection should shed light on this issue. There are also other clear differences in the returns to education, experience and tenure among regions, for both genders. In fact, Lisboa displays the highest returns to education as well as higher returns to experience (and tenure) in both years. Returns to firm size are, however, in general smaller in Lisboa than in the other regions.

To analyse the effect of workers characteristics on wage dispersion we have also tested the difference between the *9th* and the *1st* decile coefficients⁵ (Melly, 2005). If these differences are statistically significant, variations in the level of workers characteristics imply changes in the level of within-group wage inequality. For example, if the difference is positive (negative) for education, within-group inequality increases (decreases) with the level of education. Our results show that in most cases the interdecile difference is statistically significant and positive, indicating an increase in within-group inequality as a function of the workers' characteristics, particularly education and high skilled occupations.

5.2. DECOMPOSITION RESULTS

Figures 1 and 2 display the decomposition of the wage changes (from 1995 to 2005) at national and regional levels for both genders, using Melly (2005) methodology. The measures of change in wage inequality and the decomposition analysis are presented in tables 4 and 5. Considering

⁵ These tests results may be provided at request.

first the evolution of wage inequality at aggregate national level, we may conclude that there are some gender differences: whereas for men there is a slightly decrease on the rate of change in wages along the wage distribution, for women there is a slightly tendency to an increasing rate of change in wages (see figures 1 and 2). Therefore, we may expect a decrease in wage inequality between those at the top and those at the bottom of the wage distribution in the case of men and an increase in the case of women. The measures of wage dispersion displayed in table 4 confirm a small decrease in overall inequality (90/10) in the case of men from 1995 to 2005, while the opposite occurred in the women's case (table 5). The slightly decrease in overall inequality for men was stronger in the lower tail of the wage distribution (50/10). The moderate increase in women's wage inequality is explained by the increase of wage inequality in the lower tail of the wage distribution: the differential between those at 50th and those at 10th percentile increased about 3 log points from 1995 to 2005, whereas the differential between those at 90th and those at 50th percentile did not change significantly.

[figures 1 and 2, about here]

[Tables 4 and 5, about here]

Melly (2005) wage decomposition allow us to understand very important developments in the determinants of the changes in wage inequality. Both the within-groups (residuals) and the between groups (coefficients) components contributed to reduce overall wage inequality from 1995 to 2005. Indeed, the contribution of these two components for the (90/10) log wage differential is negative for both genders.

On the contrary, the covariates (characteristics) effect contributes to increase overall wage inequality for both genders. This contribution is stronger in the women's case and in the upper-tail of the wage distribution ($90/50=0.12$), but occurs almost along the entire wage distribution (figure 2; table 5). This indicates that the small increase in wage inequality for women results from changes in the work force composition, particularly at the upper-tail of the wage distribution, and not from increasing inequalities between or within workers' groups. In the men's case (figure 1; table 4), the contribution of the upgrade on the work force composition to the increase in wage inequality occurs only in the upper-tail of the wage distribution ($90/50=0.066$; $50/10=-0.006$).

Our findings as regard to the price and composition effects are in line with the results of Centeno and Novo (2009). They report evidence of negative price effects and strong composition effects after 1995, mainly in the upper-tail of the wage distribution. According to Centeno and Novo (2009), the strong increase in the supply of qualified workers after 1995, in result of the country's efforts to improve education, may explain these results. The key role of the compositional aspects on explaining the change in inequality, reflects the shortage of skilled workers in the eighties and nineties in Portugal. This is a particular feature of the Portuguese labour market. Evidence for USA (Juhn et al., 1993; Autor et al, 2008) reports a more modest contribution of the compositional changes of the work force for the change of wage inequality.

Analysing now wage inequality at regional level, we conclude that the change in wages along the wage distribution is clearly heterogeneous among regions and genders (see: figures 1 and 2; tables 3 and 4). In fact, for males, the change in wages increases along the wage distribution in Lisboa, but clearly decreases in the Norte and Algarve and remained more or less stable in the Centro. For example, in the region of Lisboa, the wage differential between those at 90th and those at the 10th percentile increased about 9 log points (see table 4); the differential in the

lower-tail (50/10) of the wage distribution increased about 3 log points, whereas in the upper-tail (90/50) increased 5.5 log points. On the contrary, in the Norte and in the Algarve, the measures of change in wage inequality indicate a decrease in inequality along the wage distribution, stronger in the upper-tail, particularly in the Algarve.

This regional heterogeneity on the evolution of regional inequality is also evident for women. Once again, there are regions where the change in wages typically increase along the wage distribution (Norte, Centro), whereas in others this change decreases (Alentejo and Algarve). In particular, the wage differential between those at the top and at the bottom of the wage distribution decreased significantly in the Algarve (90/10): -8.6 log points, while in the Norte and Centro the same wage differential increased 14.5 and 7.7 log points, respectively (see table 5). As in the cases where wage inequality increases, in the cases where it decreases, the movements in the upper-tail (90/50) of the wage distribution are more pronounced than in the lower-tail (50/10).

Concerning the intra-regional decomposition analysis (figures 1 and 2; tables 4 and 5), the evolution of the part of the wage change explained by changes in coefficients (the between-groups component), is in line with the aggregate national evolution. In fact, there is a clear and generalised decrease of the wage premiums for the groups at the top-end of the wage distribution relatively to those at the median (90/50). This evolution occurs for both genders and across all the regions, but is more pronounced for women. The decreasing coefficients effect is a consequence of the reduction in the wage premiums related to education (for men) and high skilled occupations (for men and women) from 1995 to 2005, which exerts a stronger effect at the upper tail of the wage distribution, as we have seen in previous section (see tables 2 and 3). Quite likely, the

increase in the supply of qualified workers, resulting from the country efforts to improve education, contributed to reduce these wage premiums (Centeno and Novo, 2009).

Also in line with the evolution at national level is the contribution of the residuals component to reduce intra-regional wage inequality, mainly at the upper-tail of the wage distribution (90/50). A general negative contribution of residuals to inequality change means that within specific groups of workers, the wage differentials are lower in 2005 than in 1995. This trend occurs for both genders but its contribution to reduce inequality is clearly lower than the between component.

Referring to the contribution of the characteristics effect at regional level, we conclude that the evolution is not homogenous. In fact, in some regions the characteristics effect was strong enough to increase regional wage inequality. This is the case of Lisboa for males and of Norte and Centro for females (see: figures 1 and 2; tables 4 and 5). The positive characteristics effect is particularly strong at the upper-tail of the wage distribution (90/50). This development means that there were upgrading movements in the work force composition, reinforcing the weight of the groups at the top-end of the wage distribution. Therefore, inequality increased in some regions (Lisboa: males; Norte and Centro: females) due to changes in the composition of the work-force and not because the wage differential between or within defined groups had increased.

However, both the Algarve and Alentejo, in the case of men, did not follow this trend as there was a decreasing contribution of the characteristics effect to the wage change along most of the wage distribution. This effect is even negative along the entire wage distribution for males in the case of Algarve, but also negative along important ranges of the wage distribution in the case of the

Alentejo. A negative characteristics effect means a downgrade of workers characteristics (workers' skills and firms characteristics). Data on table 1 seems to exclude the hypothesis of downgrade of educational qualifications of the work force, as the average educational level increases. However, there was a decrease in the average levels of experience, tenure and firm size, which should have an important influence on these results.

On the whole, these results imply that wage inequality in Portugal is better analysed taking into account the regional dimension. Regions and, consequently, regional inequality, may have different dynamics. Public policy measures to reduce wage inequality should be designed taking these results into account. Our results demonstrate that wage inequality increased in the regions where there were upgrading movements on the work force composition, mainly at top of the wage distribution. Therefore, policies directed towards reducing intra-regional wage inequality should target workers' skills and firm characteristics at lower tail of the wage distribution.

CONCLUSIONS

In this paper we analysed intra-regional wage inequality in Portugal using Melly (2005) decomposition approach. To the best of our knowledge, this is the first application of this methodology to study issues of intra-regional inequality. This approach allows analysing wage inequality along the entire wage distribution unlike the studies that are carried out using single index measures (Gini, Taylor). In addition, by using Melly (2005) approach we may identify the reasons for the changes in wage inequality in three components: change in characteristics, change in returns to characteristics and change in residuals.

Our results show that there is regional heterogeneity on the evolution of wage inequality in Portugal. In fact, there are regions where wage inequality increased (males: Lisboa; females: Norte and Centro), whereas in others it decreased (males: Norte and Algarve; females: Alentejo and Algarve). The characteristics effect is the main responsible for this asymmetric evolution. Indeed, wage inequality increased in regions where there were substantial improvements of workers characteristics, mainly in the upper-tail of the wage distribution. Furthermore, our results also show that, in general, there was a decline in the wage premiums – the between component - related to education, high skilled occupations and other worker's skills, which contributed to reduce wage inequality. Likewise, the residual or within-group component of the Melly (2005)'s wage decomposition also contributed to reduce wage inequality.

All in all, the divergent developments in overall inequality of the Portuguese regions mainly result from different changes in the composition effect. Public actions aiming at reducing intra-regional wage inequality should take these differences into account, mainly focusing on workers at the lower tail of the wage distribution. Therefore, analysing inequality at intra-regional level and along the wage distribution may be quite relevant, even in the case of a small country as Portugal, in order to improve effectiveness of policies needed to reduce wage inequality.

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Tables and Figures

Table 1 Descriptive Statistics – selected variables

	Norte		Centro		Lisboa		Alentejo		Algarve		Portugal	
	1995	2005	1995	2005	1995	2005	1995	2005	1995	2005	1995	2005
MEN												
In hourly wage	0.978 (0.538)	1.114 (0.521)	1.014 (0.504)	1.186 (0.505)	1.343 (0.651)	1.460 (0.675)	1.089 (0.539)	1.200 (0.533)	1.088 (0.552)	1.144 (0.490)	1.112 (0.594)	1.235 (0.583)
Exp	24.345 (12.101)	24.673 (12.190)	25.544 (12.744)	25.193 (12.670)	25.619 (12.910)	24.125 (12.572)	25.911 (13.228)	24.679 (12.649)	25.144 (12.846)	24.851 (12.677)	25.107 (12.596)	24.644 (12.464)
Tenure	8.614 (8.969)	7.977 (9.061)	8.481 (9.012)	7.671 (8.907)	9.585 (9.682)	7.947 (9.111)	8.565 (9.143)	7.000 (8.433)	6.651 (8.025)	5.293 (7.318)	8.836 (9.216)	7.719 (8.951)
Lfsize	3.799 (1.703)	3.331 (1.604)	3.607 (1.604)	3.203 (1.581)	4.212 (1.924)	3.773 (1.859)	3.354 (1.621)	3.077 (1.640)	3.182 (1.542)	2.894 (1.402)	3.851 (1.773)	3.392 (1.689)
Secondary education	0.085	0.125	0.093	0.143	0.162	0.229	0.112	0.164	0.124	0.181	0.114	0.163
University degree	0.036	0.073	0.030	0.072	0.087	0.149	0.029	0.066	0.029	0.057	0.051	0.093
Senior officials and Managers	0.026	0.043	0.025	0.043	0.057	0.064	0.029	0.044	0.040	0.046	0.036	0.049
Professionals	0.021	0.040	0.017	0.039	0.044	0.076	0.012	0.032	0.013	0.031	0.027	0.049
Technicians and Associate professionals	0.084	0.092	0.086	0.093	0.158	0.165	0.102	0.087	0.098	0.090	0.110	0.113
WOMEN												
In hourly wage	0.723 (0.463)	0.943 (0.493)	0.750 (0.470)	0.965 (0.467)	1.105 (0.616)	1.275 (0.616)	0.758 (0.465)	0.976 (0.442)	0.868 (0.482)	1.013 (0.441)	0.854 (0.545)	1.050 (0.541)
Exp	20.676 (10.899)	22.027 (11.859)	21.579 (11.553)	23.054 (12.514)	22.796 (12.512)	21.905 (12.753)	23.539 (12.601)	23.792 (13.126)	23.682 (12.559)	23.283 (12.899)	21.748 (11.734)	22.383 (12.411)
Tenure	7.844 (8.045)	7.542 (8.483)	7.264 (7.757)	7.114 (7.825)	8.353 (8.720)	7.582 (8.571)	6.667 (7.665)	6.428 (7.768)	5.620 (7.162)	5.383 (7.575)	7.757 (8.184)	7.291 (8.301)
Lfsize	4.062 (1.758)	3.403 (1.684)	3.829 (1.741)	3.301 (1.642)	3.789 (1.953)	3.504 (1.881)	3.143 (1.703)	3.017 (1.6078)	3.064 (1.612)	2.865 (1.554)	3.855 (1.828)	3.362 (1.732)
Secondary education	0.098	0.171	0.125	0.189	0.226	0.281	0.158	0.214	0.177	0.235	0.149	0.213
University degree	0.035	0.110	0.035	0.116	0.098	0.202	0.032	0.094	0.026	0.092	0.054	0.136
Senior officials and Managers	0.011	0.022	0.010	0.023	0.027	0.035	0.014	0.024	0.011	0.028	0.016	0.026
Professionals	0.018	0.056	0.019	0.057	0.046	0.090	0.013	0.041	0.010	0.039	0.026	0.065
Technicians and Associate professionals	0.043	0.079	0.046	0.072	0.120	0.135	0.054	0.080	0.063	0.077	0.069	0.094

Table 2: Wage equations for Men -median regression coefficients

	Algarve		Alentejo		Norte		Centro		Lisboa		Portugal	
	1995	2005	1995	2005	1995	2005	1995	2005	1995	2005	1995	2005
Constant	0.601*	0.479*	0.763*	0.535*	0.743*	0.450*	0.777*	0.599*	0.544*	0.413*	0.660*	0.466*
	(0.060)	(0.060)	(0.043)	(0.045)	(0.013)	(0.022)	(0.019)	(0.030)	(0.023)	(0.021)	(0.011)	(0.010)
Secondary education	0.174*	0.103*	0.174*	0.126*	0.231*	0.179*	0.142*	0.133*	0.228*	0.206*	0.233*	0.193*
	(0.027)	(0.016)	(0.024)	(0.014)	(0.010)	(0.008)	(0.010)	(0.008)	(0.010)	(0.007)	(0.006)	(0.004)
University degree	0.329*	0.310*	0.755*	0.527*	0.630*	0.561*	0.543*	0.468*	0.607*	0.543*	0.621*	0.551*
	(0.092)	(0.049)	(0.107)	(0.054)	(0.029)	(0.016)	(0.043)	(0.021)	(0.020)	(0.014)	(0.018)	(0.010)
Exp	0.020*	0.014*	0.019*	0.016*	0.019*	0.015*	0.018*	0.019*	0.023*	0.024*	0.021*	0.019*
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.0004)	(0.0004)
Exp2	-0.030*	-0.023*	-0.028*	-0.026*	-0.028*	-0.023*	-0.029*	-0.032*	-0.035*	-0.038*	-0.031*	-0.029*
	(0.004)	(0.003)	(0.004)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Tenure	0.015*	0.018*	0.014*	0.020*	0.007*	0.012*	0.009*	0.015*	0.013*	0.023*	0.009*	0.016*
	(0.003)	(0.002)	(0.003)	(0.001)	(0.001)	(0.0004)	(0.001)	(0.001)	(0.001)	(0.001)	(0.0005)	(0.0003)
Tenure2	-0.029*	-0.027*	-0.025*	-0.022*	-0.004	-0.012*	-0.012*	-0.017*	-0.016*	-0.034*	-0.008*	-0.017*
	(0.011)	(0.007)	(0.010)	(0.004)	(0.002)	(0.001)	(0.003)	(0.001)	(0.002)	(0.004)	(0.002)	(0.001)
Lfsize	0.100*	0.101*	0.083*	0.082*	0.063*	0.071*	0.071*	0.073*	0.059*	0.070*	0.068*	0.078*
	(0.005)	(0.004)	(0.005)	(0.004)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)
Senior officials and Managers	0.831*	0.474*	0.571*	0.513*	0.790*	0.521*	0.740*	0.518*	0.851*	0.889*	0.808*	0.645*
	(0.089)	(0.066)	(0.065)	(0.067)	(0.027)	(0.021)	(0.045)	(0.027)	(0.019)	(0.025)	(0.019)	(0.016)
Professionals	0.688*	0.536*	0.364*	0.478*	0.682*	0.590*	0.632*	0.550*	0.690*	0.644*	0.700*	0.599*
	(0.176)	(0.059)	(0.108)	(0.058)	(0.045)	(0.024)	(0.051)	(0.031)	(0.023)	(0.020)	(0.025)	(0.013)
Technicians and Associate professionals	0.363*	0.435*	0.373*	0.416*	0.464*	0.461*	0.376*	0.442*	0.475*	0.522*	0.468*	0.485*
	(0.028)	(0.026)	(0.029)	(0.024)	(0.012)	(0.012)	(0.014)	(0.014)	(0.011)	(0.014)	(0.007)	(0.007)
N	2793	5367	4589	7219	35232	45892	18575	27253	29147	33904	90336	119635

Notes: Bootstrap standard errors with 100 replications in parentheses. Industry dummies and other 5 professional dummies were included but not reported.

(*) significant at 1% level, (**) significant at 5% level

Table 3: Wage equations for Women -median regression coefficients

	Algarve		Alentejo		Norte		Centro		Lisboa		Portugal	
	1995	2005	1995	2005	1995	2005	1995	2005	1995	2005	1995	2005
Constant	0.829* (0.090)	0.524* (0.050)	0.795* (0.082)	0.478* (0.033)	0.957* (0.043)	0.411* (0.013)	0.868* (0.048)	0.478* (0.020)	0.418* (0.027)	0.401* (0.020)	0.694* (0.021)	0.412* (0.010)
Secondary education	0.087* (0.023)	0.113* (0.012)	0.088* (0.021)	0.141* (0.013)	0.148* (0.012)	0.160* (0.006)	0.130* (0.011)	0.129* (0.006)	0.156* (0.009)	0.159* (0.008)	0.147* (0.006)	0.163* (0.004)
University degree	0.497* (0.115)	0.390* (0.028)	0.461* (0.071)	0.546* (0.030)	0.409* (0.026)	0.538* (0.013)	0.472* (0.038)	0.500* (0.014)	0.515* (0.022)	0.498* (0.012)	0.463* (0.014)	0.515* (0.009)
Exp	0.012* (0.002)	0.011* (0.001)	0.008* (0.002)	0.008* (0.001)	0.006* (0.001)	0.012* (0.0005)	0.009* (0.001)	0.010* (0.001)	0.016* (0.001)	0.016* (0.001)	0.010* (0.0005)	0.012* (0.0004)
Exp2	-0.022* (0.004)	-0.018* (0.003)	-0.017* (0.003)	-0.012* (0.003)	-0.009* (0.001)	-0.019* (0.001)	-0.015* (0.002)	-0.017* (0.001)	-0.027* (0.002)	-0.027* (0.001)	-0.016* (0.001)	-0.019* (0.001)
Tenure	0.007** (0.003)	0.014* (0.001)	0.012* (0.003)	0.015* (0.001)	0.003* (0.001)	0.008* (0.0004)	0.009* (0.001)	0.013* (0.0004)	0.014* (0.001)	0.020* (0.001)	0.006* (0.001)	0.013* (0.0003)
Tenure2	-0.007 (0.012)	-0.014* (0.003)	-0.006* (0.011)	-0.015* (0.002)	-0.004** (0.002)	-0.009* (0.001)	-0.020* (0.005)	-0.013* (0.001)	-0.016* (0.004)	-0.020* (0.002)	-0.006 (0.002)	-0.013* (0.0005)
Lfsize	0.077* (0.004)	0.064* (0.003)	0.068* (0.005)	0.050* (0.003)	0.049* (0.001)	0.043* (0.001)	0.066* (0.002)	0.053* (0.001)	0.071* (0.002)	0.064* (0.002)	0.062* (0.001)	0.054* (0.001)
Senior officials and Managers	0.594* (0.145)	0.335* (0.058)	0.427* (0.118)	0.320* (0.093)	0.770* (0.041)	0.505* (0.027)	0.562* (0.082)	0.390* (0.043)	0.760* (0.023)	0.738* (0.027)	0.791* (0.020)	0.572* (0.017)
Professionals	0.619* (0.141)	0.512* (0.054)	0.592* (0.182)	0.542* (0.054)	0.972* (0.036)	0.642* (0.018)	0.986* (0.048)	0.653* (0.019)	0.735* (0.025)	0.640* (0.017)	0.866* (0.016)	0.655* (0.010)
Technicians and Associate professionals	0.378* (0.040)	0.401* (0.030)	0.445* (0.045)	0.391* (0.019)	0.473* (0.022)	0.402* (0.012)	0.432* (0.021)	0.386* (0.013)	0.526* (0.018)	0.494* (0.012)	0.538* (0.010)	0.442* (0.007)
N	2127	4273	2607	5204	24286	34253	11420	20211	18286	26211	58726	90152

Notes: Bootstrap standard errors with 100 replications in parentheses. Industry dummies and other 5 professional dummies were included but not reported.

(*) significant at 1% level (**) significant at 5% level

Table 4: Decomposition of changes in measures of wage dispersion - Men

Region	Statistic	Total change	Residuals	Coefficients	Characteristics
Algarve	<i>Median</i>	0.0735* (0.012)	-0.018** (0.007)	0.131* (0.010)	-0.039* (0.009)
	90–10	-0.164* (0.023)	-0.06** (0.023)	-0.025 (0.02)	-0.078** (0.027)
	50–10	-0.046* (0.011)	-0.022** (0.011)	0.013 (0.008)	-0.037* (0.007)
	90–50	-0.117* (0.022)	-0.038 (0.021)	-0.038** (0.017)	-0.041 (0.024)
Alentejo	<i>Median</i>	0.100* (0.010)	0.007 (0.006)	0.132* (0.008)	-0.039* (0.008)
	90–10	-0.025 (0.021)	0.026 (0.015)	-0.050* (0.019)	-0.002 (0.018)
	50–10	-0.030* (0.01)	-0.001 (0.007)	-0.002 (0.007)	-0.027* (0.006)
	90–50	0.004 (0.018)	0.027** (0.012)	-0.048* (0.014)	0.025 (0.016)
Norte	<i>Median</i>	0.137* (0.003)	-0.011* (0.002)	0.142* (0.003)	0.006* (0.002)
	90–10	-0.040* (0.011)	-0.040* (0.008)	-0.067* (0.008)	0.067* (0.008)
	50–10	-0.015* (0.004)	-0.020* (0.003)	0.002 (0.002)	0.004** (0.001)
	90–50	-0.026* (0.009)	-0.020* (0.007)	-0.070* (0.007)	0.064* (0.007)
Centro	<i>Median</i>	0.169* (0.00)	-0.007* (0.003)	0.180* (0.004)	-0.004 (0.003)
	90–10	0.013 (0.012)	0.012 (0.008)	-0.020** (0.009)	0.021** (0.009)
	50–10	0.007 (0.005)	-0.006 (0.004)	0.015* (0.003)	-0.002 (0.002)
	90–50	0.007 (0.010)	0.018** (0.007)	-0.034* (0.007)	0.023* (0.008)
Lisboa	<i>Median</i>	0.110* (0.005)	-0.008* (0.003)	0.135* (0.004)	-0.017* (0.004)
	90–10	0.088* (0.011)	-0.031* (0.007)	-0.006 (0.009)	0.125* (0.008)
	50–10	0.033* (0.005)	-0.007 (0.004)	0.030* (0.004)	0.010* (0.003)
	90–50	0.055* (0.009)	-0.024* (0.006)	-0.036* (0.008)	0.115* (0.007)
Portugal	<i>Median</i>	0.123* (0.003)	-0.010* (0.001)	0.143* (0.002)	-0.010* (0.002)
	90–10	-0.014** (0.006)	-0.034* (0.004)	-0.041* (0.005)	0.060* (0.005)
	50–10	-0.008* (0.002)	-0.015* (0.002)	0.013* (0.002)	-0.006* (0.001)
	90–50	-0.007 (0.005)	-0.018* (0.004)	-0.054* (0.005)	0.066* (0.004)

Notes: Bootstrap standard errors with 100 replications are in parentheses.

(*), (**) significant at 1% and 5% level, respectively.

Table 5: Decomposition of changes in measures of wage dispersion - Women

Region	Statistic	Total change	Residuals	Coefficients	Characteristics
Algarve	<i>Median</i>	0.151*(0.011)	0.002 (0.007)	0.121*(0.009)	0.028*(0.009)
	90–10	-0.086**(0.031)	-0.083**(0.026)	-0.090 (0.117)	0.087**(0.037)
	50–10	-0.024**(0.010)	-0.013**(0.009)	-0.015(0.036)	0.004 (0.006)
	90–50	-0.062** (0.028)	-0.070* (0.023)	-0.075 (0.083)	0.083**(0.034)
Alentejo	<i>Median</i>	0.224*(0.010)	-0.001 (0.006)	0.177*(0.008)	0.048*(0.008)
	90–10	-0.031 (0.030)	0.023 (0.020)	-0.125* (0.029)	0.071**(0.032)
	50–10	-0.004 (0.009)	-0.003 (0.008)	-0.024**(0.008)	0.022*(0.006)
	90–50	-0.027 (0.027)	0.026 (0.019)	-0.101*(0.029)	0.049 (0.030)
Norte	<i>Median</i>	0.213*(0.003)	0.002 (0.002)	0.156*(0.003)	0.054*(0.003)
	90–10	0.145*(0.012)	-0.054 (0.118)	-0.119*(0.011)	0.318* (0.013)
	50–10	0.050* (0.003)	-0.007 (0.031)	0.004 (0.003)	0.054* (0.002)
	90–50	0.095* (0.011)	-0.047 (0.088)	-0.123*(0.010)	0.264*(0.012)
Centro	<i>Median</i>	0.215*(0.004)	-0.005 (0.003)	0.168*(0.005)	0.052*(0.003)
	90–10	0.077* (0.017)	-0.059* 0.012)	-0.123*(0.013)	0.259* (0.016)
	50–10	0.030* (0.004)	-0.008**(0.004)	-0.006 (0.004)	0.044* (0.003)
	90–50	0.048** (0.015)	-0.051*(0.011)	-0.117*(0.013)	0.215* (0.015)
Lisboa	<i>Median</i>	0.168*(0.007)	-0.003 (0.004)	0.118*(0.005)	0.054*(0.005)
	90–10	0.027**(0.010)	-0.018**(0.008)	-0.081*(0.011)	0.125*(0.008)
	50–10	0.009 (0.006)	-0.003 (0.004)	-0.029*(0.004)	0.040* (0.004)
	90–50	0.018**(0.008)	-0.015**(0.007)	-0.052*(0.009)	0.085*(0.007)
Portugal	<i>Median</i>	0.206* (0.003)	-.0004* (0.001)	0.138* (0.002)	0.072* (0.002)
	90–10	0.032* (0.008)	-0.044* (0.004)	-0.102*(0.006)	0.178* (0.008)
	50–10	0.034* (0.003)	-0.013* (0.002)	-0.010* (0.002)	0.057* (0.002)
	90–50	-0.002 (0.006)	-0.031* (0.004)	-0.092* (0.006)	0.120* (0.006)

Notes: Bootstrap standard errors with 100 replications are in parentheses.

(*), (**) significant at 1% and 5% level, respectively.

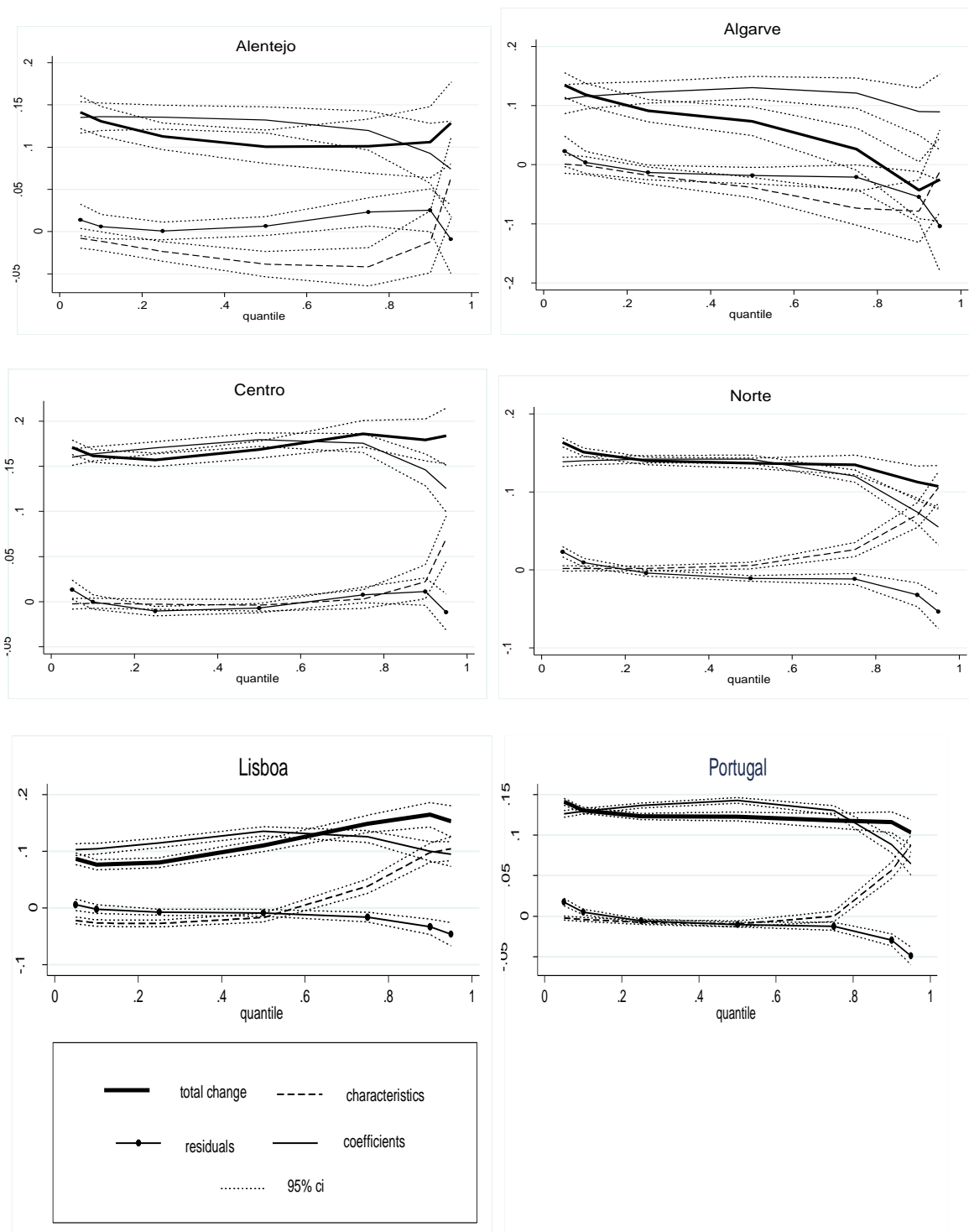


Figure 1: Decomposition of wage differences – Men

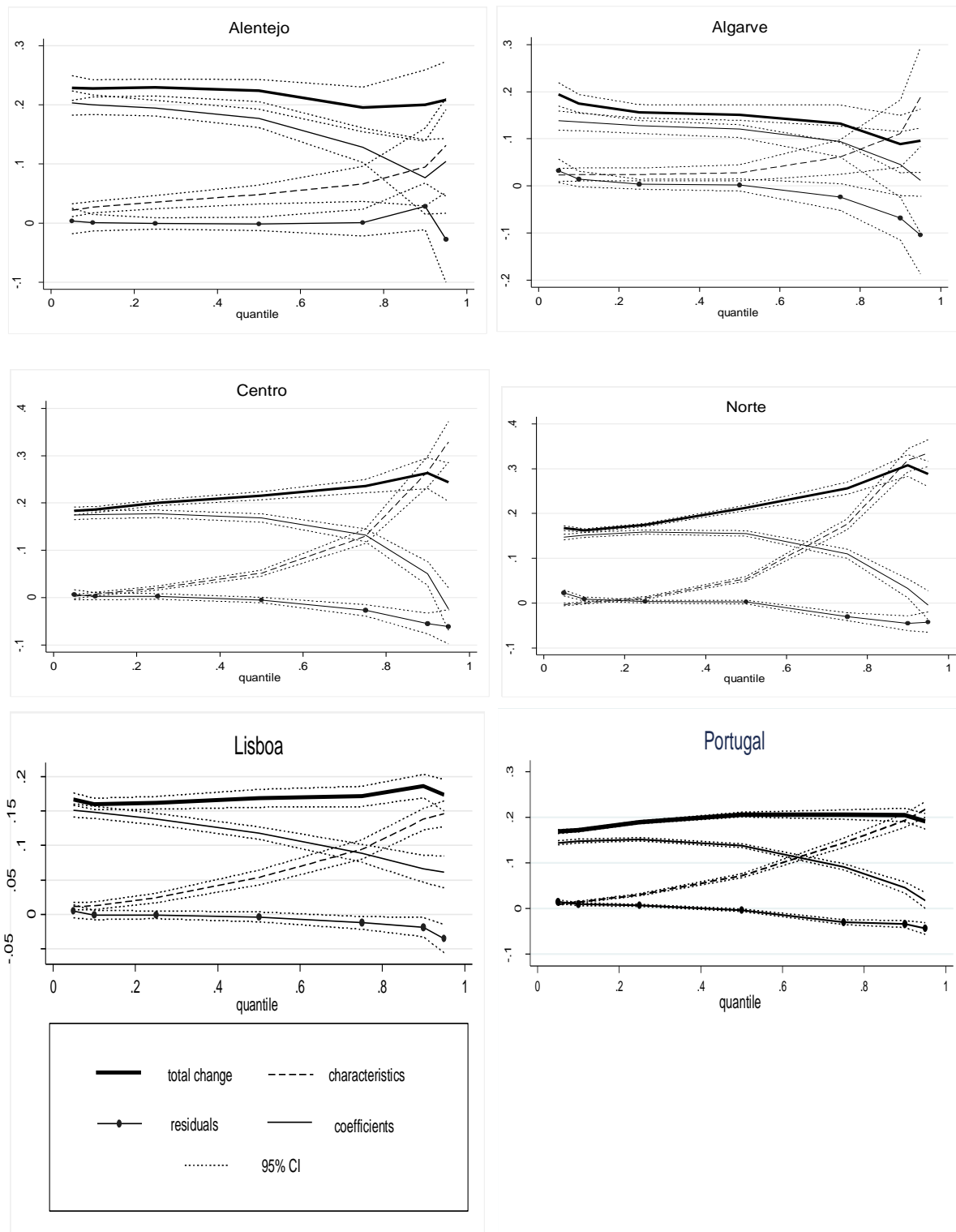


Figure 2: Decomposition of wage differences – Women

APPENDIX A. Definition of variables

In hourly wage	Logarithm of the hourly wage rate (wage rate includes base remuneration, other regularly paid components and payment for overtime; the hours of work includes the normal duration of work and overtime hours). Wages were deflated using the regional consumer price index from INE and are at 1995 prices.
exp	years of potential experience in the labour market = (age - years of education - 6)
exp2	$\text{exp}^2/100$
tenure	tenure in the current job (in years)
tenure2	$\text{tenure}^2/100$
secondary education	dummy variable; equals one if individual has a secondary education (twelve years).
university degree	dummy variable; equals one if individual has an university degree.
lfsize	Logarithm of the firm size
occupational dummies	Dummy variables identifying occupations at one digit level of aggregation of the Portuguese occupational classification.
industry dummies	Dummy variables identifying the economic sector where the individual works, at one digit level of aggregation.