

**Firms' wage policies:
New evidence from linked employer-employee data**

Fátima Suleman
Sérgio Lagoa
Abdul Suleman
Marta L. Pereira
2013

WP n.º 2013/06

DOCUMENTO DE TRABALHO

WORKING PAPER





DINÂMIA'CET
CENTRO DE ESTUDOS SOBRE A MUDANÇA
SOCIOECONÓMICA E O TERRITÓRIO
ISCTE-IUL

Firms' wage policies:

New evidence from linked employer-employee data

Fátima Suleman*

Sérgio Lagoa**

Abdul Suleman***

Marta L. Pereira****

WP n.º 2013/06

DOI: 10.7749/dinamiacet-iul.wp.2013.06

1. INTRODUCTION	3
2. WAGE POLICIES IN ECONOMIC LITERATURE	4
3. DESCRIPTION OF DATA	8
4. MULTIVARIATE ANALYSIS: FUZZY CLUSTERING	11
5. EMPIRICAL FINDINGS	13
a. Wage typologies.....	13
b. Firms' characteristics linked to wage typologies	16
6. CONCLUDING REMARKS	19
REFERENCES	21

* DINÂMIA'CET – IUL and ISCTE – IUL, Corresponding author: fatima.suleman@iscte.pt.

** DINÂMIA'CET – IUL and ISCTE – IUL.

*** BRU – IUL and ISCTE – IUL.

**** DINÂMIA'CET – IUL and ISCTE – IUL.

Firms' wage policies:
New evidence from linked employer-employee data¹

Abstract

The research on wage policies has been triggered by the interest in identifying whether labour market or institutional forces shape the wage settings inside firms. This paper draws on linked employer-employee data and uses a fuzzy c-means clustering analysis to identify typical wage policies of medium and large firms in Portugal. Empirical evidence suggests that firms are segmented into four clusters that can be labelled according to wage rules as “*Regulated*”, “*Asymmetric*”, “*Hierarchical*” and “*Discretionary*”. The first two clusters comprise low wage firms, and are highly responsive to market conditions. The firms belonging to the latter clusters take advantage of discretionary power to differentiate the workforce. Our findings therefore illustrate different dimensions of wage flexibility. Furthermore, we found that employment flexibility and wage adjustments can coexist, and affects female, young, and blue collar workers in particular.

¹ This paper draws on the research carried out within the Project “FLEX - Flexible wages for flexible contracts? The dynamics of the relationship between wage policy and employment contracts at the firm level” funded by FCT – Fundação para a Ciência e a Tecnologia - PTDC/EGE-ECO/108547/2008, Portugal. The research was possible thanks to kindness of Office for Strategy and Studies (GEE), Ministry of Economy and Employment for access to the data, Quadros de Pessoal. This paper has benefited from helpful comments by two anonymous referees, by Helena Lopes and participants of Industrial Relations in Europe Conference (IREC), Lisbon, 5-7 September 2012 and 10th European Conference of the International Labour and Employment Relations Association (ILERA), Amsterdam, 20-22 June 2013. We particularly acknowledge the support from Diana Alves.

1. INTRODUCTION

The way wages are allocated across individuals within firms reflects the influence of factors that are beyond human capital predictions (Prendergast, 1998). Employers tend to design and implement compensation systems to accomplish specific goals and needs (Dulebohn and Werling, 2007). The perception that firms seek to achieve an intentional wage policy, that allows to develop specific skills, economise transaction costs and at the same time guarantee efficient governance, can be traced back to the internal labour market model (ILM) (Doeringer and Piore, 1971). A further contribution on the subject comes from Baker, Gibbs and Holmstrom (1994) who offer an empirical picture of wage policy of one single firm. Their most relevant conclusion is that “none of the three leading theories – on-the-job training, learning and incentives, alone can explain the data” and thus in practice wage theories are expected to overlap (Levine *et al.*, 2002). Despite the relevance of that research, it has the limitations of a case study and does not make it clear if or how one theory takes precedence over others, if at all.

Our empirical research draws on Portuguese linked employer-employee data (LEED), known as Quadros de Pessoal (Cardoso and Portugal, 2005; Cardoso and Portela, 2009), and examines the wage policy of 2220 medium and large sized firms which account for about 800 thousand workers and aim to identify typical wage policies that prevail in the Portuguese economy and subsequently ascertain how they interact with workplace characteristics. It refers to the year of 2009. The data on wages provided by LEED were coarse grained into firm level data and used to construct potential indicators of wage policy, as in Lazear and Shaw (2006).

The design of variables took into account the different dimensions and the associated rules of wage policies reported in economic literature. It includes equity concerns as in the ILM model (Doeringer and Piore, 1971) and collective bargaining models (OECD, 2004); response to market conditions studied in wage cyclical models (Devereux and Hart, 2006); and incentive devices detailed in performance related pay models (Medoff and Abraham, 1980). We focus on the way firms combine different rules and procedures given the wage levels, hierarchy, growth and flexibility that can crystallise a wage policy.

The resulting data on firms were submitted to a fuzzy clustering analysis. We decided to use this approach to decompose firm data because it allows us to operationalise concepts that underline theoretical models, to configure the concepts into wage determination theories (Kvist, 2007) and to assess how each firm positions itself in the context set out by actual wage policies. In practice, typical wage policies are intended as labels that allow the estimated prevalent conditions or fuzzy clusters to be linked to one or more wage theory.

In the subsequent data analysis, we focused on the workplace characteristics associated with the fuzzy clusters that emerged from the first empirical stage. While the effects of size and industry affiliation on wage differentials have been largely explored in the literature (Groschen, 1991; Brown and Medoff, 1989), little attention has been given to the relationship between wage policy and employment contracts (Bhandari and Heshmati, 2008; Dias, Marques and Martins, 2012). The originality of our research lies in the use of an adequate analytical tool which enables us to describe the diversity of wage policies and to link them to workplace characteristics.

The following questions guided our research. How do firms combine wage rules that shape their wage policy? What is the wage structure of a firm like? Are wages responsive to market conditions? Are wages more rigid/flexible in firms that make more intense use of standard/flexible contracts? Do particular groups of workers benefit/suffer from specific wage and contract rules?

The paper is organised in the following manner. Section 2 offers a survey of literature on wage policies in economic literature. Section 3 details the data and methodological options regarding wage rules variables, while Section 4 explains the motivation to use fuzzy clustering analysis to identify wage policy patterns. The empirical results are presented and discussed in Section 5. Herein, we analyse the wage policy patterns and the associated workplace characteristics. Finally, some concluding remarks are given in Section 6.

2. WAGE POLICIES IN ECONOMIC LITERATURE

The rules and procedures associated with wage decisions and other internal functioning of firms have long been regarded as a mysterious “*black box*”. Despite the relevance of this topic, the literature has progressed on the basis of human capital theory that generally points to individual skills as the primary source of wage differentials (Becker, 1964). A clear understanding of the internal organisation of firms provides an insight into the way labour markets operate, and is particularly linked to the internal labour market (ILM) model (Doeringer and Piore, 1971). Researchers have been interested in the question on whether the wage settings inside firms are shaped by the market or institutional forces (e.g. Lin, 2005; Hassink and Russo, 2008).

From the classical competitive perspective of the labour market, buyers and sellers meet to transact hours of work and agree on a price which translates into a wage rate. Accordingly, the employment relationship is a spot market transaction that in many ways resembles the transaction of goods or services, whereby the price is adjusted to bring supply and demand into equilibrium. So, firms may adjust nominal or real wages to supply and demand shocks (Baker,

**Firms' wage policies:
New evidence from linked employer-employee data**

Gibbs and Holmstrom, 1994; Devereux and Hart, 2006; Caju, Rycx, and Tojerow 2008; Seltzer, 2010; Portugal, Carneiro and Guimarães, 2010) but also protect certain type of skills, such as specific skills (Carneiro, Guimarães and Portugal, 2009; Devereux and Hart, 2006) or transferable skills e.g. industry-specific skills (Weinberg, 2001).

In contrast to this, economists interested in the regulation of the employment relationship claim that wages are determined by institutional processes where market forces play quite a minor role (Doeringer and Piore, 1971). They assume the labour market cannot be compared to any other market and the trade in labour services is much more complex than are spot market transactions. For instance, trade unions and management undertake a joint process of regulation to set pay and employment conditions including wage levels, wage growth, wage dispersion and wage rigidity (Martins, 2011). Collective agreements can be reached at several levels, namely single and multi-employer or industry-wide agreements (OECD, 2004). While the latter virtually leave little scope for employers' discretion, the single-firm agreements allow for a more decentralised level of bargaining. Therefore, centralised bargaining tends by nature to reduce wage inequalities, whereas decentralisation gives employers more scope to adjust wages to market conditions and to reward perceived skills (OECD, 2004; Bastos, Monteiro and Straum, 2009). Nonetheless, in the context of a regulated labour market, employers can avail themselves of the wage cushion to overcome the restrictions posed by collective agreements to increase the salary rate prescribed by regulation (Cardoso and Portugal, 2005; Jung and Schnabel, 2011).

Furthermore, firms set explicit wage rules that can deal with the complexity of employment contracts related to incentive devices, training investments in specific skills and transaction costs. Explicit individual or group-based incentive schemes may be used to induce workers' effort, productivity and cooperation. Individual incentives include the link between wage growth and individual productivity measured through supervisors' assessment (Bishop, 1987; Lazear, 2000; Flabbi and Ichino, 2001; Dohmen, 2004; Serneels, 2008), and the dispersion of wage growth in line with the employee's performance (Grund and Westergaard-Nielsen, 2008). Group incentives consist of both profit sharing schemes that are designed to increase productivity through workers' cooperation (FitzRoy and Kraft, 1987), and rent sharing schemes that, alongside cooperation, fulfil the goal of controlling workers' bargaining power, promote fairness and reciprocity, and deal with failures of corporate governance (Black and Strahan, 2001).

Firms may develop long-term employment relationships and rules that commit workers to certain behaviours (Abraham and Prosch, 2000), or allow wage adjustments on the basis of information on worker skills (Holmstrom, 1982). For instance, Lazear (1979) points to deferred

compensation as a motivator for developing long-term relationships. Seniority-based pay schemes involve lower wages at the start of the career than the wages implied by productivity. However, workers can expect to be rewarded in the future. This procedure potentially prevents and discourages workers from leaving the firm unless they achieve a better position in the external labour market. Learning models point to the evolution of wages according to the arrival of information about workers' abilities and productivity (Farber and Gibbons, 1996).

The internal labour market (ILM) model follows the same rationale of promoting a long-term relationship between employees and organisations and, at the same time, aims to protect investments in firm-specific skills. In an ILM, job assignment and pay system are clearly integrated in a highly codified pay structure set by collective agreements or managerial decisions. Wages are then attached to jobs rather than to workers. In other words, wages depend on the position in the pay structure where high-level jobs are clearly associated with high pay. The scope for employer discretion is limited (Grimshaw *et al.*, 2001), while incentives mechanisms arise from differences in pay between levels and internal promotion. Wages are shielded from the competition of the external labour market, with a kind of wage rigidity that does not allow the wage to adjust to the business cycle or other external factors. Furthermore, in ILMs, wages rarely rely on performance evaluation or any other form of incentive pay (Levine *et al.*, 2002).

Nevertheless, firms adopting ILM or other standardised rules may be challenged to promote incentive devices to differentiate employees according to observable or non-observable characteristics. Therefore, the scope of employer discretion entails a strengthening of instruments that favours wage differentiation, e.g. within levels dispersion, and consequently leads to an individualisation of the employment relationship. However, empirical evidence does not support any deep-seated change from ILM to the new model (Levine *et al.*, 2002).

Despite the relevance of the reported literature, the focus has been on the individual worker. The way that firms combine different rules and procedures regarding wage level, hierarchy, growth and flexibility which crystallise a wage policy is little explored in the literature. The research efforts reported have given rise to the following research hypothesis that will be submitted to empirical test:

Hypothesis 1: *Firms make specific combinations of wage rules and procedures that position them closer to (far from) a pure model.*

In relation to wage decisions, there is a fair amount of research that focuses on the relationship between wage rules and firms' characteristics. Groshen (1991), for example, surveys the

**Firms' wage policies:
New evidence from linked employer-employee data**

literature about firm size and industry affiliation effects. Structured labour markets such as ILM are more likely to exist in large firms (Doeringer and Piore, 1971) because of substantial fixed costs that presume a long-term employment relationship, progression rules structured in job ladders, and detailed division of labour (Levine *et al.*, 2002).

Additionally, firms tend to merge internal options with external labour market information to position themselves in the labour market. By matching the competition, firms attempt to keep labour costs comparable to those of competitors; lead policy (i.e. higher-wages) makes firms attractive while the lag approach positions firms below competitors (Fisher, Schoenfeldt and Shaw, 1996). High-wage and low-wage firms coexist in the labour market. High-wages are expected to occur more in large firms (Brown and Medoff, 1989), which are more productive and capital-intensive and employ more high-skilled workers than small firms (Abowd, Kramarz and Margolis, 1999). Belfield and Wei (2004) relate a sizeable wage premium in large firms with the presence of ILM.

Several studies have acknowledged large and persistent wage differentials among industries (Krueger and Summers, 1988) indicating that workers gain rents in some sectors. ILM are more common in certain industries (see Grimshaw *et al.*, 2001) like for example the banking industry (Seltzer and Frank, 2007; Seltzer, 2010; Suleman and Sgobbi, 2010; Suleman, 2012), while labour intensive industries, such as textile and clothing, pay lower wages to face intensive international competition (Nordås, 2004). The latter industries represent ports of entry in the labour market for low-skilled labour and accommodate a large proportion of the female labour force. Cost cutting strategies also explain wage differentials between permanent and flexible workers as reported by Bhandari and Hesmati (2008) in their study on Indian manufacturing.

The following hypotheses have emerged from the literature on what factors influence firms' decisions regarding their wage policy:

Hypothesis 2: *The wage policy model is conditioned by firm size and production technology;*

Hypothesis 3: *Market competition contributes to shaping wage rules. Price sensitive product markets and labour intensive industries impose cost pressures and, at the same time, lead to strategies to lower wage and job quality.*

Hypothesis 4: *Sorting workers by skills influences firm decisions.*

3. DESCRIPTION OF DATA

The potential of LEED for a deeper understanding of the labour market and its policy relevance is well-documented in the literature (Bryson, Forth, and Barber, 2006). Usually researchers use LEED to estimate an earnings equation to explain individual wage differentials. These econometric models include specific person and firm effects and are estimated by a variety of statistical techniques (see e.g. Abowd, Kramarz, and Margolis, 1999). However, less attention has been paid to the potential features provided by LEED to explore wage differentials across firms. In this case, the unit of analysis should be the firm rather than the individual. Our aim is to identify the wage policies adopted by Portuguese medium and large firms. Lazear and Shaw (2006) followed this line of reasoning to compare firms' wage structures and hiring and mobility patterns in eight European countries.

We follow this latter approach to examine Portuguese medium and large firms' wage policy using *Quadros de Pessoal*, which is a longitudinal LEED annually compiled by the Ministry of Economy and Employment by means of a standard inquiry, and it is mandatory for every firm with wage-earners (see Cardoso and Portugal, 2005; Cardoso and Portela, 2009 for details). This dataset has already been used to check the impact of firms' characteristics on several labour market outcomes. Cardoso (2000) shows that Portuguese firms reward human capital differently; Lima and Pereira (2003) suggest that employer learning impacts workers' careers in large firms; Cardoso and Portugal (2005) offer evidence on employers' discretionary power using a wage cushion to individualise wages; Carneiro, Guimarães and Portugal (2009) point out the procyclicality of real wages; and Portugal (2008) offers evidence on rent sharing schemes. Firms also segment their workforce on the basis of the labour contract, differentiating workers by age (Martins, 2007) and tenure (Carneiro, Guimarães and Portugal, 2009). These studies have a common denominator as they use the worker as the unit of analysis rather than the firm, and focus on a particular dimension of wage policy. Our study puts the firm at the centre of analysis, and attempts to offer a comprehensive picture of firms' wage policies in medium and large sized firms in Portugal. For this purpose, we selected a sample of firms according to specific criteria, namely firms with at least 80 employees; this gives a sample size of 2220 firms, accounting for about 800 thousand workers.

Following the various above-mentioned theories, we constructed a set of variables associated with rules and procedures of a wage policy grouped around four wage dimensions: level, hierarchy, growth and flexibility. In so doing, we were able to simultaneously examine wage distribution; the link between wages and occupational structure; wage changes; and the

**Firms' wage policies:
New evidence from linked employer-employee data**

use of wages as an adjustment process. We stress that the firm data are calculated by averaging out the data at the worker level.

Table 1 details the 17 variables constructed to address the four dimensions referred above. The variables account for pay practices at the firm level and, on the whole, allow us to characterise the underlying wage policy.

**Table 1
Variables used to define wage rules**

Variable short name	Variable specification	Information provided
Wage levels		
Hourly wage	Average total wage: firm average hourly wage	Distribution of wages Position of firm vis-à-vis the competition in the general labour market
Firm/industry wage	Average total wage comparatively to industry: Proportional difference between firm's average total hourly wage and the average wage in the industry	Position of firm vis-à-vis the direct competitors in the industry labour market
90/10	Wage dispersion: Proportional wage gap between the 90 th and the 10 th percentiles	Inequality between high-wage and low-wage earners. Wage differentials to reward skills
Gini	Wage dispersion: Gini coeficient	Overall inequality of wage distribution
Skewness	Wage asymmetry: Skewness of total wage	Degree of asymmetry of wages Wage differentials to reward skills
Entry-wage	Entry level wage: Wage differential between newly hired (tenure up to one year) and incumbents	Competition around general skills or value of specific or general skills
Insiders/outsideers	Entry-level wage: Wage differential between insiders in the core job and outsideers that go to the core job	Competition around general skills or value of specific or general skills
Education premium	Education premium: Pearson correlation between years of schooling and hourly wage	Value of general skills
Wage hierarchy		
Wage hierarchy	Pay structure: Spearman correlation between job level and wage	Wages tied to job hierarchy
Intra job dispersion	Within job dispersion: coefficient of variation (CV) of total wages in core job	Internal equity controlling for job level. Incentive devices within job
Wage growth		
Wage growth	Average wage growth: wage increase in last four years	High and low wage growth firms
Growth dispersion	Growth dispersion: standard Deviation (SD) of average wage growth	Distribution of wage growth Wage growth used as incentive
Growth skewness	Selection in wage growth: skewness of wage growth	Selective incentive devices
Tenure profile	Wage growth and tenure: Pearson correlation between wage and tenure	Value of firm-specific skills
Wage flexibility		
Wage cushion	Wage cushion: difference between total wage and bargained wage	Incentive devices: employers' discretion to individualise wages
Wage adjustment	Cyclicality of wages: elasticity of wages to unemployment rate	Wages used as adjustment process
Rent sharing	Rent sharing: Pearson correlation between mean wage and firm sales of previous year	Incentive devices: employers' discretion to obtain cooperation

Firms' wage policies:
New evidence from linked employer-employee data

Although some variables are self-descriptive, as is the case of static dispersion indicators, others deserve further explanation. This is mostly the case of dynamic variables, but the same applies to the variables that are not readily available in the dataset.

Hourly wage represents an employee's real wage including base pay, additional payments paid regularly and payment of overtime². A simple correlation appeared suitable to obtain the wage hierarchy that relates the eight levels job hierarchy³ with wages; the education premium represents the correlation between years of schooling and wages; while the tenure profile corresponds to the correlation between years with the same employer and wages.

Now we turn to variables that demanded specific calculations. For example, the wage cushion is the ratio of individual total wage to base pay that generally corresponds to contractual wage defined in collective agreement⁴. The sensitivity of wages to labour market conditions, labelled wage adjustment, represents the proportional change in the average firm's wage divided by the proportional change in the unemployment rate in the *previous* year⁵. The variables to explore the employers' capacity to attract a skilled workforce from the labour market include entry-level wages consisting of proportional wage differentials between newly hired (tenure up to one year) and incumbents. The same idea is also explored for insider-outsider wage differentials for the modal job inside each firm. We note that static variables refer to the year of 2009, the last available dataset, while dynamic variables cover the five-year period from 2005 to 2009. Table 2 reports descriptive statistics of variables related to wage dimensions specifically level, structure, growth and flexibility.

² The wages were deflated using the price index from 1994. The total wage was then divided by total working time including overtime.

³ The eight levels include apprentices, interns and trainees; non-qualified professionals; semi-qualified professionals; qualified professionals; higher-qualified professionals; supervisors, team-leaders; intermediary executives; and top executives.

⁴ According to Cardoso and Portugal (2005), the correlation between base pay and contractual wage is high. For this reason, they and we use the mode of the base wage for a given job category as contractual wage and calculate the wage cushion.

⁵ Previous year's unemployment rate seems to be more appropriate since, in Portugal, wages are negotiated at the end of year before being implemented at the start of the next year.

Table 2
Descriptive statistics of the 17 variables used to study the wage policy of firms

Variables	Mean	sd
Hourly wage	4.75	2.55
Firm/industry wage	0.14	0.43
90/10	1.63	1.06
Gini	0.23	0.08
Skewness	3.68	2.08
Entry-wage	-0.12	0.24
Insiders/outside	0.02	0.03
Education premium	0.37	0.19
Wage hierarchy	-0.65	0.19
Intra job dispersion	0.25	0.16
Wage growth	0.04	0.04
Growth dispersion	0.11	0.06
Growth skewness	2.15	1.34
Tenure profile	0.18	0.23
Wage cushion	1.86	0.93
Wage adjustment	-0.30	1.39
Rent sharing	0.10	0.55

The multivariate firm data were submitted in the first stage to a fuzzy clustering analysis in order to identify wage typologies that prevail among medium and large sized firms. Hypothetically, each typology characterises the typical wage policy of firms and subsequently allows it to be labelled. In the second stage of data analysis, we used a set of variables related to workplace characteristics to analyse how they interact with those typologies, namely workforce characteristics, firm size, industry affiliation, equity composition, and regulations through collective bargaining (see Table 6). Ultimately, we aim to examine how they interact with a particular wage policy.

4. MULTIVARIATE ANALYSIS: FUZZY CLUSTERING

We propose to empirically construct typical patterns or typologies that prevail in the universe of medium and large sized Portuguese firms so as to identify the existing wage policies. More specifically, we want to assign $N = 2200$ firms to a smaller number of $c \geq 2$ clusters, i.e. typologies, although we have no prior information about c nor to which cluster(s) a particular

firm should belong. What type of cluster analysis should be performed to tackle such heterogeneous population?

Where it is difficult to clearly identify a sharp boundary between typologies, as in the case of firms' data, a fuzzy clustering approach is recommended to perform data analysis (Hwang, DeSarbo and Takane, 2007). Fuzzy clustering is an overlapping method of data decomposition where each case (i.e. firm) is allowed to be a partial member of two or more clusters at the same time. Partial membership of a case in a cluster is a number between 0 and 1 that indicates how close or far the case is from that cluster. Therefore, a membership of 0 corresponds to no membership at all, whereas a full membership in a cluster is represented by 1. A fuzzy approach, together with the concept of partial membership, potentially allows the details of firms' individual practices to be captured as it does not force any firm to fully belong to one cluster. The memberships of a given set of firms may, for instance, indicate whether there is a second-best cluster affecting the wage structure, and subsequently allows the underlying workplace characteristics to be examined (Everit *et al.*, 2011).

The data analysis was carried out through fuzzy c-means algorithm (Bezdek, 1981). To run this algorithm we must define a priori the number of clusters c and the weighting exponent m . For the purpose of the number of clusters, we used the subtractive clustering method (Chiu, 1994) and realised that the solution of $c = 4$ clusters would be more consistent than any other. Based on this cluster solution, we run the algorithm for different values of m which accounts for the fuzziness of c clusters, and found $m = 1.6$ to be a suitable value for our dataset.

The output of fuzzy c-means algorithm is a set of c prototypes (technically, cluster centroids) and, for each firm, the corresponding membership degrees to those prototypes, which form a fuzzy c-partition. The prototypes are full members of fuzzy clusters in the classical sense, i.e. have a membership of one in fuzzy clusters. Although they are useful to characterise wage policies, it is convenient for practical purposes to relax the condition of full membership to some high level of similarity (Normander and Prosser, 2000) that somehow expresses a threshold of strong agreement (Bezdek, 1974) with either one or more group of clusters. This procedure potentially provides a more insightful picture of the distribution of firms in the context set out by existing wage policies as well as on workplace characteristics that might be influencing their wage policy. In our study, we fixed the referred threshold to $\alpha = 0.75$.

5. EMPIRICAL FINDINGS

a. Wage typologies

Table 3 displays the distribution of the 2220 firms on the estimated fuzzy 4-partition. As mentioned above, the different groups were constructed on the basis of a level of similarity of 0.75 or more. In this table, we deliberately used the letters V, E and F (Vertex, Edge and Face) to denote different groups in the fuzzy partition to mimic its geometrical counterpart. Prototypes are termed, P1, P2, P3 and P4. Prototype P1 is labelled as “*Regulated*”; P2 as “*Asymmetric*”; P3 as “*Hierarchical*”; and finally P4 as “*Discretionary*”. Below we explain the reasons underlying this labelling.

**Table 3: Distribution of Portuguese firms on the fuzzy 4-partition
(level of similarity $\alpha = 0.75$)**

Membership in				Total = 2220
One Fuzzy Cluster				
V_1 405 (18.2%)	V_2 185 (8.3%)	V_3 103 (4.6%)	V_4 151 (6.8%)	844 (38.0%)
Two Fuzzy Clusters				
$E_{1,2}$ 386 (17.4%)	$E_{2,3}$ 41 (8.3%)	$E_{3,4}$ 124 (5.6%)		1198 (54.0%)
$E_{1,3}$ 606 (27.3%)	$E_{1,4}$ 40 (1.8%)	$E_{2,4}$ 1 (0.0%)		
Three Fuzzy Clusters				
$F_{1,2,3}$ 141 (6.4%)	$F_{1,2,4}$ 7 (0.3%)	$F_{1,3,4}$ 28 (1.3%)	$F_{2,3,4}$ 2 (0.1%)	178 (8.0%)
Four Fuzzy Clusters				0

The values in Table 3 indicate considerable heterogeneity of Portuguese medium and large firms. We found 38% of firms assigned to typical patterns, while the model allowed more than 62% of firms to be classified into two (54%) and three (8%) fuzzy clusters. Therefore, the *fuzzification* of cluster configuration offers us a large amount of information to interpret. For the sake of simplicity and clarity, first we focus on fuzzy cluster prototypes, which identify typical patterns, and then explore the potential of a fuzzy approach to data analysis. By doing so, we attempt to answer to our research questions on how firms combine wage rules; what are the characteristics of a firm wage structure, and to what extent the wages are responsive to market conditions.

The four fuzzy prototypes resulting from the application of a fuzzy c-means clustering, show that medium and large Portuguese firms can be segmented by wage setting decisions. Table 4 reports the estimates used to examine the similarities and dissimilarities among firms, and ultimately indicate the patterns underlying each wage policy. We first label prototypes

**Firms' wage policies:
New evidence from linked employer-employee data**

according to more distinctive features and then qualitatively describe specific wage rules and procedures that potentially unveil a wage policy. Prototypes were *a posteriori* ordered by mean hourly wage.

**Table 4
Fuzzy c-means estimates of cluster prototypes (P1, P2, P3 and P4)**

Wage rules	P1	P2	P3	P4
	Regulated	Asymmetric	Hierarchical	Discretionary
Hourly wage	3.39	3.47	5.18	10.01
Firm/industry wage	-0.04	-0.01	0.23	0.74
90/10	1.29	1.01	2.11	2.41
Gini	0.20	0.20	0.27	0.27
Skewness	3.00	6.57	3.15	2.54
Entry-level wage	-0.12	-0.10	-0.14	-0.18
Insider/outsider	0.02	0.01	0.02	0.03
Education premium	0.40	0.31	0.40	0.30
Wage hierarchy	0.66	0.58	0.69	0.65
Intra job dispersion	0.20	0.21	0.28	0.35
Wage growth	0.03	0.03	0.04	0.05
Growth dispersion	0.10	0.11	0.13	0.13
Growth skewness	1.91	2.22	2.26	2.33
Tenure profile	0.20	0.17	0.17	0.19
Wage cushion	1.49	1.56	2.04	3.10
Wage adjustment	-0.34	-0.35	-0.20	-0.32
Rent sharing	0.09	0.08	0.11	0.13

“*Regulated*” firms pay the lowest wages compared to their competitors but at the same time, compete for general skills and pay a high education premium (correlation education-wage = 0.40). Some evidence suggests that firms adhere to the rules stipulated in collective agreements, namely the relationship between wages and job hierarchy as measured by the correlation job-wages (0.66); the correlation tenure-wages (0.20); the lowest value of wage cushion (1.49); and, the lowest within-job dispersion (0.20). However, the wages are particularly procyclical indicating that employers strongly adjust wages to market conditions (elasticity of wages = -0.34).

“*Asymmetric*” firms pay low wages but try to match the competition. The strongest asymmetry of wages is a distinctive feature here, indicating that firms in this typology make use of wage incentives. In other words, a small proportion of workers earn high wages, whereas a large proportion earn low wages (skewness = 6.57). Firms within this cluster are the most flexible regarding the business cycle (elasticity of wages = -0.35) and seem to be far from collective settings. For instance, the correlation between job and wage and between tenure and wage was found to be the lowest in the sample. On the other hand, “*Hierarchical*” firms show the largest correlation between job and wage (0.69) unveiling some typical properties of internal

Firms' wage policies:
New evidence from linked employer-employee data

labour markets. Firms pay high wages, which are slightly higher than those of their direct competitors; use wage growth to differentiate workers (skewness of growth = 2.26); and protect their investments in specific skills by benefiting stayers with higher wages than newly hired workers (entry-level wage = -0.14). Moreover, firms tend to protect their workers, more than other firms, when labour market conditions worsen (elasticity = -0.20). However, the dispersion of wages within job, education premium, and wage cushion reveal the presence of incentive devices.

Firms clustered as “*Discretionary*” pay the highest wages, which are substantially higher than the wages of their direct competitors. These firms want to be attractive to skilled candidates and at the same time discourage current workers from leaving the firm. In addition to the highest wage rate, other estimates suggest that these firms might be aware of the role a compensation system plays in achieving performance goals, in underpinning organisational values and beliefs and in meeting business needs (Armstrong, 1999). Some evidence indicates closeness to the ILM model, namely the large correlation between job and wages (0.65), as well as the correlation between tenure and wages (0.19); and the largest differences between newly hired and incumbents' wages (-0.18) and growth (0.03). However, the wage adjustment (elasticity of wages = -0.32), the largest within job dispersion (0.35) and wage cushion (3.10) illustrate a substantial erosion of ILM properties and indicate strong presence of individualised pay schemes. Not surprisingly, the gap 90/10 (2.41) is the highest among the sampled firms as well as the skewness of wage growth (2.33) and the rent sharing bonuses (0.13).

The reported evidence is suggestive of two broad models of managing wages. While “*Regulated*” and “*Asymmetric*” firms try to meet the standards stipulated by collective agreement (low wage cushions) “*Hierarchical*” and “*Discretionary*” firms use the compensation system to gain competitive advantage and to achieve their main goals. Additions made to base wage and dispersion indicators suggest that individual total earnings include schemes that may be contingent on some factors. In this regard, the estimated fuzzy clusters also offer evidence on different dimensions of wage flexibility undertaken by firms. Within “*Regulated*” and “*Asymmetric*” firms, flexibility is related to the use of wages to adjust to changing market conditions, whereas “*Discretionary*” firms seem to adopt employer discretionary power to differentiate workers. The latter model also includes wage adjustment which, together with individualised rules, is suggestive of segmented human resource management. However, this suspicion deserves further empirical analysis. The estimated fuzzy clusters suggest that there is a specific combination of wage rules. Not surprisingly, while firms adopting low wage strategies try to meet the standard rules in collective agreements, high-wage firms make a combination of different incentive solutions. This evidence corroborates the research hypothesis

**Firms' wage policies:
New evidence from linked employer-employee data**

that firms make specific combination of wage rules that position them closer to (far from) one theoretical model. However, firms use similar rules regarding the wage adjustment process. Our evidence meets the overall picture that the wages in the Portuguese labour market are highly responsive to market conditions (Cardoso and Portela, 2009). This is to say, in spite of specific rules, medium and large Portuguese firms use wages adjustment to deal with economic worsening conditions, although in different degrees.

We have so far focused on typologies of wage policies. However, *fuzzification* enables us to examine firms located between clusters. We therefore proceed with a detailed examination of wage rules of firms that combine the “*Regulated*” and “*Hierarchical*” prototypes, which represent 30% of our sample (N = 606). The descriptive statistics in Table 5 suggest that incentive devices help place firms closer to “*Regulated*”, while wage level and other wage dynamic variables move firms towards the “*Hierarchical*” model. It appears that wage skewness, wage growth skewness, entry wage, and rent sharing are on average similar to firms clustered in the former typology, while all other wage rules are somehow closer to “*Hierarchical*” firms.

**Table 5
Wage rules between “Regulated” and “Hierarchical” typologies**

Wage rules similar to “Regulated” firms	Wage rules similar to “Hierarchical” firms
- Skewness	- Wage level
- Growth dispersion	- Firm/industry wage
- Growth skewness	- Gini
- Entry-wage	- 90/10
- Rent sharing	- Wage hierarchy
	- Tenure profile
	- Intra job dispersion
	- Wage cushion
	- Elasticity of wages

b. Firms' characteristics linked to wage typologies

Now we attempt to link workplace characteristics of firms to the wage policies emerging from the fuzzy clustering analysis and try to answers to our research questions on the relationship between wage policy and particular workplace characteristics. Table 6 gives a qualitative picture of predominant characteristics including workforce composition, labour regulations, social capital composition and industry affiliation⁶.

⁶ We used EUROSTAT aggregations for manufacturing industry according to technological intensity http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/Annexes/htec_esms_an2.pdf and knowledge based services aggregations http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/Annexes/htec_esms_an3.pdf. We also considered primary sector and construction, mining, quarrying industries.

Firms' wage policies:
New evidence from linked employer-employee data

Table 6
Predominant workplace characteristics associated with wage policies

Variables	Sample	<i>Regulated</i>	<i>Asymmetric</i>	<i>Hierarchical</i>	<i>Discretionary</i>
	N = 2220	N1 = 405	N2 = 185	N3 = 103	N4 = 151
Number of workers	360.75 (933.11)	180.06 (122.41)	801.84 (2225.55)	293.07 (390.66)	624.81 (1522.10)
Firm's age (years)	37.75 (55.53)	53.09 (88.54)	28.31 (36.75)	35.76 (28.55)	32.30 (29.45)
Change in number of workers	0.03 (0.16)	0.02 (0.09)	0.04 (0.10)	0.01 (0.07)	0.01 (0.08)
Proportion of workers with fixed term contract	0.23 (0.22)	0.24 (0.21)	0.30 (0.25)	0.19 (0.17)	0.10 (0.15)
Proportion of part-time workers	0.04 (0.12)	0.03 (0.10)	0.09 (0.19)	0.01 (0.02)	0.01 (0.03)
Proportion of women	0.45 (0.29)	0.56 (0.32)	0.50 (0.32)	0.31 (0.22)	0.38 (0.15)
Proportion of young workers	0.21 (0.15)	0.22 (0.17)	0.26 (0.18)	0.19 (0.11)	0.14 (0.11)
Proportion of blue colour workers	0.46 (0.33)	0.50 (0.32)	0.60 (0.36)	0.41 (0.25)	0.08 (0.14)
Unions (Categorical %)					
Collective labour contract	77.07*	82.47*	90.27*	82.52*	37.75*
Collective labour agreement	5.72	10.62	2.16	0.00	21.85
Firm's agreement	4.14	0.49	3.24	3.88	9.93
Others	13.06	6.42	4.32	13.59	30.46
Capital owners (Categorical %)					
100% domestic and private	66.31*	71.60*	71.89*	58.25*	37.75*
100% national and state owned	3.20	0.99	0.54	2.91	8.61
100% foreign	13.74	6.67	18.92	18.45	28.48
Mixed: State, private and foreign	0.50	0.00	0.54	0.00	3.97
Mixed: State and private	0.72	0.49	0.00	0.00	1.32
Mixed: public and foreign	0.09	0.00	0.00	0.97	0.00
Mixed: private and foreign	5.18	0.74	3.78	14.56	13.25
Others	10.27	19.51	4.32	4.85	6.62
Industries (Categorical %)					
Less Knowledge-intensive market services	27.39*	24.20	42.70*	27.18*	27.81*
Medium-high-technology	5.86	4.94	4.32	8.74	3.31
Medium-low-technology	8.33	7.90	6.49	11.65	1.32
Low-technology	20.95	24.20	25.95	14.56	4.64
High-tech Knowledge-intensive services	2.61	0.00	1.08	0.00	15.23
Market Knowledge-intensive services	4.50	1.73	6.49	4.85	9.93
Knowledge-intensive financial services	2.97	0.00	0.00	1.94	20.53
Other Knowledge-intensive services	14.82	26.42*	4.32	8.74	11.26
High-technology	1.40	0.25	1.62	0.97	0.66
Other less Knowledge-intensive services	1.85	2.22	1.08	0.97	1.32
Primary Sector	0.72	0.49	0.54	1.94	0.00
Construction	8.60	7.65	5.41	18.45	3.97

1. Variables in white background are quantitative and the figures are average values; the standard deviations are displayed under brackets;
2. Variables in grey are categorical (the sum of columns is 100%).
3. * indicates the mode of the distribution;
4. Boldface figures indicate above the sample mean or mode;

Firms' wage policies:
New evidence from linked employer-employee data

The estimates provided in Table 6 indicate that despite differences in firms' size, "*Regulated*" and "*Asymmetric*" share relevant characteristics. Actually, the latter are the largest firms while firms labelled as "*Regulated*" are the smallest. However, firms in these clusters employ a large proportion of women, young or blue collar workers. Not surprisingly, both types of firm prevail in low-technology industries. While textile and leather industries are more likely in "*Regulated*" cluster, "*Asymmetric*" cluster aggregates food, clothing and retail trade industries. Additionally, the firms in these clusters make large use of flexible work arrangements such as fixed term contract, and are expected to be private and domestic.

Nevertheless, on a closer look, "*Regulated*" firms appear to have particular characteristics. For instance, alongside industry-based collective agreements, firms adopt multi-firm agreements to regulate the use of labour services. This type of policies prevails in less knowledge intensive industries grouping firms with non-for profit activities. The "*Asymmetric*" firm cluster also aggregates foreign firms from less knowledge intensive market services including restaurants, retail trade and land transports.

As for foreign firms, they prevail in "*Hierarchical*" and "*Discretionary*" typologies though in different industries. The former typology gathers firms from medium-high technology (chemical and motor vehicles) and medium-low technology industries (rubber, plastic and basic materials) as well as those operating in market knowledge intensive services (KIS) (consultancy activities, and architectural and engineering activities). It should be stressed that industries related to construction (real estate promotion, civil engineering, and specialized activities of construction), and mining are predominant in this fuzzy cluster. On the other hand, "*Discretionary*" firms are more likely to be in high tech KIS (programming and broadcasting; telecommunications; and programming, consultancy and related activities), knowledge intensive financial services, market KIS (architectural and engineering activities, and activities of head offices and management consulting activities), and less knowledge intensive market services (wholesale trade, office administrative activities, and office support and other business support activities).

An additional dissimilarity between these types of firm is related to the regulation of the employment relationship. "*Discretionary*" firms make extensive use of either multiple or single employer firm-level agreements. The large proportion of "other" types of agreement is also suggestive of the decentralisation of the regulation process.

Summing up, the findings suggest that there are no clear-cut wage policies related to firm size and industry-affiliation. This evidence corroborates only partially our second research hypothesis. However, some of our findings are in line with those reported in the literature. For instance, cost reduction strategies based on low wages are widespread in low technology

industries employing blue collar workers and accommodating a large proportion of female employees (Nordås, 2004). Cost cutting strategies also interact with job flexibility as is the case of “*Regulated*” and “*Asymmetric*” firms. Actually, price sensitive product markets and labour intensive industries are characterised by cost pressures and, at the same time, adopt strategies to lower wages and job quality (Hypothesis 3). Furthermore, low skilled jobs prevail in low wage firms. This evidence is consistent with our hypothesis that skills influence wage decisions of firms (Hypothesis 4).

There is also evidence on the relationship between decentralised bargaining and employers' scope to individualise wages (OECD, 2004; Bastos, Monteiro and Straum, 2009). For instance, “*Discretionary*” firms, ruled by firm-level agreements, have the highest wage cushion and within-job dispersion. This is the case of financial services that stand at a crossroad between internal labour markets and incentive devices.

6. CONCLUDING REMARKS

In this paper we attempted to unveil the wage policies of medium and large firms in Portugal and ascertain the workplace characteristics that are associated with those policies. From the outset, we were aware of the fact that firms do not operate strictly as predicted by theoretical models; instead they are expected to combine features of different models (Baker, Gibbs and Holmstrom, 1994). Therefore, fuzzy clustering was a suitable tool to group firms according to predominant characteristics of their wage policy. Empirical evidence pointed towards a segmentation of firms in four fuzzy clusters that represent typical wage policies. While the “*Regulated*” and “*Asymmetric*” firms are characterised by low and flexible wages, the “*Hierarchical*” and “*Discretionary*” firms show characteristics of internal labour market but also seek for incentive devices.

There is clearly a duality between firms trying to manage their workers according to rules stipulated in collective agreement, and those using their compensation system to achieve major strategic goals. However, there is a striking similitude in the use of wages as an adjustment process. This evidence corroborates Cardoso and Portela's (2009) finding that wages in Portugal are highly responsive to macroeconomic conditions.

Moreover, the emerged wage policies enabled us to improve our knowledge of different dimensions of wage flexibility undertaken by firms. For instance, firms labelled as “*Regulated*” and “*Asymmetric*” represent a model of wage changes responding to (worsening) market conditions, whilst the flexibility of wages in “*Discretionary*” firms is mostly used in the context of the probable link between workforce's unobservable productive characteristics and earnings.

Firms' wage policies:
New evidence from linked employer-employee data

This finding is in line with Duarte (2008), namely that wage flexibility is greater in large firms because of their ability to design compensation schemes. Not surprisingly, employers in the “*Discretionary*” cluster use wage cushion, within-job wage and growth dispersion more intensively to differentiate employees. They also protect specific skills by paying lower wages to newly hired workers than to incumbents. However, these firms do not provide insurance for the whole workforce. There is indeed a non-negligible adjustment of wages to market conditions. Whether there is a segmentation of the workforce within this type of firm is an open question that deserves further research. From here, it stands that firms labelled as “*Asymmetric*” follow wage policies that are more conditioned by external drivers, and “*Discretionary*” firms probably try to retain high skilled workers.

Moreover, the empirical evidence pointed to the interaction between wage flexibility based on wage adjustment and job flexibility. We realised that low wage firms which clustered together manufacturing labour intensive industries like textiles and clothing, generally dominated by female young or blue collar workforce, simultaneously use flexible wages and flexible contracts. Further research is needed to clarify the relationship between female employment and flexible work arrangements.

Despite the relevance of the results achieved so far, there are noteworthy two limitations of this study. The first is linked to the lack information about variable pay in the dataset. Data on bonuses or profit sharing would be therefore useful to check for incentive models within Portuguese firms. The second limitation of our study is related to longitudinal analysis, thereby exploring how policies changes across time. While the dataset allows for further research on the evolution of wage policies patterns, the former limitation is hardly solved without dedicated data collection exercise.

Our study could be part of a renewed debate on labour market flexibility. While employment flexibility has been widely studied (e.g. Kalleberg, 2000), wage flexibility deserves further attention due to its political, social and economic relevance. We suggest that labour market policies and other initiatives should be differentiated according to the dimensions of wage flexibility reported in this study. Ultimately, the rationale of labour market regulations would not be the same to deal with wage adjustment or with wage differentials. Policy makers and other social actors should be aware of differentiated impacts of wage flexibility inside firms, and how it could affect some specific groups of workers.

REFERENCES

- ABOWD, J. M., Kramarz, F. and Margolis, D. N. (1999), 'High wage workers and high wage firms', *Econometrica*, 67:2, pp.251-333.
- ABRAHAM, M. and Prosch, B. (2000), 'Long-term employment relationships by credible commitments', *Rationality and Society*, 12:3, pp. 284-306.
- ARMSTRONG, M. (1999), *Employee Reward*, London: Institute of Personnel and Development.
- BAKER, G., Gibbs, M. and Holmstrom, B. (1994), 'The Wage Policy of a Firm', *The Quarterly Journal of Economics*, 109:4, pp. 921-955.
- BASTOS, P., Monteiro, N. P. and Straum, O. R. (2009), 'Firm heterogeneity and wages in unionised labour markets: theory and evidence', *Labour Economics*, 16, pp.440-450.
- BECKER, G. S. (1964), *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education*, Chicago: University of Chicago Press.
- BELFIELD, C. and Wei, X. (2004), 'Employer size-wage effects: evidence from matched employer employee survey data in the UK', *Applied Economics*, 36, pp.185-193.
- BEZDEK, J.C. (1974), 'Cluster Validity with Fuzzy Sets', *Journal of Cybernetics*, 3:3, pp.58-73.
- BEZDEK, J.C (1981), *Pattern Recognition with Fuzzy Objective Function Algorithms*, New York: Plenum Press.
- BHANDARI, A.K. and Heshmati, A. (2008), 'Wage Inequality and Job Insecurity among Permanent and Contract Workers in India: Evidence from Organized Manufacturing Industries', *Journal of Applied Economics*, 7:1, pp.80-111.
- BISHOP, J. (1987), 'The recognition and Reward of Employee Performance', *Jornal of Labor Economics*, 5:4, pp.36-56.
- BLACK, S.E. and Strahan, P.E. (2001), 'The division of spoils: rent-sharing and discrimination in a regulated industry', *American Economic Review*, 91:4, pp.814-831.

Firms' wage policies:
New evidence from linked employer-employee data

- BROWN, C. and Medoff, J. (1989), 'The Employer Size-Wage Effect', *Journal of Political Economy*, 97:5, pp.1027-1059.
- BRYSON, A., Forth, J. and Barber, C. (2006), 'Making linked employer-employee data relevant to policy', *DTI Occasional Paper*, N. 4.
- CAJU, P., Rycx, F. and Tojerow, I. (2008), 'Rent-Sharing and the Cyclicity of Wage Differentials', *IZA Discussion Paper*, N. 3844.
- CARDOSO, A.R. (2000), 'Wage differentials across firms: An Application of multilevel modelling', *Journal of Applied Econometrics*, 15, pp.343-354.
- CARDOSO, A. R. and Portela, M. (2009), 'Micro Foundations for Wage Flexibility: Wage Insurance at the Firm Level', *The Scandinavian Journal of Economics*, 111:1, pp.29-50.
- CARDOSO, A.R. and Portugal, P. (2005), 'Contractual Wages and the Wage Cushion under Different Bargaining Settings', *Journal of Labor Economics*, 23:4, pp.875-902.
- CARNEIRO, A., Guimarães, P. and Portugal, P. (2009), 'Real Wages and the Business Cycles: Accounting for Worker and Firm Heterogeneity', *IZA Discussion Papers*, N. 4174.
- CHIU, S.L. (1994), 'Fuzzy Model Identification based on Cluster Estimation', *Journal of Intelligence and Fuzzy Systems*, 2, pp.267-278.
- DEVEREUX, P. J. and Hart, R. A. (2006), 'Real Wage Cyclicity of Job Stayers, within-Company Job Movers, and Between-Company Job Movers', *Industrial and Labor Relations Review*, 60, pp.105-119.
- Dias, D. A., Marques, C. R. and Martins, F. (2012), 'Wage Rigidity and Employment Adjustment at the Firm Level: Evidence from Survey Data', *Banco de Portugal*, Working Paper N. 12|2012.
- DOERINGER, P. and Piore, M. (1971), *Internal Labor Markets and Manpower Analysis*, Massachusetts: Heath Lexington.
- DOHMEN, T.J. (2004), 'Performance, seniority, and wages: formal salary systems and individual earnings profiles', *Labour Economics*, 11:6, pp.741-763.

Firms' wage policies:
New evidence from linked employer-employee data

- DUARTE, C. (2008), 'A Sectoral Perspective on Nominal and Real Wage Rigidity in Portugal', *Banco de Portugal, Autum Economic Bulletin*, pp.187-199
- DULEBOHN, J.H. and Werling, S.E. (2007), 'Compensation research past, present, and future', *Human Resource Management Review*, 17, pp. 191-207.
- EVERITT, B. S., Landau, S., Leese, M. and Stahl, D. (2011), *Cluster Analysis*, UK: John Wiley & Sons, Ltd, (5th edition).
- FARBER, H.S. and Gibbons, R. (1996), 'Learning and wage dynamics', *The Quarterly Journal of Economics*, 111:4, pp. 1007-1047.
- FISHER, C.D., Schoenfeldt, L.F. and Shaw, J.B. (1996), *Human Resource Management*, Princeton, New Jersey: Houghton Mifflin Compan, (3rd edition).
- FITZROY, F.R. and Kraft, K. (1987), 'Cooperation, productivity, and profit sharing', *The Quarterly Journal of Economics*, 102:1, pp. 23-35.
- FLABBI, L. and Ichino, A. (2001), 'Productivity, seniority and wages: new evidence from personnel data', *Labour Economics*, 8, pp.359-387.
- GRISMSHAW, D., Ward, K.G., Rubery, J. and Beynon, H. (2001), 'Organisations and the Transformation of the Internal Labour Market', *Work Employment Society*, 15:1, pp.25-54.
- GROSHEN, E. L. (1991), 'Five Reasons Why Wages Vary Among Employers', *Industrial Relations*, 30:3, pp.350-381.
- GRUND, C. and Westergaard-Nielsen, N. (2008), 'Dispersion of Employees' Wage Increases and Firm Performance', *Industrial & Labor Relations Review*, 61, pp.484-501.
- HASSINK, W. and Russo, G. (2008), 'Wage differences between internal and external candidates', *International Journal of Manpower*, 29: 8, pp.715-730.
- HOLMSTROM, B. (1982), 'Moral Hazard in Teams', *Bell Journal of Economics*, 13:2, pp. 324-340.
- HWANG, H., DeSarbo, W. and Takane, Y. (2007), 'Fuzzy Clusterwise Generalized Structured Component Analysis', *Psychometrika*, 72:2, pp.181-198.

Firms' wage policies:
New evidence from linked employer-employee data

JUNG, S. and Schnabel, C. (2011), 'Paying More than Necessary? The Wage Cushion in Germany', *Review of Labour Economics and Industrial Relations (LABOUR)*, 25:2, pp.182-197.

KALLEBERG, A.L. (2000), 'Nonstandard employment relations: Part-time, temporary and contract work', *Annual review of sociology*, 26, pp.341-365.

KRUEGER, A.B. and Summers, L.H. (1988), 'Efficiency wages and the inter-industry wage structure', *Econometrica*, 56:2, pp. 259-293.

KVIST, J. (2007), 'Fuzzy set ideal type analysis', *Journal of Business Research*, 60:5, pp. 474-481.

LAZEAR, E.P. (1979), 'Why is there mandatory retirement?' *Journal of Political Economy*, 87:6, pp.1261-1284.

LAZEAR, E. P. (2000), 'Performance Pay and Productivity', *The American Economic Review*, 90, pp.1346-1361.

LAZEAR, E.P. and Shaw, K.L. (2006), *The Structure of Wages: an International Comparison*, Chicago: The University of Chicago Press.

LEVINE, D.I., Belman, D., Charness, G., Groshen, E. and O'Shaughnessy, K.C. (2002), *How New is the "New Employment Contract"?*, USA: W.E. Upjohn Institute.

LIMA, F. and Pereira, P.T. (2003), 'Careers and wages within large firms: Evidence from a matched employer-employee data set', *International Journal of Manpower*, 24:7, pp. 812-835.

LIN, M.-J. (2005), 'Opening the Black Box: The Internal Labor Markets of Company X', *Industrial Relations*, 44:4, 659-706.

MARTINS, P. S. (2007), 'Heterogeneity in real wage cyclicality', *Scottish Journal of Political Economy*, 54:5, pp.684-698.

MARTINS, F. (2011), 'Price and Wage Setting in Portugal, Learning by Asking. Wage Dynamics Network', *Working Paper N. 1314 / April*, <http://www.ecb.europa.eu>.

MEDOFF, J.L. and Abraham, K. G. (1980), 'Experience, performance, and earnings', *The Quarterly Journal of Economics*, 95:4, pp.703-736.

**Firms' wage policies:
New evidence from linked employer-employee data**

NORDÅS, H. K. (2004), 'The Global Textile and Clothing Industry post the Agreement on Textiles and Clothing', *WTO Secretariat*, Discussion Paper N. 5.

NORMANDER, B. and Prosser, J.I. (2000), 'Bacterial Origin and Community Composition in the Barley Phytosphere as a Function of Habitat and Presowing Conditions', *Applied and Environmental Microbiology*, 66:10, pp. 4372-4377.

OECD (2004), 'Wage-setting Institutions and Outcomes', *Employment Outlook*, Chapter 3, pp. 127-181.

PORTUGAL, P. (2008), 'Wage setting in the Portuguese labor market: A microeconomic approach', in Franco, F. (ed.), *Challenges ahead for the Portuguese economy*, Lisbon: ICS, pp. 71-84.

PORTUGAL, P., Carneiro, A. and Guimarães, P. (2010), 'On The Cyclical Sensitivity of Real Wages', *Banco de Portugal*, Winter Economic Bulletin, pp.87-99.

PRENDERGAST, C. (1998), 'What Happens within Firms?', in Haltiwanger, J., Manser, M. E. and Topel, R. (eds.), *A Survey of Empirical Evidence on Compensation Policies*, Chicago: University of Chicago Press, pp. 329-359.

SELTZER, A. (2010), 'Did firms cut nominal wages in a deflationary environment? Micro-level evidence from the late 19th and early 20th century banking industry', *Explorations in Economic History*, 47, pp.112-125.

SELTZER, A. J. and Frank, J. (2007), 'Promotion tournaments and white collar careers: evidence from Williams Deacon's Bank, 1890-1941'. *Oxford Economic Papers*, 59, pp.i49-i72.

SERNEELS, P. (2008), 'Human capital revisited: The role of experience and education when controlling for performance and cognitive skills', *Labour Economics*, 15, pp.1143-1161.

SULEMAN, F. (2012), 'The impact of skills and performance on earnings: the evidence from retail bankers', *International Journal of Human Resource Management*, 23:11, pp.2205-2220.

SULEMAN, F. and Sgobbi, F. (2010) 'The evolution of internal labour markets in the Portuguese banking industry: A preliminary analysis with linked employer-employee data', in Sá, C., Cerejeira, J., Portela, M., Monteiro, N. and Guimarães, D. (eds.), *Economic Analysis Using Linked Employer-Employee Data*, Lisboa: Cadernos Sociedade e Trabalho, GEP/MTSS.

WEINBERG, B.A. (2001), 'Long-Term Wage Fluctuations with Industry-Specific Human Capital', *Journal of Labor Economics*, 19:1, pp.231-264.