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The impact of segregation on wage inequality: a look at recruitment and pay policies at the firm level

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Abstract

Wage dispersion within firms has increased, whilst segregation of workers according to their schooling level has also increased, as some firms "specialise" in workers with a high level of education and other "specialise" in workers with low level of education. This study analyses the interaction between the demand for education by firms and the wage in the Portuguese economy. A bivariate regression is implemented in wich the joint decision of the wage and education of the workers to be recruited is modelled. Some of the conclusions of the single-equation wage model are inverted, because that model captures a mixture of the firm's recruitment policy and the firm's wage policy. This is the case of the returns to experience and seniority. It is also observed that the increase in wage discrimination against women is more pronounced than captured by traditional uniequational model. The same occurs with the wage premium for education.

Keywords: recruitment, segregation, wages, inequality, simultaneous equations

JEL classification: C3, J23, J31

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1 Introduction

Several hypotheses have been advanced over the last 30 years to explain the increase in wage dispersion recorded in different economies. These explanations range from labour supply, associated with demographic mutations, proposed in the 1970s (Welch, 1979), to technological progress, in the 1990s (Berman *et al.*, 1998), or the role played by international trade (Borjas and Ramey, 1994). The role of the firm as wage decision-maker was frequently highlighted (Kramarz *et al.*, 1996). As a result of this debate, it was considered important to analyse the interaction between the recruitment policies and pay policies implemented by firms and to describe their impact on the trends in Portuguese wage inequality.

Over the last two decades, Portugal has revealed an high level of inequality, identical to that of the United Kingdom, and slightly lower than that of the United States, with the wage distribution being characterised by a relatively compressed lower half, and an upper half in which dispersion is high. The increase in wage dispersion recorded during this period has essentially been the result of the separation of higher wages in relation to the rest of the distribution, and was particularly pronounced after 1986, coinciding with the country's economic growth and the increase in real wages. According to Vieira *et al.* (1997), between 1985 and 1992 there was an increase in the returns to University graduates relative to high-school graduates, a divergence which was aggravated after the country joined the European Community, in particular after 1989. Vieira *et al.* also comment that relative wage trends favoured more complex jobs, associated with higher wages, and normally performed by male workers with a high level of schooling.

Studies on a firm level indicate that "good" firms recruit "good" workers, to whom they pay an additional wage premium. It is to be noted in particular that the returns to education have been increasing, whilst seniority has become a less valued attribute (Cardoso, 1999). In the view of Vieira *et al.*, the restructuring of the Portuguese economy, in particular that associated with the implementation of technological innovations, may have generated a change in the demand for more educated workers.

The increase in the returns to education occurred alongside the growing supply of more educated labour force. In fact, between 1985 and 1997, the education of workers in the Portuguese economy increased by an average 1.3 years, whilst the schooling distribution dispersion decreased.

Advancing in relation to the methodologies used in the traditional inequality analyse, this study aims to model the joint decision of the firm regarding the workers' wage and education, using a simultaneous equation model. With the increase in education of the workforce in Portugal, what changes have been made by firms in their recruitment policies? Has the homogeneity of the workforce within firms increased, with some firms "specialising" in more educated workers and others in less educated workers or, on the contrary, has the segregation of workers across firms decreased? What are the implications of this for pay policies?

An empirical analysis of these questions is based on the database "Quadros de Pessoal" provided by the Portuguese Ministry for Labour and Solidarity. This database is the result of a compulsory survey of firms and contains information about over two million workers each year. In practice, it represents a census of firms, establishments and their workers. The analysis will be implemented for the period 1985 to 1997, for a population of full-time employees, aged between 16 and 65. Workers from agriculture, fishing, mining and the public administrative sector were excluded. The analysis will cover firms with a minimum of five workers in the above-mentioned conditions. This restriction is associated with the nature of the problem to be studied. An analysis of the degree of homogeneity of the workforce within firms requires that they have a minimum size.

Section 2 describes trends in the schooling level of Portuguese workers. Section 3 analyses trends in worker segregation across firms. Section 4 justifies the use of the simultaneous equations model in modelling firm decisions, while the results of the analysis are presented in section 5. These are followed by the conclusions.

2 Trends in worker education

During the period between 1985 and 1997, worker education increased by an average 1.3 years (table 1), a trend justified, in part, by the change in minimum compulsory education.

Data in table 2 emphasise that the improvement in schooling is pronounced. In 1985 the percentage of workers with six or more years of education was 35%, whereas in 1997 this figure was 61%. In relative terms, there was a reduction in the distribution dispersion, as demonstrated by the coefficient of variation (C.V.).

Table 1: Descriptive statistics on the schooling distribution

	Kurtosis	Skewness	Mean	C.V.	Gini	$\frac{p90}{p10}$	$\frac{p50}{p10}$	$\frac{p90}{p50}$	$\frac{p95}{p50}$
1985	3,8300	1,2307	5,9047	0,6125	0,3019	3	1	3	3
1997	3,0327	0,9100	7,1914	0,5153	0,2741	3	1,5	2	1,25

Source: Portugal, MTS, DETEFP (1985 and 1997). p stands for percentile.

Table 2: Schooling distribution

	1985	1997	Δ
Years	%	%	*p.p.*
0	2,82	0,59	-2,23
2	5,37	1,64	-3,73
4	54,08	36,38	-17,70
6	13,36	23,59	10,23
9	7,99	16,38	8,39
12	12,83	15,87	3,04
15	1,46	1,70	0,24
17	2,09	3,85	1,76

Source: Portugal, MTS, DETEFP (1985 and 1997). *p.p.* stands for percentage points.

3 Trends in worker segregation across firms

The increasing homogenisation of the workforce within firms has been documented by Kramarz *et al.* (1996), Kremer and Maskin (1996) and Juhn *et al.* (1993). According to these authors, in countries such as the United States of America, the United Kingdom and France, these trends accompanied an increase in wage inequality. According to the work of Kremer and Maskin (1996), the segregation of workers across firms by their skills will be assessed for Portugal using the following segregation index (ρ),

$$\rho = \frac{\sum_{j=1}^{J} \sum_{i \in Z_j} (q_i - \bar{q}) \sum_{k \in Z_j} \frac{(q_k - \bar{q})}{z_j}}{\sum_{j=1}^{J} \sum_{k \in Z_j} (q_k - \bar{q})^2}, \tag{1}$$

in which Z_j represents the set of the workers of firm j, z_j the volume of employment of the firm j, J the total number of firms, i and k designate the workers, q is a measure of the

worker skill, and $\bar{q}$ is the mean of these skills in the economy.

In the numerator of the index we have the correlation between (i) the deviation of the skill of an individual in relation to the economy mean and (ii) the dispersion of the skill of workers in a firm around the economy mean. Equally, the expression in the denominator can be understood as the variance of skills in the economy. The further the skills of individuals are from the mean in the same direction and proportion as the skills of other workers in the same firm, the greater the correlation between their skills and the skills present in the firm. In this way, the greater the homogenisation of workers within firms, the closer the value of the numerator is to the value of the denominator; in other words, the closer the index is to its maximum value of 1. In a situation in which the correlation between the skills of a worker and his colleagues in the firm is reduced, as a result of a great heterogeneity of the work force within firms, the index will be closer to its minimum value of 0.

However, this index should be corrected for random segregation, since, according to Carrington and Troske (1997), the random allocation of individuals to firms generates a non-null segregation, when measured by conventional indexes, in particular the dissimilarity index and the Gini segregation coefficient. It is therefore necessary to control for random deviations in the absence of segregation, and it is observed that the smaller the size of the units (in this case the firms) in which the individuals or minorities work, the greater the random segregation.

The study of segregation can thus be supplemented with the introduction of slight changes to Kremer and Maskin's proposal, in particular, the application of a procedure similar to that which Carrington and Troske implemented for the dissimilarity index and for the Gini segregation coefficient. The underlying principle is that, even if individuals are distributed across firms in a random manner, the index would always capture some degree of segregation, given the existence of differences in the number of workers at each firm. The aim is, therefore, to isolate the degree of systematic segregation existing in each sample.

The main point of the analysis is thus to calculate the segregation associated with the random allocation of individuals to firms. Maintaining the size of firms in terms of number of workers and the skills of workers, individuals are randomly redistributed through firms and the segregation index suggested by Kremer and Maskin is then calculated. This procedure is repeated 100 times in order to obtain the distribution of the randomly associated segregation

index. The mean of this distribution (ρ^*) provides an estimate of the random segregation. Following the methodology implemented by Carrington and Troske, the systematic segregation index can be obtained through the following expression:

$$\hat{\rho} = \begin{cases} \frac{\rho - \rho^*}{1 - \rho^*} \text{ if } \rho \geq \rho^* \\ \frac{\rho - \rho^*}{\rho^*} \text{ if } \rho < \rho^* \end{cases} \tag{2}$$

where $\hat{\rho} \in [-1, 1]$. If there is an excess of segregation in relation to random segregation, in other words if $\rho > \rho^*$, then $\hat{\rho}$ quantifies the excess of segregation in relation to what is expected from random allocation, in terms of the maximum segregation that can occur, $1 - \rho^*$. Whilst $\hat{\rho} = 1$ corresponds to the maximum segregation, $\hat{\rho} = 0$ corresponds to the random distribution of workers across firms. When $\rho < \rho^*$ we face a situation in which there is an excess of *impartiality* in the distribution of skills in the firm, that is, not even random allocation would be able to obtain that balance in the distribution of individuals. As this index assesses random deviation, its interpretation is not based on the quota of minorities nor on the size of the units. However, with the increase in the size of units, the modified segregation index, $\hat{\rho}$, tends toward the value of the original index, ρ.

Implementing this analysis for the Portuguese economy, the values found for the segregation index for worker education, as well as those for wage segregation, for the years 1985 and 1997, are provided in the table 3.

Table 3: Segregation index (corrected for random allocation of workers)

	Schooling	Hourly wage
1985	0,25809	0,37240
1997	0,34285	0,35223

Source: Portugal, MTS, DETEFP (1985 and 1997)

It can be observed that between 1985 and 1997 there was an increase in segregation across firms by education in the order of 8.5 percentage points. This increase in segregation by skills points to a change in firms' recruitment policies. On the other hand, there has been a reduction in segregation by wages, as firms have apparently also changed their pay policies. Inside each firm, the homogeneity of skills has increased, whilst the homogeneity of wages has decreased. In other words, the role of the firm as regards wage harmonisation between its workers has been reduced, although harmonisation of skills has occurred. The

joint change of recruitment and wage policies highlights the interaction between demand for education and wage formation, as well as its effect on wage inequality.

4 Simultaneity of decisions to recruit and pay

Having verified, on the one hand, the increase in segregation of workers across firms by their education and, on the other hand, the increase in wage dispersion within the firm, we come up against the following question: which have been the changes in wage distribution, controlling for the recruitment policy?

The recruitment policy in terms of education and its effect on the pay policy shall be assessed, implementing a bivariate regression, in which the dependent variables are the workers' hourly wage and the completed years of formal education. The use of a bivariate regression, besides modelling a simultaneous decision by the firm, enables overcoming a problem of endogeneity inherent to the traditional wage model.

In a typical wage regression, the dependent variable is the logarithm of the wage, years of education are used as an independent variable, along with a set of other regressors which control for other dimensions of the human capital of workers, as well as characteristics of both occupation and firm. In this case, it is understood that the coefficient of the education variable reflects the response of the wage to an additional year of education. However, a single-equation linear regression model fails in the estimation of this parameter, since it does not take into account the firm's preferences regarding educational level. That is, education and the disturbance term in the wage equation are correlated, since firms chose the level of education which, given their competitive advantages, maximise their intertemporal net benefits. Hence, heterogeneity in the selection, in other words, the recruitment policy adopted by the employer, is not captured by the traditional model. The skill present in each firm is therefore not random, and both variables, wage and skill, approximated here by education, are endogenous.

This endogeneity of education implies that estimates of a single-equation linear regression model for the wage are not consistent. The simultaneity of decisions to pay and recruit implies, therefore, that they should be modelled together. In this way, the coefficients should be estimated using simultaneous equation methods. In this paper, estimation of the model

is based on the use of instrumental variables estimators, since these are consistent. To be more specific, the Three-Stage Least Squares method was chosen, since, according to Greene (1999), of all the instrumental variables estimators that use only the sample information included in the system, this is asymptotically efficient.

The model proposed here may then be represented, in its structural form, by the system with the following equations:

$$\begin{aligned} school_i &= \alpha_0 + \alpha_1 * lhw_i + \alpha_2 * sex_i + \alpha_3 * exper_i + \alpha_4 * foreign_i \\ &\quad + \alpha_5 * pub_i + \alpha_6 * lsworker_i + \alpha_r * region_i + \alpha_a * industry_i \\ &\quad + \alpha_s * soccup_i + \alpha_j * jurid_i + \varepsilon_{si} \end{aligned} \tag{3}$$

and

$$\begin{aligned} lhw_i &= \beta_0 + \beta_1 * school_i + \beta_2 * sex_i + \beta_3 * exper_i + \beta_4 * expers_i + \beta_5 * tenure_i \\ &\quad + \beta_6 * t1_i + \beta_7 * foreign_i + \beta_8 * pub_i + \beta_9 * lsworker_i + \beta_r * region_i \\ &\quad + \beta_a * industry_i + \beta_t * tirc_i + \beta_j * jurid_i + \varepsilon_{wi} \end{aligned} \tag{4}$$

where

$$\begin{aligned} \boldsymbol{\varepsilon}_i &= \begin{bmatrix} \varepsilon_{si} \\ \varepsilon_{wi} \end{bmatrix}, \\ E\left[\boldsymbol{\varepsilon}_i\right] &= \mathbf{0}, \\ E\left[\boldsymbol{\varepsilon}_i \boldsymbol{\varepsilon}_i^{'}\right] &= \Sigma, \\ E\left[\boldsymbol{\varepsilon}_i \boldsymbol{\varepsilon}_t^{'}\right] &= \mathbf{0}, \text{ for all } i \neq t, \end{aligned}$$

No observation is correlated with observations in different moments of time, and the disturbance terms of the two equations, for each observation, may be correlated. The disturbance terms follow a bivariate normal distribution.

These two equations are designated behavioral equations (Greene, 1999). There are two endogenous variables, the logarithm of the hourly wage[1] (lhw) and complete years of education ($school$), the remainder being thirteen exogenous variables[2]. The first equation is

[1] The hourly wage (hw) is computed as $hw = \frac{bw+ts+rs}{nh}$, all the right-hand side variables referring to monthly reported figures: bw stands for base-wage, ts is the payment indexed to tenure, rs are regularly paid subsidies and nh is the normal duration of work.

[2] For a detailed description of the variables, see table 4 in appendix. Descriptive statistics are presented in table 5.

over-identified, the variables potential experience ($expers$), tenure within the firm ($tenure$), tenure less than 1 year ($t1$) and the bargaining regime ($tirc$) having been excluded, as characteristics of the worker which do not influence the schooling choice of the firm, whilst the second equation is exactly identified, a situation in which only the level of skill of the occupation ($soccup$) was excluded. In the wage equation, the *soccup* variable was excluded because it was understood that its effect on the wage is already captured by education level and worker's experience. However, skill associated with occupation plays a significant role in the choice of schooling by the firm, since different occupations demand different worker skills. The education equation includes as regressors wage, gender (sex) – to control for any discrimination between men and women in the recruitment process –, as well as experience ($exper$), since there may be an exchange between education and experience in choosing the characteristics of the worker who should occupy a given vacancy. As such, there is interaction between the education that the firm chooses and the wage payed to the worker. In turn, wage is a function of the education of the worker recruited by the firm. The remaining explanatory variables are intended to control for the different characteristics of the firms, in particular whether they are controlled by foreign capital ($foreign$), by public capital (pub), their gross labour productivity ($lsworker$), and the aspects such as location ($region$), economic sector ($industry$), or the ownership structure ($jurid$). In the wage equation, the square of experience ($expers$) is included. Length of service ($tenure$) is also included, as well as a dummy for the case of workers with less than one year in the firm ($t1$).

5 Determinants of the choice of schooling and wage by firms

The results for the two equations, wage and education, of the simultaneous equation model will now be analysed. In the definition of the base category in the case of dummy variables, the most frequent category was used. The base category are male individuals with 4 years of education, who work in national private firms in the Retail Trade, and whose length of service in the firm is greater than one year. In legal terms, the firm is a Partnership Company, and the labour relationship is governed by a Collective Bargaining Contract. The firm is located in the region of Lisbon and Tagus Valley.

Starting the analysis with the education demand equation, the result of which can be found in tables 6 and 7, we can observe that the higher the wage the firm has to pay a worker with a certain skill and a certain education, the more the firm increases its preference for less educated individuals. The wage is not the price of education, but rather the return to something more comprehensive which is the worker's skill, hence the possibility of exchange between education and other dimensions of skill. The exchange factor is low in 1985, since an increase of 10%[3] in the wage leads, on average, to a reduction in the years of education demanded by the firm of 0.11. Between 1985 and 1997, this factor increased considerably, reaching 0.46. Consequently, in 1997 firms weighed more heavily the wage that they paid to more educated individuals in the hiring decision. The coefficient of experience corroborates the interpretation according to which education is potentially compensated by other dimensions of skill, since the more experienced the worker hired by the firm is, the less his education will tend to be. The firm combines the different dimensions of skill in its recruitment decision, so as to choose an individual corresponding to its recruitment and pay preferences.

In 1985 firms tended to employ women only if they were better educated than men. This difference between men and women in education for performing the same type of job, and inside the same firm, is no longer statistically significant in 1997, at a significance level of 5%.

Firms under foreign or public majority ownership, as well as those with greater gross labour productivity – assessed as sales per worker –, tend to employ more educated workers, a fact which is reinforced during the period under analysis. In 1997, firms controlled by the State or by foreign capital tended to recruit, on average, individuals with one year more education than private Portuguese firms.

With the exception of the region of Alentejo and Algarve, there was a deterioration in the position of the rest of the country in relation to Lisbon and Tagus Valley, particularly in the region of North and Inner Centre. Individuals recruited in this region tended to have one year less education than those from Lisbon region.

[3]Since the logarithm wage is used as explanatory variable in the education equation, the first order derivative relative to this variable is: $\frac{\partial school}{\partial lhw} = \alpha_1$. Approximately, if lhw increases $0,095$, it means that, in 1985, schooling decreases $0,11$. That is, $lhw' = lhw + 0,095$, or, $hw' = e^{lhw+0,095}$. So, $hw' = hw * e^{0,095}$, meaning that $\frac{hw'}{hw} = 1,10$, representing a 10% increase in the wage.

The sectors which seek workers with less education include Food, Beverages and Tobacco, Textiles, Clothing and Shoes, Wood and Cork, Construction and Public Works, and Hotels and Restaurants. The most demanding in terms of education include Electricity, Gas and Water, Communications, Banking and Insurance, and Services supplied to firms. Comparing tables 6 and 7, we can conclude that Retail Trade, the sectors of Paper, Graphic Arts and Publishing, Electricity, Gas and Water, Transport and Storage, and Banks and Insurance all presented a significant growth in their tendency to recruit more educated individuals. The Banking and Insurance sector, in particular, increased its education demand by one year on average. A less favourable trend, in the sense that there was an increased tendency to recruit relatively less educated workers, was apparent in the sectors of Food, Beverages and Tobacco, Textiles, Clothing and Footwear, Basic Metals, and Hotels and Restaurants. Basic Metals recorded, in relative terms, a reduction of nearly one year in schooling recruited.

In relation to the ownership structure of Partnerships, Joint-stock Companies presented a greater tendency to seek more educated workers, a fact which is reinforced during the period under analysis. Trends and positions in Sole Proprietorship Companies were the opposite. As expected, individuals performing jobs of greater responsibility or complexity tend to have more years of education, in particular Managers and Professionals, a trend which became more marked between 1985 and 1997.

Moving on to an analysis of the wage equation, we can observe that the use of the simultaneous equations model, in particular with the introduction of a recruitment equation associated with the traditional wage equation, frees the traditional equation's coefficients. The correlation between schooling and earnings across workers is contaminated by the recruitment policy. The single-equation model lacks explanatory variables which are correlated with the variables included, so the coefficient estimates are not consistent. The estimate bias is, therefore, a function of the correlation between the included variables and the excluded variables. Traditionally, the wage equation excludes knowledge about the firm's recruitment policy. A comparison of tables 10 and 11 with tables 8 and 9 shows the change in the coefficients of the regressors when knowledge about the firm's recruitment policy is introduced. The analysis of the wage equation in the context of the simultaneous equations model can thus be compared with the results which would be observed in the case of the single-equation model. The wage regression coefficients are available in the columns coef.*,

reflecting correction on the level of dummy variables for the fact that the dependent variable is logarithmised.[4]

When we observe the wage penalty imposed on women in the labour market, we can verify that it has increased by nearly 37%. In 1997, women tended to earn 21% less than men. The traditional wage regression only reveals a penalty increase of about 25%. Considering that in 1985 women to be hired for a given work vacancy tended to have 0.37 more years of education and that the premium for an additional year of education is 0.104, we can conclude that, on average, the penalty for women was not 15%, but rather 11%[5]. In other words, the penalty increase was even higher as a result of the average difference in education in the recruitment of women which existed in 1985.

Analysis of the education premium is also distinct between the two regression models. Controlling for education demand, the premium was not only double in 1985, 10% in relation to the 5% captured by the OLS, but also presented much higher growth, bordering on 38%. In 1997, for each additional year of education, individuals tended to earn, on average, 14% more.

Unlike the trend captured by the OLS, a reduction of 8%, the premium for experience increased by nearly 13% and in 1997 was almost 4% for each additional year of experience. The same occurred with the returns to tenure. The results of the simultaneous equations model demonstrated an increase of 16% relative to OLS wage equation. The reduction in penalty for recently hired individuals decreased more sharply in this model, and it can be observed that in 1997 individuals with less than one year at the firm have, on average, a wage reduction of 3%.

Typically, a Collective Bargaining Agreement and a Firm Agreement are associated with higher wages than that verified for a Collective Bargaining Contract, most notably the premium of 8% for a Firm Agreement in 1997. A Government Mandatory Regime corresponds, on average, to lower wages, a negative effect which increased during the period under analysis.

It is quite clear that the gains associated with workers in firms controlled by foreign capital, or public capital, or in firms with greater gross labour productivity are less than

[4]The wage percentages change associated with the dummy variables in the wage equation is $coef.^* = e^{coef} - 1$.

[5]$-11\% : -0,1517 + 0,3596 * 0,1040 = -0,1143$

those captured by the OLS. Moreover, the deterioration in these premiums for the period under analysis is more marked when controlled for recruitment policy, with the exception of more productive firms. Bearing in mind that these types of firm normally recruit more educated individuals, and that this trend has been reinforced, what the OLS model captures is a mixture of the recruitment policy and the pay policy. However, the premium remains positive, notably in the case of "foreign firms" with an average wage premium of 12%.

Lower wages in relation to the Lisbon and Tagus Valley region are not so marked if the recruitment policy is taken into consideration. The recovery between 1985 and 1997 is greater if we estimate the two equations together. In the case of the Alentejo and Algarve region, there was even a wage premium of 2% in 1997. Joint-stock Companies, in 1997, presented a wage premium of 6% in relation to Partnership Companies, less than that observed for 1985. Sole Proprietorship Companies are normally associated with lower wages, the difference between these firms and Partnership Companies, in 1997, being 4%.

It is clear that if one controls for firm preferences regarding worker education, it can be observed that all industry sectors have a wage premium in relation to Retail Trade. The sectors which increase their wage premium include Wood and Cork, and Textiles, Clothing and Footwear. In the case of workers in Wood and Cork, the increase in the wage premium was approximately 11 percentage points, leading to an average wage advantage in 1997 of about 11%. There was also a significant increase in the relative remuneration of workers in the Textiles, Clothing and Footwear sector, with a wage premium of 11%, in 1997. For the level of education recruited, which is clearly lower than that of Retail Trade, and which grew even farther apart over the period under analysis, firms in this sector pay relatively more.

The sectors of Products made of Nonmetal Minerals, Primary Metals and Food, Beverage and Tobacco also presented an increase in the wage premium. In these last two cases, the trends between 1985 and 1997 are clearly the opposite of those captured by the OLS. Whilst the single-equation model records a fall in the wage premium, the simultaneous equations model show that there has been an increase. The result is even more interesting when compared with the result of the education equation. The sharp reduction in education demand verified in these sectors is associated, as in the case of Textiles, Clothing and Footwear, with an increase in remuneration, signifying, possibly, wage gains, but for relatively less educated workers.

In the case of the Paper, Graphic Arts and Publishing sector, the wage gain was less pronounced than that observed with the OLS, a fact which can be associated, in part, with the increase in relative demand for education recorded in this sector. In this case, they recruited more educated workers, and paid better than in 1985. Once again, the gain observed in the single-equation model is the result of the joint increase in demand for more educated workers and in remuneration. In other words, with the OLS it is not possible to isolate the increase in remuneration associated with this sector because the effect of the sector on the wage also captures its effect in the recruitment policy.

In 1985, the sectors in which better wages were paid, given the level of education sought, were Electricity, Gas and Water, Transport and Storage, Communications and Banking and Insurance, all with a wage premium of over 33% in relation to Retail Trade. In 1997, the sectors of Products made of Nonmetal Minerals and Construction and Public Works, recorded a wage premium of between 19% and 29%. In the case of the last two of these sectors, it can be observed that they typically sought not very educated labour, but paid them over the average for the education in question.

In general, all the economic activities came close to the remuneration of Retail Trade. The dispersion of the wage premium associated with the sectors decreased, since whereas in 1985 the largest wage premium was 42%, in 1997 it was 26%. The Electricity, Gas and Water, and Banking and Insurance sectors generally paid good wages but, given the increase in the demand for education recorded, they lost part of their wage advantage. In other words, given the labour that they hired, they were no longer outstanding in terms of wage in relation to the remaining branches of economic activity.

6 Conclusion

This study has aimed to analyse the effect of recruitment policy on pay policy using a simultaneous equations model. The methodology used makes significant progress in relation to OLS, since it enables the introduction of information regarding firm preferences as to the skill of workers, at the same time as it allows a problem of endogeneity inherent to that model to be solved. A confrontation of the results of the simultaneous equations model with the OLS is therefore interesting.

The analysis of the recruitment of workers according to their level of education and its impact on wages leads to the following conclusions. At the end of the 1990s, firms presented, in their hiring decision, greater sensitivity to the remuneration of education. Given the sharp increase in the wage premium for education, in certain circumstances firms opt to hire less educated workers with, for example, greater experience. This substitution between dimensions of worker skill has become more pronounced over recent years.

In the recruitment policy, discrimination against women has decreased. Discrimination is no longer significant in 1997, unlike 1985. However, there was a significant increase in the penalty in terms of wage and, in 1997, the average wage of women was 21% lower than that of men, for the same education, experience, seniority, and for companies in the same economic sector and region of the country and with the same proprietorship.

As regards the wage premium for education, the increase in the wage advantage for the more highly educated was much more pronounced than that detected by the OLS model. It is also to be noted that there was an inversion in the results regarding trends in the premium for experience and for seniority. Unlike the OLS results, the simultaneous equations model captures an increase in the wage premium for these two worker characteristics during the period under analysis.

For workers employed at firms controlled by foreign capital or public capital, or in firms with greater labour productivity, although the general orientation of the OLS conclusions is maintained, there is a change in the intensity of the wage premiums. The OLS results reflect a combination of recruitment policy and remuneration policy and, in particular, capture an increased demand for more educated workers by these type of firms. The wage penalty normally associated with certain sectors is also sometimes an illusion, in the sense that these sectors typically seek less skilled workers. This is the case of Textiles, Clothing and Footwear.

There was also a reinforcement of regional asymmetries in the hiring of education, with particular emphasis on the considerable increase in demand for more educated workers in the region of Lisbon and Tagus Valley. The opposite trend was recorded in the remuneration of hired labour. In other words, for workers with identical education, differences in pay between the regions were reduced.

It can therefore be concluded from the analysis presented here that there is important interaction between the demand for skills and wage formation. The central idea to be retained

is that the increase in wage inequality was strongly affected by the changes occurring in both recruitment and pay by the firms. In this study, however, the two decisions of firms were studied together, without taking into consideration that the same firm decides about the wages of several workers, and that information exists about the same worker over a period of time. Having demonstrated the action of recruitment policy on payment policies, it will be important in the future to study in further detail the effect of the specific characteristics of firms and of individuals; in other words, it will be important to control for the unobserved heterogeneity of these two participants in the labour market.

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Table 4: Variables definition

Variable	Definition	Values
SEX	Gender	1: Women
LHW	Logarithm of hourly wage	continuous
SCHOOL	Completed years of schooling	0
		2
		4
		6
		9
		12
		15
		17
EXPER	Potencial experience	continuous
EXPER-S	Potencial experience squared	continuous
TENURE	Tenure within the firm	continuous
T1	Tenure less than 1 year	1: $<$ 1 ano
FOREIGN	$\frac{\text{Foreign Capital}}{\text{Capital Stock}}$	1: >50%
PUB	$\frac{\text{Public Capital}}{\text{Capital Stock}}$	1: >50%
LSWORKER	Logarithm of sales per worker	continuous
SOCCUP	Skill associated with the occupation	1: Top managers and professionals
		2: Other managers and professionals
		3: Foremen and supervisors
		4: Highly skilled personnel
		5: Skilled personnel
		6: Semi-skilled personnel
		7: Unskilled personnel
		8: Apprentices
JURID	Ownership structure	1: Partnership
		2: Joint-stock company
		3: Sole proprietorship
		4: Other ownership structures

Table 4: Variables definition

Variable	Definition	Values
INDUSTRY	Industries	1: Food, beverages and tobacco
		2: Textiles, clothing and footwear
		3: Wood and cork
		4: Paper, Graphic Arts and Publishing
		5: Chemical products and petroleum
		6: Products made of nonmetal minerals
		7: Primary metals
		8: Fabricated metals
		9: Electricity, gas and water
		10: Construction and public works
		11: Wholesale trade
		12: Retail trade
		13: Hotels and restaurants
		14: Transports and Storage
		15: Communications
		16: Banking and insurance
		17: Real estate services
		18: Services supplied to firms
		19: Other domestic and personal services
TIRC	Bargaining regime	1: Collective bargaining agreement
		2: Collective bargaining contract
		3: Government mandatory regime
		4: Firm agreement
REGION	Region	1: Littoral North - Braga, Porto, Viana do Castelo
		2: Littoral Centre - Aveiro, Coimbra, Leiria
		3: Lisbon and Tagus Valley - Lisboa, Santarém, Setúbal
		4: North and Inner Centre - Bragança, Castelo Branco, Guarda, Vila Real, Viseu
		5: Alentejo and Algarve - Beja, Évora, Faro, Portalegre

Table 5: Descriptive statistics

Variable	Mean 1985	Mean 1997	Variable	Mean 1985	Mean 1997
Sex	0.3041	0.3761	industry-1	0.0588	0.0449
school	5.9047	7.1914	industry-2	0.1565	0.1665
Exper	25.1327	20.8960	industry-3	0.0364	0.0211
Exper-s	755.045	570.6574	industry-4	0.0279	0.0239
Tenure	14.3417	9.0021	industry-5	0.0548	0.0286
T1	0.0382	0.1679	industry-6	0.0384	0.0346
foreign	0.0837	0.1199	industry-7	0.0177	0.0066
Pub	0.1708	0.0805	industry-8	0.1127	0.1065
lsworker	14.5313	8.0470	industry-9	0.0178	0.0122
Tirc-1	0.0622	0.0387	industry-10	0.0838	0.1096
Tirc-2	0.7770	0,8500	industry-11	0.0883	0.0866
Tirc-3	0.0193	0.0276	industry-12	0.0543	0.1070
Tirc-4	0.1415	0.0837	industry-13	0.0381	0.0531
region-1	0.2824	0.3139	industry-14	0.0718	0.0569
region-2	0.1159	0.1463	industry-15	0.0393	0.0263
region-3	0.5357	0.4508	industry-16	0.0532	0.0460
region-4	0.0389	0.0489	industry-17	0.0022	0.0053
region-5	0.0271	0.0401	industry-18	0.0141	0.0525
Jurid-1	0.5272	0.5653	industry-19	0.0340	0.0119
Jurid-2	0.2176	0.3554	Lwage	5.1825	5.4951
Jurid-3	0.0376	0.0404	Soccup-4	0.0421	0.0646
Jurid-4	0.2175	0.0388	Soccup-5	0.4342	0.4717
Soccup-1	0.0258	0.0368	Soccup-6	0.2072	0.1720
Soccup-2	0.0187	0.0350	Soccup-7	0.0967	0.0993
Soccup-3	0.0492	0.0501	Soccup-8	0.1261	0.0705
Number of observations in 1985			Number of observations in 1997		
967374			1148687		

Source: Portugal, MTS, DETEFP (1985 and 1997)

Note: See table 4 for a description of the variables.

Table 6: Simultaneous equations model results for the schooling equation for the year 1985

Variable	Coefficient	t	Variable	Coefficient	t
FOREIGN	0,7017	43,9	INDUSTRY-1	-0,4879	-27,9
PUB	0,4787	30,2	INDUSTRY-2	-1,1113	-71,4
LSWORKER	0,2500	76,6	INDUSTRY-3	-0,7744	-38,2
JURID-2	0,5347	52,8	INDUSTRY-4	-0,0935	-4,2
JURID-3	-0,4393	-27,0	INDUSTRY-5	0,3444	16,2
JURID-4	0,5028	36,1	INDUSTRY-6	-0,2017	-9,6
SOCCUP-1	7,6658	204,9	INDUSTRY-7	0,6307	23,9
SOCCUP-2	5,0159	162,6	INDUSTRY-8	0,1633	9,8
SOCCUP-3	1,8236	107,4	INDUSTRY-9	1,2289	34,1
SOCCUP-4	2,9710	156,8	INDUSTRY-10	-0,5675	-33,4
SOCCUP-6	-1,4472	-155,9	INDUSTRY-11	0,7675	44,9
SOCCUP-7	-2,0415	-148,6	INDUSTRY-13	-0,7299	-36,9
SOCCUP-8	-0,3999	-38,8	INDUSTRY-14	0,5661	23,9
REGION-1	-0,4269	-47,4	INDUSTRY-15	2,1938	59,5
REGION-2	-0,4167	-35,9	INDUSTRY-16	3,6413	98,2
REGION-4	-0,4048	-23,2	INDUSTRY-17	2,2075	33,7
REGION-5	-0,2433	-12,9	INDUSTRY-18	2,7225	85,4
LHW	-1,1597	-25,2	INDUSTRY-19	0,7855	37,0
SEX	0,3596	42,5	CONS	1,0344	52,3
EXPER	-0,0973	-265,9			

Source: Portugal, MTS, DETEFP (1985)

Note: See table 4 for a description of the variables.

Table 7: Simultaneous equations model results for the schooling equation for the year 1997

Variable	Coefficient	t	Variable	Coefficient	t
FOREIGN	1,0983	73,4	INDUSTRY-1	-1,1357	-63,0
PUB	1,1365	59,7	INDUSTRY-2	-1,8081	-123,9
LSWORKER	0,4877	104,6	INDUSTRY-3	-0,9772	-40,6
JURID-2	1,0528	89,3	INDUSTRY-4	0,7429	29,9
JURID-3	-0,9629	-53,8	INDUSTRY-5	0,6723	28,8
JURID-4	1,1695	59,1	INDUSTRY-6	-0,0918	-4,1
SOCCUP-1	11,0194	172,9	INDUSTRY-7	-0,6437	-16,1
SOCCUP-2	6,8393	154,9	INDUSTRY-8	0,0769	5,1
SOCCUP-3	3,0149	111,0	INDUSTRY-9	1,6226	41,4
SOCCUP-4	3,8405	147,8	INDUSTRY-10	-0,9409	-66,6
SOCCUP-6	-1,5049	-120,9	INDUSTRY-11	0,8161	51,4
SOCCUP-7	-2,5374	-129,9	INDUSTRY-13	-1,4825	-78,4
SOCCUP-8	-1,8566	-87,4	INDUSTRY-14	1,0778	42,1
REGION-1	-0,9823	-91,5	INDUSTRY-15	1,5165	48,8
REGION-2	-0,9334	-75,7	INDUSTRY-16	4,6403	112,8
REGION-4	-1,1426	-59,5	INDUSTRY-17	1,1374	25,4
REGION-5	-0,0540	-3,2	INDUSTRY-18	1,8335	87,6
LHW	-4,8409	-71,3	INDUSTRY-19	0,7698	24,3
SEX	0,0213	1,9	CONS	3,1890	94,3
EXPER	-0,1073	-263,7			

Source: Portugal, MTS, DETEFP (1997)

Note: See table 4 for a description of the variables.

Table 8: Simultaneous equations model results for the wage equation for the year 1985

Variable	Coefficient	t	coef.*	Variable	Coefficient	t	coef.*
Sex	-0,1645	-184,2	-0,1517	industry-1	0,0765	33,8	0,0795
school	0,1040	438,3	0,1040	industry-2	0,0517	26,0	0,0531
Exper	0,0364	243,8	0,0364	industry-3	0,0010	0,4	0,0010
Exper-s	-0,0004	-156,2	-0,0004	industry-4	0,0993	35,5	0,1044
Tenure	0,0068	128,9	0,0068	industry-5	0,1923	81,2	0,2120
T1	-0,0626	-32,8	-0,0607	industry-6	0,1951	75,8	0,2154
foreign	0,1925	130,2	0,2123	industry-7	0,0674	20,2	0,0697
Pub	0,1410	77,2	0,1514	industry-8	0,1165	57,7	0,1236
lsworker	0,0285	93,0	0,0285	industry-9	0,4142	112,6	0,5131
Tirc-1	0,0175	8,1	0,0176	industry-10	0,1880	88,1	0,2068
Tirc-3	-0,0071	-2,6	-0,0070	industry-11	0,0706	34,1	0,0732
Tirc-4	0,0281	13,0	0,0285	industry-13	0,0602	23,5	0,0621
region-1	-0,0645	-62,8	-0,0625	industry-14	0,2852	117,1	0,3300
region-2	-0,0832	-61,8	-0,0798	industry-15	0,4172	125,8	0,5177
region-4	-0,1357	-66,0	-0,1269	industry-16	0,3589	113,4	0,4318
region-5	-0,0581	-24,2	-0,0565	industry-17	0,2150	26,2	0,2398
Jurid-2	0,0825	80,5	0,0860	industry-18	0,1188	31,7	0,1261
Jurid-3	-0,0540	-26,6	-0,0526	industry-19	0,0665	25,2	0,0687
Jurid-4	0,0415	22,6	0,0424	Cons	3,3945	644,6	3,3945

Source: Portugal, MTS, DETEFP (1985)

Notes: coef.* presents the coefficients correction for the discrete variation associated with the dummy variables; see table 4 for a description of the variables.

Table 9: Simultaneous equation model results for the wage equation for the year 1997

Variable	Coefficient	t	coef.*	Variable	Coefficient	t	coef.*
Sex	-0,2331	-243,8	-0,2079	industry-1	0,0963	40,0	0,1011
school	0,1431	546,4	0,1431	industry-2	0,1080	58,2	0,1140
Exper	0,0410	272,8	0,0410	industry-3	0,1053	32,6	0,1111
Exper-s	-0,0005	-150,3	-0,0005	industry-4	0,1156	38,1	0,1225
Tenure	0,0079	120,0	0,0079	industry-5	0,1298	45,8	0,1385
T1	-0,0329	-26,3	-0,0324	industry-6	0,2324	86,0	0,2617
foreign	0,1152	82,5	0,1221	industry-7	0,1075	19,9	0,1135
Pub	0,0447	17,5	0,0457	industry-8	0,1141	59,8	0,1209
lsworker	0,0165	39,4	0,0165	industry-9	0,1689	35,6	0,1840
Tirc-1	0,0393	10,7	0,0401	industry-10	0,2058	108,4	0,2285
Tirc-3	-0,0383	-14,1	-0,0376	industry-11	0,0417	21,3	0,0426
Tirc-4	0,0794	25,7	0,0826	industry-13	0,0337	14,5	0,0343
region-1	-0,0318	-27,6	-0,0313	industry-14	0,2564	99,3	0,2923
region-2	-0,0349	-24,7	-0,0343	industry-15	0,1735	46,0	0,1895
region-4	-0,1234	-59,1	-0,1161	industry-16	0,2051	55,3	0,2277
region-5	0,0240	10,6	0,0243	industry-17	0,0460	7,7	0,0470
Jurid-2	0,0538	50,7	0,0553	industry-18	0,0238	9,7	0,0241
Jurid-3	-0,0429	-19,5	-0,0420	industry-19	0,0572	13,7	0,0589
Jurid-4	0,0372	15,4	0,0379	Cons	3,6847	813,6	3,6847

Source: Portugal, MTS, DETEFP (1997)

Notes: coef.* presents the coefficients correction for the discrete variation associated with the dummy variables; see table 4 for a description of the variables.

Table 10: OLS results for the wage equation for the year 1985

Variable	Coefficient	t	coef.*	Variable	Coefficient	t	coef.*
Sex	-0,1599	-198,3	-0,1478	industry-1	0,0302	14,8	0,0306
school	0,0536	500,7	0,0536	industry-2	-0,0117	-6,5	-0,0116
Exper	0,0311	222,4	0,0311	industry-3	-0,0570	-24,5	-0,0554
Exper-s	-0,0004	-167,3	-0,0004	industry-4	0,1009	39,9	0,1061
Tenure	0,0077	151,4	0,0077	industry-5	0,2057	96,1	0,2284
T1	-0,0558	-29,8	-0,0543	industry-6	0,1568	67,6	0,1697
foreign	0,2304	173,4	0,2591	industry-7	0,0773	25,7	0,0804
Pub	0,1648	99,1	0,1792	industry-8	0,1092	59,9	0,1154
lsworker	0,0408	149,2	0,0408	industry-9	0,4376	131,1	0,5490
Tirc-1	-0,0026	-1,2	-0,0026	industry-10	0,1412	73,6	0,1517
Tirc-3	-0,0076	-2,9	-0,0076	industry-11	0,1054	56,4	0,1111
Tirc-4	0,0227	10,6	0,0229	industry-13	0,0079	3,4	0,0079
region-1	-0,0877	-95	-0,0839	industry-14	0,2863	129,5	0,3315
region-2	-0,1094	-90,3	-0,1037	industry-15	0,4707	154,7	0,6011
region-4	-0,1627	-87,7	-0,1502	industry-16	0,5247	181,9	0,6899
region-5	-0,0757	-34,9	-0,0729	industry-17	0,3536	47,8	0,4241
Jurid-2	0,1038	112,5	0,1093	industry-18	0,2486	73,5	0,2823
Jurid-3	-0,0688	-37,6	-0,0665	industry-19	0,1028	43,2	0,1082
Jurid-4	0,0713	42,6	0,0739	Cons	3,6316	773,4	3,6316
F Test				46433			

Source: Portugal, MTS, DETEFP (1985)

Notes: coef.* presents the coefficients correction for the discrete variation associated with the dummy variables; see table 4 for a description of the variables.

Table 11: OLS results for the wage equation for the year 1997

Variable	Coefficient	t	coef.*	Variable	Coefficient	t	coef.*
Sex	-0,2043	-255,3	-0,1848	industry-1	0,0105	5,2	0,0105
school	0,0626	538,7	0,0626	industry-2	-0,0013	-0,9	-0,0013
Exper	0,0285	229,5	0,0285	industry-3	0,0075	2,8	0,0075
Exper-s	-0,0004	-153,3	-0,0004	industry-4	0,1621	63,7	0,1759
Tenure	0,0073	129,1	0,0073	industry-5	0,1594	67,0	0,1728
T1	-0,0476	-44,3	-0,0465	industry-6	0,1621	71,6	0,1760
foreign	0,1629	139,5	0,1769	industry-7	0,0372	8,2	0,0379
Pub	0,0696	32,2	0,0721	industry-8	0,0993	62,0	0,1044
lsworker	0,0471	136,5	0,0471	industry-9	0,2030	50,9	0,2250
Tirc-1	0,0492	15,6	0,0504	industry-10	0,1259	79,5	0,1341
Tirc-3	0,0732	31,6	0,0760	industry-11	0,0899	54,9	0,0941
Tirc-4	0,1152	43,6	0,1221	industry-13	-0,0352	-18,0	-0,0346
region-1	-0,0832	-86,8	-0,0798	industry-14	0,2574	118,5	0,2935
region-2	-0,0921	-78,2	-0,0879	industry-15	0,2179	68,4	0,2435
region-4	-0,1709	-97,7	-0,1571	industry-16	0,4403	141,7	0,5531
region-5	-0,0010	-0,5	-0,0010	industry-17	0,1258	25,0	0,1341
Jurid-2	0,1073	121,5	0,1133	industry-18	0,1277	62,3	0,1362
Jurid-3	-0,0864	-46,7	-0,0828	industry-19	0,1052	30,0	0,1109
Jurid-4	0,1016	50,1	0,1070	Cons	4,2498	1190,1	4,2498
F Test				41199			

Source: Portugal, MTS, DETEFP (1997)

Notes: coef.* presents the coefficients correction for the discrete variation associated with the dummy variables; see table 4 for a description of the variables.

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