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The Diversity of Personnel Practices and Firm Performance

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ABSTRACT

The Diversity of Personnel Practices and Firm Performance*

Personnel economics tends be based on single-firm case studies. Here we examine the personnel practices of nearly 5,000 firms, over a period of 20 years, using detailed matched employer-employee panel data from Portugal. In the spirit of Baker et al. (1994a,b), we consider different dimensions of personnel management within each firm: worker turnover, the role of job levels and human capital as wage determinants, the dispersion of wages within job levels, the importance of tenure in terms of promotions and exits, and the scope for careers. We find a large degree of diversity in most of these practices across firms. Moreover, some personnel practices are shown to be robust predictors of higher levels of firm performance, even after controlling for time-invariant firm heterogeneity and other variables: low wage dispersion at low and intermediate job levels and a tight relationship between human capital variables and wages.

JEL Classification: M51, M52, J31

Keywords: personnel economics, job levels, wages, big data

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1 Introduction

The seminal contributions of Doeringer & Piore (1971) and Baker et al. (1994*a*,*b*) have raised great interest in the operation of internal labour markets (Lazear & Oyer 2004). Before their contributions emerged, economists tended to restrict their attention to the allocation and reward of labour in external labour markets. However, the discussion of personnel practices in Doeringer & Piore (1971) and the detailed analysis of a large U.S. firm in Baker et al. (1994*a*,*b*) highlighted the potential for greater insight and a more comprehensive understanding of labour markets through the study of different personnel practices, including hirings, separations, remuneration, promotions, etc.

One important limitation of the empirical analysis conducted in Baker et al. (1994*a*,*b*) is that it concerns a single, U.S. firm. Several other more recent studies are subject to the same limitation, even if in some cases a small set of firms is considered (Ariga et al. 1999, Treble et al. 2001, Lin 2006). While such an approach based on a single or a small set of firms helps one to establish the potential complexity and richness of personnel practices, it may of course also be very misleading (Baker & Holmstrom 1995, Lazear & Oyer 2007). In this context, our paper makes an important and original contribution to the literature by presenting comparable evidence, along several personnel dimensions similar to those studied in Baker et al. (1994*a*,*b*), for a very large number of firms (nearly 5,000 in total), from different sectors and sizes, followed over a long period of time. This approach is made possible by our use of detailed matched employer-employee panel data set that results from a mandatory census of all firms that operate in Portugal.

Our approach is also motivated by Bloom & Reenen (2007) and a number of additional, related contributions, who describe the diversity of different management practices using survey-based evidence and then relate those practices to firm performance. In our case, we seek to address some limitations of surveys - namely their subjective nature - by examining instead comparable quantitative data from each one of the thousands of firms considered in our analysis. Following Baker et al. (1994*a*,*b*), we consider several dimensions of personnel practices, computed separately for each firm and, in some cases, for each firm-year too. More specifically, the personnel practices we consider are: the role of jobs and human capital as wage determinants, the size of worker turnover, the degree of wage dispersion within job levels, the role of tenure in terms of promotions and exits, and some additional characteristics

of careers in firms.

After characterising our sample of firms in terms of the dimensions above, we move to the second contribution of this paper, in which we assess the predictive power of the different personnel practices we consider in terms of firm performance (Bartel et al. 2004, Bartel 2004). Of course, personnel practices are not necessarily exogenous, even when conditioning on time-invariant firm heterogeneity and other control variables, as we do. Therefore, our results in this analysis cannot necessarily be interpreted as causal evidence. However, causal studies are rare and typically based on single-firm studies that, again, can be hard to generalise (Lazear 2000, Bandiera et al. 2007). Moreover, it is arguable that at least some of the diversity in personnel practices that we document in our analysis is driven by random experimentation by firms, which will be unsure about the best practices to adopt in their specific cases. Overall, we regard our approach as an interesting and original compromise between internal and external validity in the literature on personnel practices and firm performance.

The remaining of the paper is structured as follows: Section 2 describes the matched employer-employee panel data used in this paper; Section 3 explains the different dimensions of personnel practices that we consider; Section 4 presents the results and the robustness checks; and, finally, Section 5 summarises and discusses the results.

2 Data

This paper draws on 'Quadros de Pessoal' (QP), a particularly rich annual census of all firms based in Portugal that employ at least one worker. In this census, conducted and administered by the Ministry of Employment, each firm provides extensive information about the firm itself and also about each one of their workers employed at the census reference month.[1]

The extensive coverage of 'Quadros de Pessoal' implies that the only worker categories not present in the data are the self-employed and those employed as public servants. Moreover, the period covered by the data is also relatively long, starting in 1982 and ongoing (however, individual-level is not available for 1990 and 2001).

The long list of variables available in the data includes unique, time-invariant identifiers for each firm and each employee. Other firm-level variables are industry (5-digit code), region (up to 400 different units), number of employees, firm age, public, private/domestic or foreign

[1]See Cabral & Mata (2003), Martins (2009) and Martins et al. (2012) for other papers that also use this data set. The census month is March (up to 1993) and then October (from 1994).

ownership, sales, and equity. At the worker-level, the data set includes information about schooling, age, gender, tenure, occupation (5-digit code), wages (5 different variables), hours worked, job level (2-digit code) and promotions. Job levels are worker categories established by the Ministry of Employment and, to that extent, comparable across firms. The eight job levels, described in Table 12, range from '1', top management, to '8', apprentices (Lima & Pereira 2003).

There are several wage variables, all of them expressed in monthly values (the most common frequency of pay in Portugal), including base wages, tenure-related payments, overtime pay, subsidies and 'other payments' (a residual category including bonuses and profit- or performance-related pay). All wages have been deflated using Portugal's CPI and are expressed in 2004 euros. There is also information about normal hours and overtime hours per month. The benchmark measure of pay adopted in this study is based on the sum of all five types of pay divided by the sum of the two types of hours worked, resulting in a total hourly pay variable.

Although there are more than 250,000 firms per year in the country and in the data set, we consider in our study only those that are present in the data over a relatively long period and that are also of a relatively large size. Our main concern was to draw on a set of firms that have enough data so that their personnel practices can be studied in detail. Moreover, access to data for the same firm over a relatively long period is also important, in order to be able to conduct a meaningful longitudinal analysis.

Our sampling criterion was to select only firms that employ at least 50 employees per year over at least 10 years over the period 1986-2004. The restrictions result in a sample of 4,792 firms (and 72,107 firm-year observations). See Table 11, for the distribution of these firms across industries.

3 Personnel practices

We consider several variables that describe different relevant dimensions of the personnel practices of firms. Our choice of variables is motivated by the approach adopted in Baker et al. (1994*a*,*b*) while is also shaped by the characteristics of the data set and the many opportunities that it offers.

The first set of variables concerns the level of turnover in each firm's workforce and cor-

respond to the percentages of new workers and exiting workers in each firm in each year. Specifically, for each firm-year, we compute the percentage of the current workforce that has less than one full year of tenure in the firm and the percentage of the current workforce that is not employed in the firm in the following year. If the firm is not available in the data in such year - typically because that is also the last year in our full data set, 2004 - the latter variable is not computed. Moreover, we also measure the job level at which new workers are entering the firm and the job level at which exiting workers are in their last observation in the firm. These two latter components allow for an analysis of the importance of ports of entry and exit, respectively.

The second group of variables - directly inspired by Baker et al. (1994*b*) - concerns the contrasting role of human capital and job level variables in terms of explaining worker wages.[2] In particular, for each one of the 4,792 firms in our sample, we estimate the following two standard wage regressions, based on pooled data of all workers employed in the firm:

$$w_{it} = X_{it}^{a\prime}\beta_1 + \lambda_t + \epsilon_{it}, \tag{1}$$

$$w_{it} = X_{it}^{b\prime}\beta_2 + \lambda_t + \epsilon_{it}, \tag{2}$$

in which w_{it} denotes the logarithm of the real hourly wage of worker i in year t, X_{it}^a is a vector of human capital characteristics (schooling, quadratics in experience and tenure and a gender dummy variable), X_{it}^b is a vector of seven job level dummy variables, and λ_t are year effects.

For each firm, we collect the adjusted R^2's from each one of the two regressions above, which indicate the contribution of either human capital variables or job levels in terms of explaining wage dispersion within firms. We are particularly interested in assessing the degree of dispersion across firms of those variables. These adjusted R^2's are also considered in the second-stage analysis, in which we analyse their partial correlation with firm performance.

The third group of variables concerns the wage dispersion within each job level (and in each firm). Specifically, for each one of the firms in our sample, we estimate the following wage regressions:

$$w_{it} = X_{it}^{a\prime}\beta_1 + X_{it}^{b\prime}\beta_2 + \lambda_t + \epsilon_{it}, \tag{3}$$

in which the variables are the same as in equations 1 and 2.

[2]See also the models of worker assignment (Sattinger 1993).

We then take the absolute value of the residuals from equation 3 for each firm and calculate their coefficients of variation, for each year, and for each one of three groups of job levels (levels 1 and 2, levels 3 to 5 , and levels 6 to 8). These coefficients of variation can be interpreted as measures of the degree to which human capital and job level variables are important wage determinants in each firm. The greater the magnitude of the coefficients of variation, the less important are job levels and human capital variables in shaping workers' pay in each firm.

The fourth type of variable is about the length of a worker's career. Here we consider all job spells within each firm, defined as the period of time since a worker is hired until the worker leaves the firm. We distinguish between completed and ongoing spells, depending on whether the worker is still employed in the firm by the last year in which the firm is found in our data (2004 or before). Finally, we average these two spell lengths across workers for each firm over the 1991-2000 period.

The fifth group of variables concerns the role of tenure in a given job level in terms of the likelihood that a worker is promoted or that a worker leaves a firm (voluntarily or not). For each firm, we estimate a simple linear probability model in which the dependent variable is switched on either for workers that are promoted in the subsequent year or for workers that are not present in the firm in the subsequent year. In particular, we estimate the following equations:

$$Promoted_{it} = \beta_1 JLTenure_{it} + X_{it}^{a\prime}\beta_2 + X_{it}^{b\prime}\beta_3 + \lambda_t + \alpha_i + \epsilon_{it}, \tag{4}$$

$$Leaver_{it} = \beta_1^* JLTenure_{it} + X_{it}^{a\prime}\beta_2^* + X_{it}^{b\prime}\beta_3^* + \lambda_t + \alpha_i + \epsilon_{it}, \tag{5}$$

in which $Promoted_{it}$ takes value one if worker i is promoted in year t (i.e. worker i was in a higher job level in year $t+1$ than in year t) and value zero otherwise, while $Leaver_{it}$ takes value one if worker i leaves the firm in year t (i.e. worker i is not employed by the same firm in year $t+1$) and value zero otherwise. Moreover, $JLTenure_{it}$ measures the number of years that worker i has been in his/her current job level by year t. X_{it}^a, X_{it}^b and λ_t have the same content has in the equations above and α_i is a worker fixed effect.[3]

These two specifications allows us to interpret β_1 and β_1^* as indicating the 'effect' of increases in a worker tenure at the same, given job level in a firm in terms of the likelihood that the worker is promoted or in terms of the the likelihood that the worker leaves the firm, respectively.

[3]See Martins (2011) for a study of worker mobility across firms, using the same data set.

Finally, we compute variables that proxy some aspects of the internal labour market of each firm. We consider the average job level at which new workers enter the firm, the average job level from which workers leave the firm and the average job level of workers that have been in their firm for at least one year.

4 Results

4.1 Personnel Practices

We present descriptive statistics of our sample of firms and their personnel practices variables in Tables 1 - which we describe below - and 2 - which we also report for the sake of completeness. The worker entry rate is defined as explained above, i.e. the percentage of new workers in each year and each firm, while the worker exit rate is the percentage of workers employed in a given year by a given firm that will not be employed in the same firm in the following firm. We find that these rates, on average, are 15% and 18%, respectively. However, the results indicate that there is considerable dispersion around those mean values, as the standard deviations are 10% and 7%, respectively. Indeed, this point is made clear in Figure 1, which depicts kernel distributions of entry and exit rates across the firms in our sample. Moreover, Figure 2, which presents a scatterplot of the two variables, suggests that they are moderately positively correlated, although several firms are growing or reducing their size (i.e. with entry rates very different from exit rates).

Next, we present the descriptive statistics concerning the adjusted R^2's from wage regressions on human capital or job-level variables. We find that their mean values across all firms are similar, at 0.495 and 0.518, respectively. However, such values again hide a reasonable level of dispersion, with standard deviations of 0.13 in both cases. This is clear from Figure 3, which presents kernel distributions of the two sets of adjusted R^2 statistics. Moreover, Figure 4, a scatterplot of these two statistics, indicates a strong positive correlation between the two variables, i.e. the more human capital matter in explaining wages, the more job-level variables also matter in explaining wages.

The third set of results concerns the degree of wage dispersion at different job levels. Our evidence indicates that such dispersion increases with the hierarchical importance of the job level. The average dispersion at lower job levels is 0.742, increasing to 0.998 at intermediate levels and reaching 1.027 at the higher job levels. Moreover, there is always a considerable

amount of dispersion in each of these measures, as the standard deviations range from 0.186 to 0.205. These dispersions are also clear from Figure 5, which depicts the kernel distributions of the our measures of wage dispersion for the top and low job level categories. Moreover, Figure 6, a scatter plot of the two measures of wage dispersion indicates very little evidence of correlation between the two measures of dispersion.

Next, we consider the results regarding the effect of job-level tenure on the probability of being promoted or the probability of leaving the firm. We find that both mean coefficients are positive (0.0002 and 0.003, respectively) but both exhibit an enormous amount of variability (standard deviations of 0.026 and 0.021, respectively). This is clear from Figure 7, which presents kernel densities of the two sets of coefficients. Moreover, we also find that a large part of the coefficients are insignificant, especially in the case of separations, as shown in Figures 8 and 9. We also observe that there is no systematic relationship between the role of job-level tenure in terms of promotions and the role of job-level tenure in terms of separations - see the scatter plot of the two coefficients in Figure 10.

Finally, we consider our evidence regarding careers in firms. We find that the average tenure of completed spells, across all firms, is 7.836. However, once again, this mean figure masks considerable dispersion, as its standard deviation is 4.939 - see also Figure 11. On a related note, we find that the average difference of the job level at which workers join the firm and the job level at which workers leave the firm (only completed spells) is relatively low, at 0.409, even if, again, its dispersion is considerable (0.497).[4]

Moreover, Figure 12 presents kernel distributions of the average job level at which workers join, leave or remain in their firms. As expected, there is a large concentration of workers joining firm from low job levels, although again the dispersion there is considerable (starred line).

We also report descriptive statistics of different firm characteristics. We find average log sales per worker of 14.9, log hourly wages of 1.4, and log number of workers of 4.8. The average job level is 5.3, the average schooling years is 6.6, the average years of tenure is 9.3, while average experience is 24.2. 9.8% of firms are foreign owned, average log equity is 13.5, and the average year of birth is 1967.

[4]Recall that a hierarchically high job level is associated with a lower number - the job level variable ranges from 1, top management, to 8, apprentices.

4.2 Firm Performance

Having established a striking level of diversity of personnel practices across firms, we now present the results regarding the second part of the paper. Here we examine the relationship between firm performance (measured in terms of labour productivity) and the different personnel practices described above. Specifically, we estimate models as follows:

$$Performance_{it} = \sum_j \beta_j Practice^j_{it} + X'_{it}\delta_2 + \lambda_t + \alpha_i + \epsilon_{it}, \quad (6)$$

in which $Performance_{it}$ is the logarithm of sales per worker at firm i in year t and $Practice^j_{it}$ denotes the value of $Practice^j$ for firm i in year t. X_{it} are control variables, including (average) worker and firm characteristics, as those described in the bottom part of Tables 1 and 2.

We also consider different specifications of the equation above, namely by allowing for different sets of controls. In our first results, we estimate cross-section models, without any controls for firm heterogeneity - see Tables 3 and 4, the former considering each personnel practice individually and the latter considering all personnel practices simultaneously. These results are based on firm-level averages of firm performance and personnel practices over the years in which the firms are present in the data.

We find that only our measures of wage dispersion at the bottom and intermediate job levels are significant and they have negative signs. Moreover, when pooling all measures of personnel practices, the significantly negative relationships between wage dispersion at the bottom and intermediate job levels and firm performance prove robust. Finally, across all specifications, the control variables are generally significant and have the expected signs.

Next we consider pooled data, in which we draw on repeated observations of the same firm, in order to take advantage of the fact that several personnel practices are derived on a firm-year basis - see Tables 5 and 6. As in the previous case, we find robust evidence of significantly negative relationships between wage dispersion at the bottom and intermediate job levels and firm performance. Moreover, our measures of worker turnover (either the worker entry rate or the worker exit rate) also prove to have a consistent negative relationship with firm performance. On the other hand, the average duration of completed employment spells is positively related with firm performance while there is some evidence that close fits between human capital variables and pay are good predictors of higher firm performance.

In the remaining two sets of results, we explicitly acknowledge the fact that we draw on repeated observations of the same firms, first by including industry and region fixed effects and then by including firm fixed effects instead. In the former set of results - see Tables 7 and 8 - we find, again, consistent evidence of negative relationships between wage dispersion at the intermediate and lower job levels or worker turnover and firm performance and of a positive relationship between the average length of completed employment spells and firm performance. Moreover, as in the previous analysis, we also find, although now in a consistent manner, that a close fit between human capital variables and wages predicts higher levels of firm performance.

Our ultimate test of robustness of the results above is derived from estimations of 6 that include controls for time-invariant firm heterogeneity - see the results in Tables 9 and 10. Again, we find that worker turnover and wage dispersion at lower and intermediate job levels predict lower performance. On the other hand, we cannot estimate the effect of the average tenure of completed employment spells, as we have defined this variable at the firm level, not at the firm-year level, and therefore it is time invariant. Having this caveat in mind, we find that the average length of careers in the firm is now significantly positively related to firm performance. Finally, as in previous models, there is also some evidence that a close fit between human capital variables and wages predicts higher levels of firm performance. Unlike before, we now also have some evidence that a close fit between job level variables and wages predicts lower levels of firm performance.[5]

5 Summary and discussion

In stark contrast with existing personnel economics studies, in this paper we simultaneously examine the personnel practices of a very large number of firms (4,792, in total). Moreover, our analysis covers a very long period of time, ranging from 1986 to 2004, and is based on detailed, fully comparable matched employer-employee panel data. Following Baker et al. (1994*a*,*b*), we consider different dimensions of personnel management within each firm: worker turnover, the role of job levels and human capital characteristics as wage determinants, the dispersion of wages within job levels, the role of tenure in terms of promotions and exits, and the scope for

[5]Such close fit between job levels and wages may be driven by collective bargaining and its administrative extensions. To the extent that firm performance effects have then knock-on consequences in terms of hirings and employment, these findings would be consistent with those of Martins (2014).

careers. We then not only characterise these different practices and ascertain their dispersion (or lack of) across firms, as we analyse their relationship with firm performance.

In our first main result, we find a considerable level of diversity in most of these practices across firms. This result is consistent with Bloom & Reenen (2007) and following literature, who also analyse management practices across firms, including personnel. However, in our paper we draw on objective, 'hard' data, rather than subjective, questionnaire-based information. Specifically, we find that the dispersion of personnel practices are particularly striking in domains such as worker turnover, the role of job level or human capital variables in terms of wages, and the job levels at which workers tend to enter or leave their firms.

In our second main result, we find that some personnel practices are significant positive predictors of firm performance. These practices include low wage dispersion at low and intermediate job levels, a tight relationship between human capital variables and wages, low worker turnover and, possibly, a loose relationship between job levels and wages. Critically, these results hold even when allowing for time-invariant (observed or unobserved) firm heterogeneity and when setting horse races between the different practices by pooling them in the same specifications.

As discussed before, the direction of the causality between these personnel practices and firm performance is not necessarily straightforward, particularly in the case of worker turnover. However, with respect to the result about wage dispersion, it is worthwhile to recall the literature that examines the role of fairness in terms of worker effort and firm performance (Akerlof & Yellen 1990, Fehr & Schmidt 1999, Winter-Ebmer & Zweimuller 1999, Hibbs & Locking 2000, Martins 2008, Grund & Westergaard-Nielsen 2008). Our results may help reconciling the contrasting empirical results documented, as our findings suggest that wage dispersion may improve performance at higher job levels (where the benefits from sharper incentives may dominate the costs from lack of fairness) while wage dispersion reduces performance at intermediate and lower job levels (where fairness concerns may be stronger than the gains from incentives).

Overall, to the extent that our results are interpreted causally, they may also be quite informative from the point of view of human resource managers intent on fine-tuning their personnel policies towards increasing firm performance levels. Some personnel policies that emerge from the study as potentially desirable, possibly depending on the current character-

istics of each specific firm, involve tightening the link between skills and pay (while possibly loosening the link between job levels and pay), reducing wage dispersion across similar workers - provided they are not in the highest levels of the firm hierarchy -, and reducing worker turnover.

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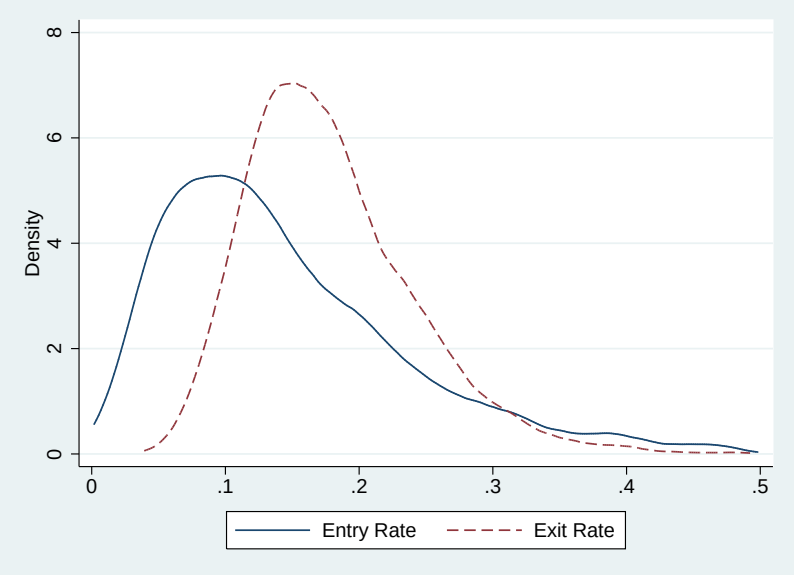
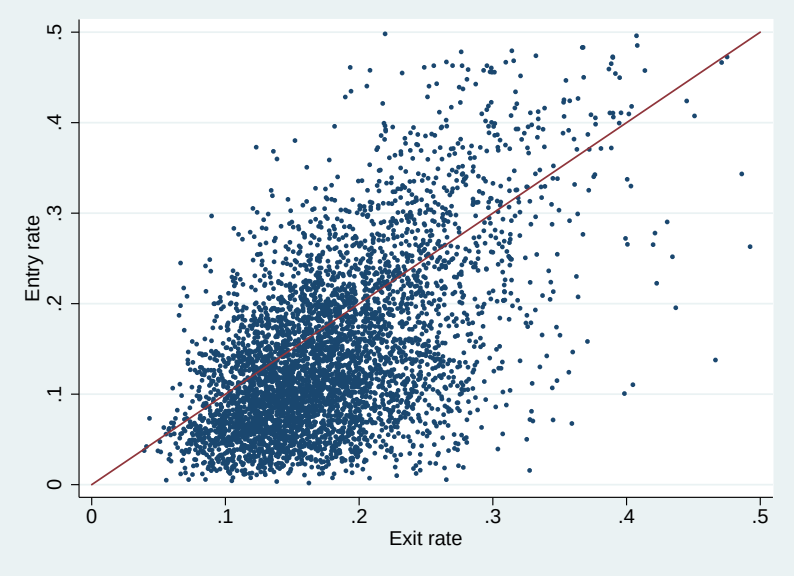
Figures

Figure 1: Distributions of entry and exit rates



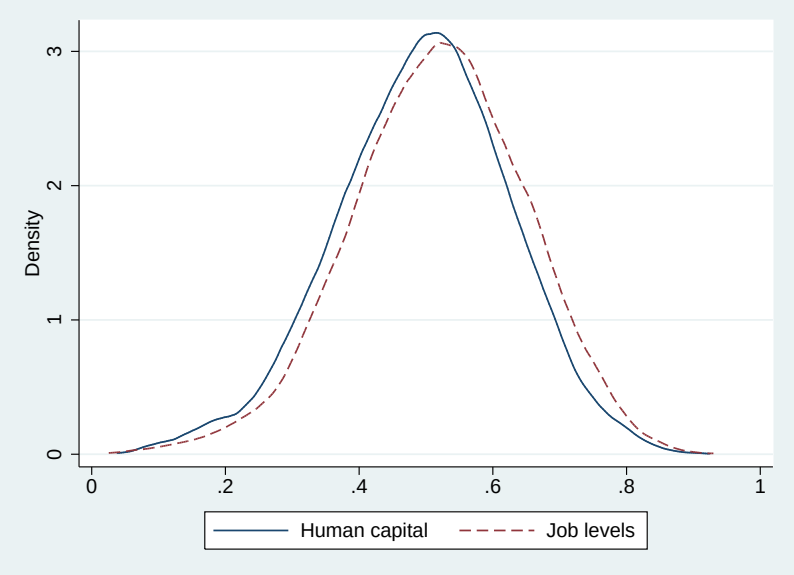
Note: Kernel distribution. The solid and dashed lines correspond to the average of the annual entry or exit rates for each firm, respectively, over the period in which the firm is available in the data (longest period possible is 1986-2004). The entry rate is the percentage of new workers in total employment; the exit rate is the percentage of exits in total employment. Cross-section data, unweighted means.

Figure 2: Scatter plot of entry and exit rates



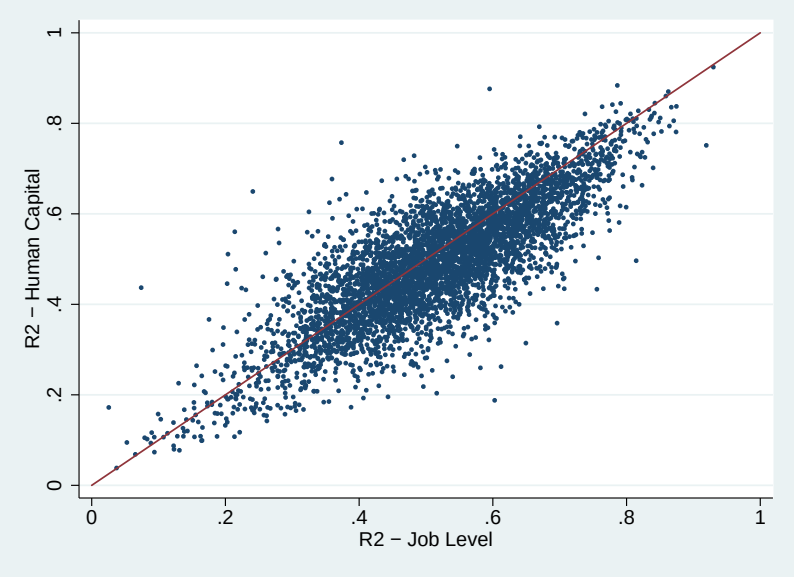
Note: Each point corresponds to the average entry and exit rates of each individual firm over the period the firm is available in the data.

Figure 3: Distributions of wage equation R^2's (human capital and job levels)



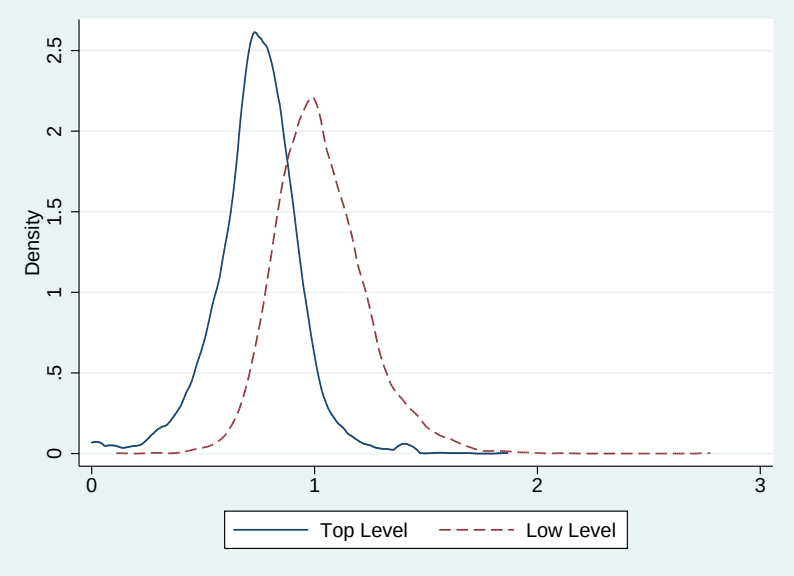
Note: Kernel density. The solid and dashed lines correspond to the coefficient of determination of wage equations based on human capital or job level variables, respectively. One R^2 per firm. Cross-section data, unweighted means.

Figure 4: Scatter plot of wage equation R^2's (human capital and job levels)



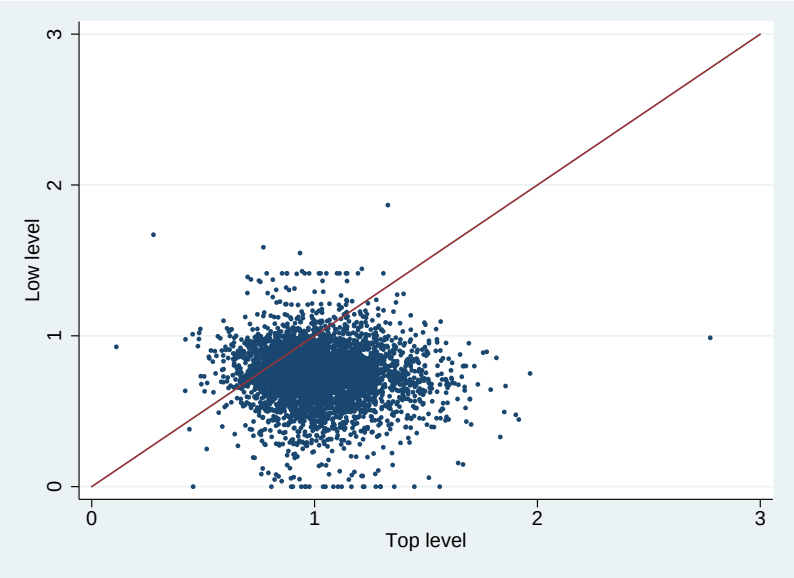
Note: Each point corresponds to the coefficients of determination of wage equations based on human capital or job level variables, respectively. One R^2 per firm. Cross-section data, unweighted means.

Figure 5: Distribution of wage dispersion at top and bottom job levels



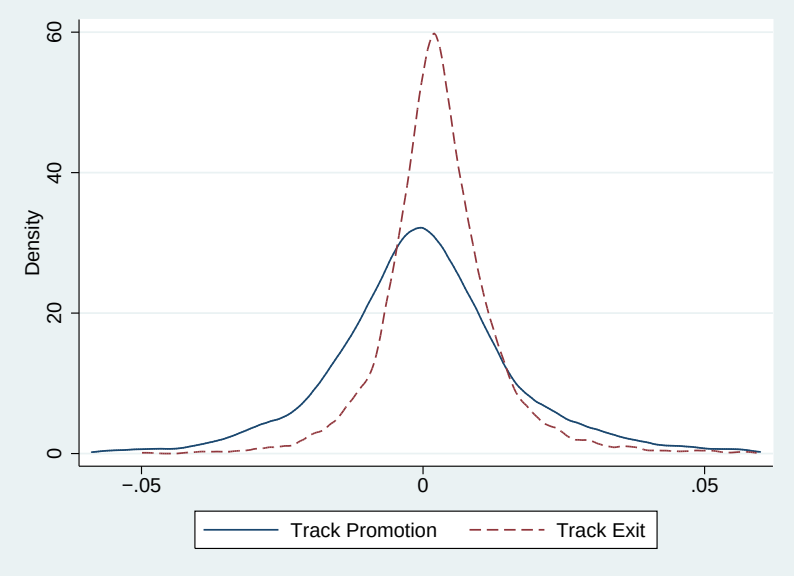
Note: Kernel distributions. The solid and dashed lines correspond to the wage residuals of top or bottom job levels, respectively. Cross-section data, unweighted means.

Figure 6: Scatter plot of wage dispersion at top and bottom job levels



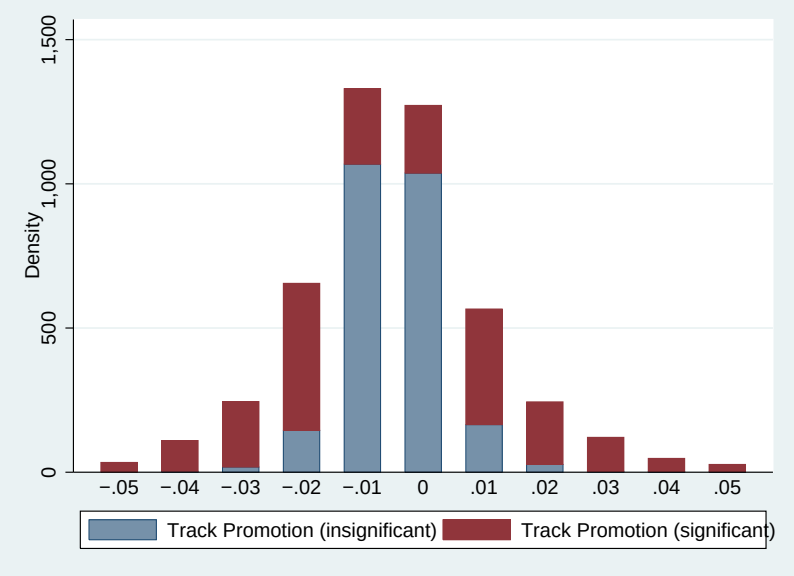
Note:

Figure 7: Distributions of the role of tenure in terms of promotions and separations



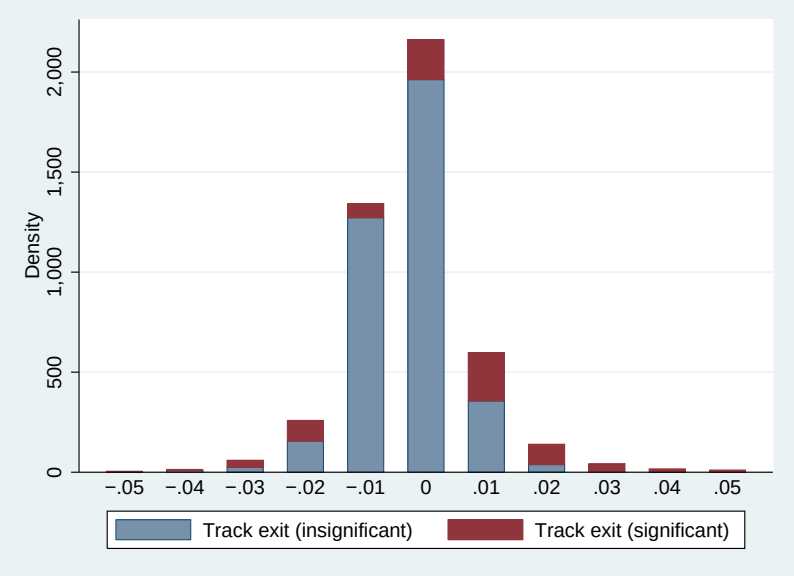
Note: Kernel distributions. The solid and dashed lines correspond to the coefficient of tenure in a regression in which the dependent variable is a dummy variable capturing whether the worker is promoted or leaves the firm, respectively. Both regressions include worker fixed effects.

Figure 8: Distributions of the role of tenure in terms of promotions



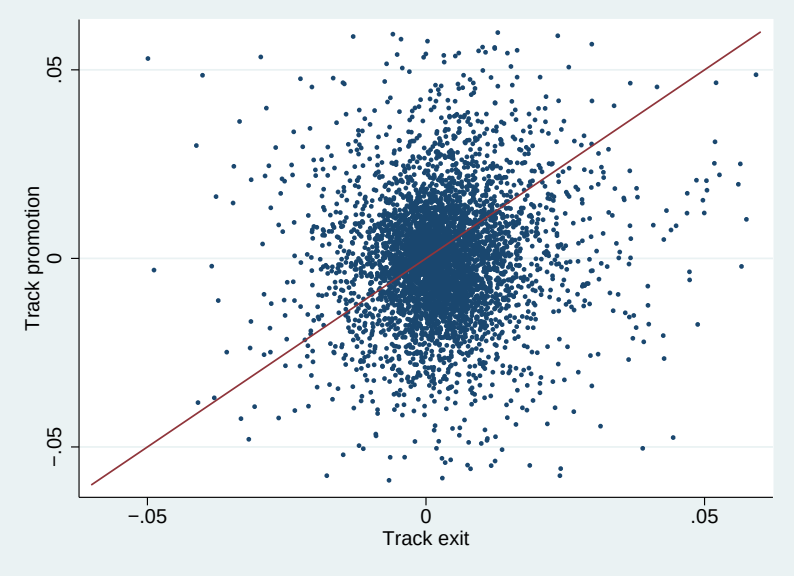
Note: Histogram of tenure coefficients in a regression in which the dependent variable is a dummy variable capturing whether the worker is promoted, controlling for worker fixed effects.

Figure 9: Distributions of the role of tenure in terms of separations



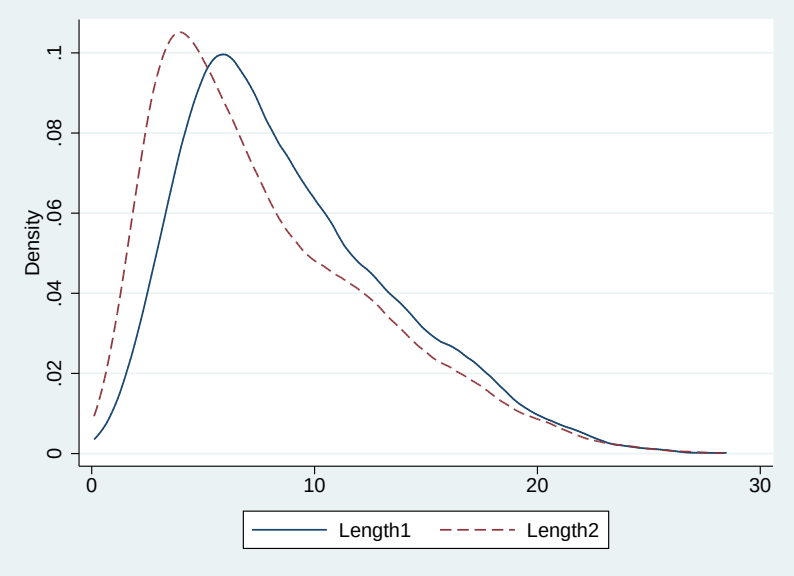
Note: Histogram of tenure coefficients in a regression in which the dependent variable is a dummy variable capturing whether the worker leaves the firm, controlling for worker fixed effects.

Figure 10: Scatter plot of the role of tenure in terms of promotions and separations



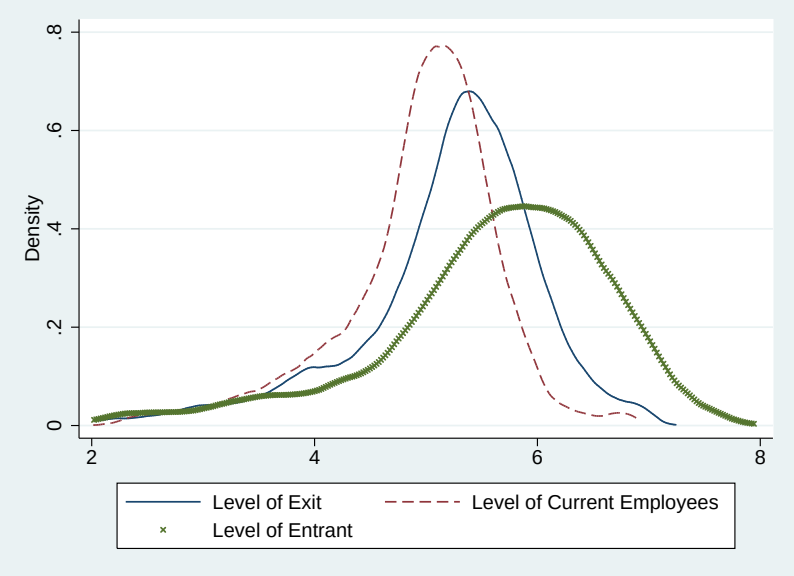
Note: Each point corresponds to the role of tenure in terms of promotions and separations in each firm.

Figure 11: Tenure distributions



Note: Kernel distributions. The solid line and dashed lines correspond to tenures of complete or incomplete job spells (employees may still in the firm after the last year in which the firm is present in the data). Cross-section data, unweighted means.

Figure 12: Dispersion in the job levels of entrants, stayers and leavers



Note: Kernel distributions. The solid, dashed and starred lines correspond to the average job level of leavers, stayers and entrants, respectively. Cross-section data, unweighted means.

Tables

Table 1: Descriptive Statistics [Cross Section data]

Variable	Mean	Std. Dev.	Min.	Max.	N
Personnel practices characteristics					
Worker entry rate	0.149	0.104	0.002	0.91	4788
Worker exit rate	0.18	0.068	0.039	0.663	4788
Human capital adj. R^2	0.495	0.13	0.038	0.924	4775
Job levels adj. R^2	0.518	0.131	0.026	0.930	4775
Wage dispersion - high job levels	1.027	0.205	0.111	2.776	4785
Wage dispersion - intermediate job levels	0.998	0.186	0.058	2.11	4786
Wage dispersion - low job levels	0.742	0.191	0	1.867	4451
Job-level-tenure promotion coefficients	0.0002	0.026	-0.995	0.28	4773
Job-level-tenure exit coefficients	0.003	0.021	-0.943	0.634	4773
Job level change (careers)	0.409	0.497	-2.241	3.375	4788
Tenure of complete spells	7.836	4.939	0.105	28.364	4788
Firm characteristics					
Log sales per worker	14.926	1.525	1.834	21.384	4727
Log wage rate	1.417	0.429	0.553	3.285	4788
Log no of worker	4.831	0.778	3.765	9.993	4788
Avg job level	5.296	0.65	1.991	7.351	4788
Avg schooling	6.642	2.067	3.169	16.241	4788
Avg tenure	9.362	4.748	0.394	27.986	4788
Avg experience	24.274	5.577	4.822	50.985	4788
Foreign owned	0.098	0.26	0	1	4788
Log equity per worker	13.504	1.788	4.892	21.817	4660
Firm birth year	1967.51	31.917	1499	2004	4781

Notes: Worker entry and exit rates denote the percentage of workers in any given firm-year that are either in their first year in the firm or that will not be present in the firm in the following year. Job level change indicates the difference between the job level of workers that are in their first and last years of tenure in their firm. Tenure of completed spells is the length of tenure of workers that are observed leaving the firm. Human capital and job levels adj. R^2 are obtained from regressions of wages on either human capital of job level variables. Wage dispersion refer to the spread of wages at different sets of job levels, after controlling for human capital and job level variables. Job-level promotion and exit coefficients are obtained from regressions of 'to-be promoted' or 'to leave' dummies on job-level tenure and other controls (including worker fixed effects). Wage rate refers to hourly 2004 euros. All results based on author's calculations using 'Quadros de Pessoal' data. Results reported are firm-level, unweighted averages when variables are derived on firm-year observations. See main text for more detailed definitions of each variable.

Table 2: Descriptive Statistics [Pooled data]

Variable	Mean	Std. Dev.	Min.	Max.	N
Personnel practices characteristics					
Worker entry rate	0.146	0.155	0	1	72103
Worker exit rate	0.178	0.153	0	1	72103
Human capital adj. R^2	0.414	0.202	-2.416	1	69758
Job levels adj. R^2	0.45	0.22	-1.276	1	71103
Job level change (careers)	0.406	1.097	-7	8	63067
Tenure of complete spells	7.91	4.898	0.105	28.364	72107
Wage dispersion - high job levels	1.029	0.43	0	6.365	68410
Wage dispersion - intermediate job levels	0.998	0.358	0	4.594	69585
Wage dispersion - low job levels	0.764	0.32	0	2.847	44307
Job-level-tenure promotion coefficients	0.005	4.269	-355.384	843.827	68089
Job-level-tenure exit coefficients	-0.022	1.389	-34.401	300.112	68089
Firm characteristics					
Log sales per worker	11.97	3.725	-4.457	23.099	53733
Wage rate	1.429	0.502	-0.174	5.677	71449
Log no of worker	4.722	0.909	0	10.319	72103
Avg job level	5.277	0.784	0.318	8	71672
Avg schooling	6.683	2.267	2	17	71580
Avg tenure	9.571	5.447	0	79.251	71860
Avg experience	24.503	6.270	0	80	71389
Foreign owned	0.096	0.295	0	1	72103
Log equity per worker	10.196	3.937	-1.209	22.613	67022
Firm birth year	1966.879	32.1	1499	2004	72027

Notes: See notes in Table 1. Results reported here are unweighted averages from firm-year observations, unless variables are measured at the firm level.

Table 3: **Personnel policies and firm performance [cross-section results]**

	A	B	C	D	E
	(1)	(2)	(3)	(4)	(5)
Worker entry rate		-.283			
		(.250)			
Worker exit rate		-.226			
		(.256)			
Job level change (careers)			.001		
			(.034)		
Tenure of complete spells			.003		
			(.008)		
Human capital adj. R^2				.229	
				(.181)	
Job levels adj. R^2				.102	
				(.177)	
Wage dispersion-high job levels					.087
					(.077)
Wage dispersion-intermediate job levels					-.256***
					(.090)
Wage dispersion-low job levels					-.255***
					(.083)
Job-level-tenure promotion coefficients					
Job-level-tenure exit coefficients					
Log no of worker	.664***	.669***	.663***	.673***	.673***
	(.027)	(.027)	(.027)	(.027)	(.029)
Avg job level	-.220***	-.209***	-.219***	-.215***	-.213***
	(.039)	(.039)	(.039)	(.039)	(.042)
Avg schooling	.081***	.084***	.081***	.082***	.056***
	(.016)	(.016)	(.016)	(.016)	(.017)
Avg tenure	-.003	-.009	-.006	-.005	.0003
	(.005)	(.006)	(.009)	(.005)	(.005)
Avg experience	.005	.006	.005	.007	.001
	(.005)	(.005)	(.005)	(.005)	(.005)
Foreign owned	.088*	.086*	.087*	.087*	.092*
	(.046)	(.046)	(.046)	(.046)	(.047)
Log equity per worker	.309***	.307***	.309***	.306***	.308***
	(.016)	(.016)	(.016)	(.016)	(.017)
Firm birth year	.001	.001	.001	.001	.002
	(.001)	(.001)	(.001)	(.001)	(.001)
Const.	3.789*	3.910*	3.804*	3.631*	5.090**
	(2.099)	(2.106)	(2.106)	(2.108)	(2.195)
Obs.	4638	4638	4638	4625	4305
R^2	.698	.698	.698	.699	.689

Notes: All columns include industry and region fixed effects. Robust standard errors. Significance levels: *: 0.10; **: 0.05; ***: 0.01.

Table 4: **Personnel policies and firm performance [cross-section results] - cont.**

	A	B	C	D	E
	(1)	(2)	(3)	(4)	(5)
Worker entry rate		-.282			-.634***
		(.263)			(.196)
Worker exit rate		-.196			-.050
		(.276)			(.204)
Job level change (careers)		.016	-.136***	-.0006	-.010
		(.035)	(.047)	(.022)	(.022)
Tenure of complete spells		.003	.034***	.007	.006
		(.008)	(.004)	(.006)	(.007)
Human capital adj. R^2		.031	.140	.006	-.057
		(.191)	(.293)	(.143)	(.145)
Job levels adj. R^2		.156	.401	.102	.094
		(.186)	(.291)	(.139)	(.140)
Wage dispersion-high job levels		.088	1.104***	.052	.049
		(.077)	(.112)	(.053)	(.053)
Wage dispersion-intermediate job levels		-.252***	.249*	-.275***	-.286***
		(.091)	(.130)	(.068)	(.066)
Wage dispersion-low job levels		-.248***	.095	-.229***	-.235***
		(.084)	(.110)	(.059)	(.060)
Job-level-tenure promotion coefficients	.105	.117	1.070	-.255	-.216
	(.461)	(.505)	(.766)	(.383)	(.326)
Job-level-tenure exit coefficients	.050	-1.365	-2.676	-1.982**	-1.479*
	(.845)	(1.393)	(1.802)	(.825)	(.870)
Log no of worker	.664***	.682***		.699***	.705***
	(.027)	(.030)		(.017)	(.021)
Avg job level	-.220***	-.200***		-.260***	-.239***
	(.039)	(.042)		(.031)	(.032)
Avg schooling	.080***	.061***		.056***	.061***
	(.016)	(.017)		(.013)	(.013)
Avg tenure	-.003	-.010		-.011	-.019**
	(.005)	(.010)		(.007)	(.008)
Avg experience	.005	.004		.00003	.0008
	(.005)	(.005)		(.004)	(.004)
Foreign owned	.088*	.087*		.040	.040
	(.046)	(.047)		(.039)	(.041)
Log equity per worker	.309***	.306***		.302***	.301***
	(.016)	(.017)		(.008)	(.012)
Firm birth year	.001	.001		.0007*	.0006*
	(.001)	(.001)		(.0004)	(.0004)
Const.	6.723***	1.255	16.999***	9.735***	8.797***
	(2.135)	(2.141)	(1.075)	(1.235)	(.879)
Obs.	4626	4284	4359	4184	4184
R^2	.698	.69	.347	.794	.797

Notes: All columns include industry and region fixed effects. Robust standard errors. Significance levels: *: 0.10; **: 0.05; ***: 0.01.

Table 5: **Personnel policies and firm performance [pooled results]**

	A	B	C	D	E
	(1)	(2)	(3)	(4)	(5)
Worker entry rate		-.189***			
		(.046)			
Worker exit rate		-.305***			
		(.037)			
Job level change (careers)			-.003		
			(.005)		
Tenure of complete spells			.010***		
			(.002)		
Human capital adj. R^2				-.085***	
				(.032)	
Job levels adj. R^2				.134***	
				(.029)	
Wage dispersion-high job levels					.014
					(.020)
Wage dispersion-intermediate job levels					-.074***
					(.020)
Wage dispersion-low job levels					-.151***
					(.016)
Log no of worker	.700***	.699***	.693***	.704***	.712***
	(.008)	(.008)	(.008)	(.008)	(.010)
Avg job level	-.199***	-.189***	-.213***	-.204***	-.149***
	(.012)	(.012)	(.012)	(.011)	(.016)
Avg schooling	.099***	.100***	.091***	.106***	.079***
	(.006)	(.006)	(.006)	(.006)	(.007)
Avg tenure	-.010***	-.015***	-.015***	-.011***	-.004**
	(.001)	(.002)	(.003)	(.001)	(.002)
Avg experience	.001	.003*	-.0005	.003*	-.006**
	(.002)	(.002)	(.002)	(.002)	(.002)
Foreign owned	.207***	.204***	.193***	.197***	.229***
	(.018)	(.018)	(.019)	(.018)	(.021)
Log equity per worker	.206***	.206***	.206***	.204***	.196***
	(.003)	(.003)	(.004)	(.003)	(.005)
Firm birth year	-.001***	-.001***	-.001***	-.001***	-.0008**
	(.0003)	(.0003)	(.0003)	(.0003)	(.0003)
Const.	12.023***	12.254***	12.091	7.301***	6.350
	(.628)	(.633)	(.000)	(.635)	(2024.601)
Obs.	50916	50916	47778	50235	30439
R^2	.916	.917	.917	.919	.915

Notes: All columns include industry and region fixed effects. Robust standard errors. Significance levels: *: 0.10; **: 0.05; ***: 0.01.

Table 6: **Personnel policies and firm performance [pooled results] - cont.**

	A	B	C	D	E
	(1)	(2)	(3)	(4)	(5)
Worker entry rate		-.344***			-.404***
		(.068)			(.054)
Worker exit rate		-.279***			-.300***
		(.050)			(.039)
Job level change (careers)		.003	-.007	.003	.0004
		(.006)	(.008)	(.005)	(.005)
Tenure of complete spells		.023***	.043***	.020***	.020***
		(.003)	(.002)	(.002)	(.002)
Human capital adj. R^2		-.230***	-.114*	-.168***	-.186***
		(.053)	(.065)	(.041)	(.042)
Job levels adj. R^2		.022	-.336***	-.037	-.073**
		(.047)	(.059)	(.036)	(.037)
Wage dispersion-high job levels		.017	.401***	.021	.029*
		(.021)	(.026)	(.016)	(.016)
Wage dispersion-intermediate job levels		-.098***	.041	-.083***	-.093***
		(.022)	(.027)	(.016)	(.016)
Wage dispersion-low job levels		-.166***	-.061***	-.151***	-.162***
		(.017)	(.020)	(.013)	(.013)
Job-level-tenure promotion coefficients	-.0007**	.0002	.001***	.055*	.054*
	(.0003)	(.0001)	(.0002)	(.032)	(.028)
Job-level-tenure exit coefficients	-.004	-.121	.545***	.064	-.059
	(.003)	(.092)	(.134)	(.075)	(.073)
Log no of worker	.700***	.696***		.709***	.713***
	(.008)	(.011)		(.008)	(.008)
Avg job level	-.201***	-.144***		-.184***	-.162***
	(.012)	(.017)		(.013)	(.013)
Avg schooling	.098***	.073***		.098***	.097***
	(.006)	(.007)		(.005)	(.006)
Avg tenure	-.010***	-.027***		-.019***	-.027***
	(.001)	(.004)		(.003)	(.003)
Avg experience	.001	-.008***		-.008***	-.007***
	(.002)	(.002)		(.002)	(.002)
Foreign owned	.208***	.210***		.217***	.216***
	(.018)	(.021)		(.015)	(.016)
Log equity per worker	.206***	.195***		.192***	.189***
	(.003)	(.005)		(.004)	(.004)
Firm birth year	-.001***	-.0007**		-.001***	-.001***
	(.0003)	(.0003)		(.0002)	(.0002)
Const.	7.316***	5.911***	14.365***	11.895***	12.379***
	(.633)	(.845)	(.140)	(.517)	(.531)
Obs.	50792	28956	30180	28356	28456
R^2	.916	.916	.852	.951	.948

Notes: All columns include industry and region fixed effects. Robust standard errors. Significance levels: *: 0.10; **: 0.05; ***: 0.01.

Table 7: **Personnel policies and firm performance [pooled results, with industry-year FE]**

	A	B	C	D	E
	(1)	(2)	(3)	(4)	(5)
Worker entry rate		-.156***			
		(.040)			
Worker exit rate		-.319***			
		(.033)			
Job level change (careers)			-.006		
			(.004)		
Tenure of complete spells			.005**		
			(.002)		
Human capital adj. R^2				.094***	
				(.030)	
Job levels adj. R^2				.080***	
				(.027)	
Wage dispersion-high job levels					.014
					(.018)
Wage dispersion-intermediate job levels					-.074***
					(.019)
Wage dispersion-low job levels					-.083***
					(.015)
Log no of worker	.802***	.800***	.812***	.818***	.842***
	(.006)	(.006)	(.007)	(.006)	(.008)
Avg job level	-.196***	-.187***	-.207***	-.199***	-.158***
	(.010)	(.010)	(.010)	(.010)	(.015)
Avg schooling	.103***	.104***	.097***	.112***	.099***
	(.005)	(.005)	(.005)	(.005)	(.007)
Avg tenure	-.016***	-.020***	-.019***	-.019***	-.016***
	(.002)	(.002)	(.002)	(.002)	(.002)
Avg experience	-.004**	-.003**	-.005***	-.0002	.0005
	(.002)	(.002)	(.002)	(.002)	(.002)
Foreign owned	.113***	.110***	.101***	.102***	.124***
	(.016)	(.016)	(.016)	(.016)	(.018)
Log equity per worker	.148***	.148***	.145***	.145***	.130***
	(.003)	(.003)	(.003)	(.003)	(.004)
Firm birth year	.0001	.00006	.0001	.00008	.0003
	(.0002)	(.0002)	(.0002)	(.0002)	(.0003)
Const.	6.575***	6.823***	6.754***	6.744***	5.872***
	(.656)	(.656)	(.667)	(.625)	(.905)
Obs.	50916	50916	47778	50235	30439
R^2	.931	.932	.932	.933	.932

Notes: All columns include industry and region fixed effects. Robust standard errors. Significance levels: *: 0.10; **: 0.05; ***: 0.01.

Table 8: **Personnel policies and firm performance [pooled results, with industry-year FE] - cont.**

	A	B	C	D	E
	(1)	(2)	(3)	(4)	(5)
Worker entry rate		-.207***			-.267***
		(.063)			(.045)
Worker exit rate		-.297***			-.316***
		(.045)			(.032)
Job level change (careers)		-.001	-.015**	-.003	-.004
		(.006)	(.007)	(.004)	(.004)
Tenure of complete spells		.013***	.025***	.008***	.010***
		(.003)	(.002)	(.002)	(.002)
Human capital adj. R^2		.065	.117*	.143***	.109***
		(.049)	(.062)	(.034)	(.035)
Job levels adj. R^2		.071	-.083	-.019	-.014
		(.044)	(.056)	(.030)	(.031)
Wage dispersion-high job levels		.011	.374***	.014	.017
		(.019)	(.024)	(.013)	(.014)
Wage dispersion-intermediate job levels		-.061***	.073***	-.057***	-.057***
		(.020)	(.026)	(.014)	(.014)
Wage dispersion-low job levels		-.066***	.108***	-.057***	-.058***
		(.016)	(.020)	(.011)	(.011)
Job-level-tenure promotion coefficients	-.0006	-.0002	-.0004	.045	.036
	(.0009)	(.002)	(.002)	(.032)	(.034)
Job-level-tenure exit coefficients	-.003	-.179**	.286**	-.025	-.098
	(.006)	(.089)	(.113)	(.061)	(.064)
Log no of worker	.802***	.837***		.874***	.870***
	(.006)	(.009)		(.006)	(.006)
Avg job level	-.197***	-.151***		-.209***	-.186***
	(.010)	(.015)		(.010)	(.011)
Avg schooling	.103***	.095***		.106***	.106***
	(.005)	(.007)		(.005)	(.005)
Avg tenure	-.016***	-.030***		-.023***	-.029***
	(.002)	(.003)		(.002)	(.002)
Avg experience	-.004**	.0004		.0004	.0006
	(.002)	(.003)		(.002)	(.002)
Foreign owned	.113***	.105***		.127***	.119***
	(.016)	(.019)		(.013)	(.013)
Log equity per worker	.148***	.130***		.121***	.120***
	(.003)	(.004)		(.003)	(.003)
Firm birth year	.0001	.0003		.0003*	.00007
	(.0002)	(.0003)		(.0002)	(.0002)
Const.	6.595***	6.081***	11.086***	6.020***	6.676***
	(.657)	(.916)	(.536)	(.507)	(.525)
Obs.	50792	28956	30180	28356	28456
R^2	.931	.932	.883	.968	.965

Notes: All columns include industry and region fixed effects. Robust standard errors. Significance levels: *: 0.10; **: 0.05; ***: 0.01.

Table 9: **Personnel policies and firm performance [firm FE results]**

	A	B	C	D	E
	(1)	(2)	(3)	(4)	(5)
Worker entry rate		-.398***			
		(.039)			
Worker exit rate		-.151***			
		(.030)			
Job level change (careers)			.005		
			(.004)		
Human capital adj. R^2				.025	
				(.029)	
Job levels adj. R^2				.042	
				(.027)	
Wage dispersion-high job levels					.008
					(.018)
Wage dispersion-intermediate job levels					-.022
					(.019)
Wage dispersion-low job levels					-.036**
					(.014)
Log no of worker	.679***	.658***	.716***	.709***	.744***
	(.009)	(.009)	(.011)	(.010)	(.017)
Avg job level	-.105***	-.082***	-.115***	-.114***	-.078***
	(.012)	(.012)	(.013)	(.012)	(.020)
Avg schooling	.025***	.024***	.024***	.047***	.042***
	(.006)	(.006)	(.007)	(.007)	(.011)
Avg tenure	-.015***	-.023***	-.014***	-.020***	-.012***
	(.003)	(.003)	(.003)	(.003)	(.004)
Avg experience	-.015***	-.016***	-.016***	-.010***	-.016***
	(.002)	(.002)	(.003)	(.003)	(.004)
Foreign owned	.065**	.058**	.071***	.054**	.031
	(.026)	(.026)	(.026)	(.025)	(.031)
Log equity per worker	.050***	.049***	.046***	.046***	.053***
	(.004)	(.004)	(.004)	(.004)	(.005)
Const.	14.841	15.131	12.916	11.904	48.925
	(3.79e+09)	(3.78e+09)	(3.65e+09)	(6.07e+09)	(1.50e+11)
Obs.	50916	50916	47778	50235	30439
R^2	.956	.956	.957	.957	.957

Notes: All columns include region fixed effects. Robust standard errors. Significance levels: *: 0.10; **: 0.05; ***: 0.01.

Table 10: **Personnel policies and firm performance [firm FE results] - cont.**

	A	B	C	D	E
	(1)	(2)	(3)	(4)	(5)
Worker entry rate		-.435***			-.430***
		(.068)			(.039)
Worker exit rate		-.145***			-.167***
		(.043)			(.024)
Job level change (careers)		.011**	.019***	.008**	.007**
		(.005)	(.005)	(.003)	(.003)
Human capital adj. R^2		.035	-.023	.064**	.058*
		(.056)	(.057)	(.031)	(.031)
Job levels adj. R^2		.042	-.004	-.053*	-.057**
		(.048)	(.049)	(.027)	(.027)
Wage dispersion-high job levels		.003	.061***	.009	.009
		(.018)	(.019)	(.010)	(.010)
Wage dispersion-intermediate job levels		-.016	.028	-.023**	-.023**
		(.020)	(.021)	(.012)	(.011)
Wage dispersion-low job levels		-.029*	.021	-.020**	-.021**
		(.016)	(.016)	(.009)	(.009)
Job-level-tenure promotion coefficients	-.0001	.0001	-.0001	-.006	-.003
	(.0008)	(.001)	(.001)	(.027)	(.027)
Job-level-tenure exit coefficients	-.002	-.040	-.036	.017	-.007
	(.005)	(.082)	(.082)	(.046)	(.046)
Log no of worker	.678***	.721***		.751***	.733***
	(.009)	(.018)		(.010)	(.010)
Avg job level	-.105***	-.054**		-.130***	-.104***
	(.012)	(.021)		(.012)	(.012)
Avg schooling	.025***	.036***		.064***	.061***
	(.006)	(.012)		(.007)	(.007)
Avg tenure	-.015***	-.021***		-.013***	-.022***
	(.003)	(.005)		(.003)	(.003)
Avg experience	-.015***	-.017***		-.012***	-.013***
	(.002)	(.005)		(.003)	(.003)
Foreign owned	.065**	.030		.045**	.040**
	(.026)	(.031)		(.018)	(.018)
Log equity per worker	.050***	.050***		.033***	.031***
	(.004)	(.005)		(.003)	(.003)
Const.	10.481	9.625	16.102***	4.542	-3.069
	(3.72e+09)	(1.13e+10)	(1.241)	(5.01e+09)	(2.21e+10)
Obs.	50792	28956	30180	28456	28456
R^2	.956	.957	.953	.986	.986

Notes: All columns include region fixed effects. Robust standard errors. Significance levels: *: 0.10; **: 0.05; ***: 0.01.

Table 11: Distribution of firms and employees across industries

Sector	Firms Freq.	Percent	Employees Percent
Food products and beverages (15)	4,884	6.77	6.73
Textiles (17)	5,675	7.87	8.19
Wearing apparel (18)	6,602	9.16	8.99
Leather and related (19)	3,267	4.53	4.45
Other non-metallic mineral products (26)	3,237	4.49	4.48
Fabricated metal products (28)	2,322	3.22	3.11
Machinery and equipment (29)	2,201	3.05	2.97
Furniture (36)	1,806	2.5	2.32
Construction (45)	6,030	8.36	8.27
Sale, maintenance and repair of motor vehicles (50)	2,846	3.95	3.75
Wholesale trade (51)	5,382	7.46	7.21
Retail trade (52)	2,171	3.01	2.94
Hotels and restaurants (55)	2,636	3.66	3.67
Land transport (60)	1,779	2.47	2.55
Other business activities (74)	2,484	3.45	3.68
Health and social work (85)	2,888	4.01	3.87
Other sectors	15,893	22.04	22.82
Total	72,103	100	100

Notes: Numbers in parentheses refer to industry code. Firm-year observations.

Table 12: **Job level description**

Level	Description	Task
1	Top executives (top management)	Definition of the firm general policy or consulting on the organization of the firm; strategic planning; creation or adaptation of technical, scientific and administrative methods
2	Intermediary executives (middle management)	Organization and adaptation of the guidelines established by the superiors and directly linked with the executive work
3	Supervisors, team leaders	Orientation of teams, as directed by the superiors, but requiring the knowledge of action processes
4	Higher-skilled professionals	Tasks requiring a high technical value and defined in general terms by the superiors
5	Skilled professionals	Complex or delicate tasks, usually not repetitive, and defined by the superiors
6	Semi-skilled professionals management)	Well defined tasks, mainly manual or mechanical (no intellectual work) with low complexity, usually routine and sometimes repetitive
7	Non-skilled professionals	Simple tasks and totally determined
8	Apprentices, interns, trainees	Apprenticeship

Notes: See Lima & Pereira (2003) for more details.