The effects of Information and Communication Technologies on pay for performance use

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Abstract: Technological change has had substantial consequences in the modern workplace. This paper analyses the influence of technology in compensation programs at individual, team or company level. This contributes to literature on work implications of ICTs by complementing research on effects on wages. Estimations are based on the European Working Conditions Survey last three waves. Main results show a positive effect of computer use on the four pay for performance schemes. Results indicate that this effect is partially mediated by job variables and it is larger for non manual than for manual occupations. However, a significant direct effect remains unexplained.

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1. Introduction

Computer based technologies have been shown to have a pervasive effect on many variables related to work. Some of them are employment or number of jobs (Akcomak et al., 2016), job polarization (Baccini and Cioni, 2010), job design (Han and Liao, 2010; Venkatesh et al., 2010) or work outcomes (Askenazy and Caroli, 2010; Martin, 2017). These effects have extended to the compensation area in aspects such as pay level and dispersion (Mallick and Sousa, 2017).

Nevertheless, the analysis of the impact of information and communication technologies on pay for performance (PFP) has been neglected in a period of growing incidence of both of them. The use of PFP is increasing as a practice to improve performance through better motivation and selection. According to the European Working Conditions Survey (hereafter, EWCS), the use of PFP has increased in the European Union in the last decades. For example, collective PFP schemes have substantially increased in the period 2000-2015. On the other hand, the use of computers in jobs is a trend in all occupations, since the digitalization of processes increases flexibility and allows the personalization of products and has become one of the main goals of companies to increase productivity.

The most straightforward link for a relationship between computers and PFP are job characteristics and work organization variables. Empirical literature on the influence of computers on task content has found that they have a significant influence on job dimensions such as job autonomy, teams or task variety (Bayo-Moriones et al., 2017). At the same time, variables like these and other related to work organization such as risk play a major role in the main theoretical models on the determinants of pay for performance use.

This paper pursues three research objectives. Firstly, we analyze the influence of computer on the incidence of four different PFP schemes: piece rate/productivity PFP, team PFP, company PFP and income from shares. Secondly, we investigate the mediating role of job characteristics in the relationship between computers and PFP. Finally, we examine whether the impact of computers on PFP is universal across occupations.

The article is organized as follows. Next section presents the theoretical framework. Section 3 describes the data and methods used to conduct the empirical analysis. Section 4 presents results, followed by the main conclusions of the paper.

2. Computer use, job characteristics and PFP

In the literature on the determinants of PFP incidence job related variables play a major role. Although this holds in empirical research too, it is in the theoretical literature where aspects related to work organization are central in the main models aimed at explaining the conditions under which pay for performance is advisable to elicit larger effort from employees in order to the firm to be more efficient in the management of employees.

There are several dimensions related to job design which have been highlighted in this literature. We will focus in five of them: the measurability of the performance, controllable risk, uncontrollable risk, the relevance of employee performance for the firm and the need of teamwork and cooperation among workers. We will also highlight how information and communication technologies are expected to impact them.

2.1. Measurability of performance

As regards measurability, the implementation of PFP requires that performance is measured in order to have a metrics upon which determine the earnings received by the employees participating in the scheme. The easier and less costly performance can be observed, the more likely PFP is to be adopted (Baker, 1992; Gibbs, 2012). This applies especially to individual and, to a lesser extent, team PFP, since for schemes at the organizational level such as plant and company, performance measures such as profit, revenues or costs are already available for another purposes in firm management.

The measurability of individual performance is strongly related to the number of tasks in the job. The larger the number of tasks, the more difficult the observation of performance. When the job is very simple, it is easier to determine precise standards against which the performance of the workers is assessed. The observability of performance is also associated to the variety of tasks in the job. When the job includes very different elements, the danger of potential distorsion behaviors increases. In these cases performance is multidimensional and the presence of differences among dimensions in the precision of measurement may lead to workers emphasizing those aspects better measured and more relevant for their earnings (Prendergast, 1999).

Computer based technologies are expected to have an influence in this point. There is a straightforward impact since electronic performance monitoring devices facilitate the measurement of worker outputs, favoring PFP introduction (Bhave, 2014; Holland et al., 2015; Jeske and Santuzzi, 2015). Nonetheless, they have also improved the measurability of inputs such as work time, promoting motivational tools not based directly in output.

Additionally, the introduction of computers in the workplace have involved new tasks in the job that did not exist in the past, such as those related to communication and information and the handling of computer equipment and applications (Dewhurst et al., 2003). In this line, Bayo-Moriones et al. (2017) highlight that information and communication technologies have implied greater levels of multitasking behavior because of the minimization of spatial and temporal boundaries

2.2. Uncontrollable risk

Uncontrollable risk refers to the factors out of the control of the worker that are important for performance (Kauhanen and Napari, 2012). Risk is a variable that has been present since the earliest theoretical models on the determinants of PFP incidence (Gibbs et al., 2009). The literature clearly points to a trade-off between uncontrollable risk and incentives. The presence of this kind of risks involves that worker performance is not solely determined by her effort and decisions. Under these circumstances PFP introduces uncertainty in the pay of risk-averse workers that would bear a cost associated to this risk. In order to accept the consequences of this uncontrollable risk, employees will demand a higher pay level. This compensation for the risk in earnings involves higher labor costs for the company if the motivational positive effect of PFP is to be maintained.

Computer technologies have been shown to generate uncertainties to those using them as part of their daily duties. Some of them are derived from the existence of technical problems. These can have their origin either in malfunctioning hardware or non-functional software (van Deursen and van Dijk, 2014). In both cases they might involve losses of time. When the technical problem is severe, it can lead to a complete stoppage of activities, whereas in minor setbacks, it can cause a deceleration of the work pace of the worker.

However, the uncertainties caused by computers are not only of a technical nature. These technologies generate interruptions in the workflows since they create unforeseen tasks (Chesley, 2014). For example, the need to reply an unexpected amount of incoming emails may create unbalance in the planned workload. Whatever the case, computers may have consequences for the worker in terms of involuntary lower performance due to unexpected negative events.

2.3. Controllable risk

Controllable risk refers to the extent to which workers can respond to uncertainty using their specific knowledge or private information (Baker, 2002; Barth et al., 2008; Gibbs, 2012; Holmstrom, 1979; Prendergast, 2002). As opposed to uncontrollable risk, where employees cannot respond to uncertainty, in a situation of controllable risk they enjoy discretion in how to respond, so that their actions determine the final consequences of the unexpected event for the firm. Whereas with uncontrollable risk the benefits of PFP are smaller, controllable risk makes incentives more powerful as a motivational tool.

Therefore, job autonomy or delegation is a central variable in the debate on the relationship between risk and PFP. If the worker enjoys discretion to act in a context of uncertainty, as happens with controllable risk, this will be associated to more PFP. If not, the situation would be of uncontrollable risk and, therefore, PFP will lose some of their positive effects.

This expected positive effects of job autonomy on PFP incidence is not free from limitations. Job discretion can cause problems of manipulation of performance standards, compromising the measurability of performance.

The literature on the implications of information and communication technologies for controllable risk points to a positive influence. Computers promote knowledge exchange and information flow, so that workers have more inputs to make better decisions. As a consequence, job autonomy can be provided to them in order to respond to uncertainty since they are better informed about the context and potential consequences of their actions (Bresnahan et al., 2002; Basaglia et al., 2010; Van Yperen et al., 2014

2.4. The relevance of worker performance for the firm

Another factor affecting the incidence of PFP for a job is the impact of job performance for the overall performance of the company. Not all jobs are equal in this dimension, since they differ in their value (Bayo-Moriones et al., 2013). The firm will be more interested in improving performance by eliciting more effort from employees through PFP in those jobs with higher strategic value (Holmstrom and Milgrom, 1991).

This value of performance is connected to job complexity. As compared to simple jobs, complex jobs are characterized by task difficulty and a higher probability of making mistakes, causing variability in performance among incumbents. This higher variability in performance is associated to greater value of job performance for the firm (Cascio and Boudreau, 2015). As a result, complex jobs are more suitable to PFP since the firm values more firm performance than for more simple jobs. Complex jobs are associated to higher requirements of skills for employees occupying them. For the tasks to be done properly, workers must have the adequate abilities and, therefore, need to me more intensively trained. Whereas in simple jobs, differences in the abilities and skills of the workers have hardly impact on performance, in complex jobs these differences are crucial and can give rise to substantial variations in firm value generation by the workers.

As happens with other technologies, computers increase labor productivity. Therefore, they amplify the effects of human inputs on outputs (Akerman et al., 2015; Aral et al., 2012). Differences in the effort and ability of the worker have a larger impact on job and firm performance when information and computer technologies have been adopted.

2.5. The need of teamwork and cooperation

The extent to which the job requires teamwork and cooperation between peers is also expected to influence the incidence of PFP schemes. On the one hand, when there is team technology, that is, the production function is defined at the team level and there are benefits of interaction, it is very difficult and costly to identify individual performance. As a result, collective schemes are the most reasonable method to link pay with performance. In addition, in order to encourage helping behaviors, individual PFP presents important caveats. So collective PFP should be favored in order to promote collaboration between workers (Jirjahn, 2002).

Both teamwork and cooperation are affected by the introduction of computer in the job. There are several arguments that support this statement. Firstly, information and communication technologies imply more complex problems, so they require teamwork to find better solutions (Basaglia et al., 2010). In addition, computer technologies reduce coordination costs, so the working of teams is facilitated since communications costs are reduced (Cairncross, 1997). Finally, computer based technologies promote shared goals through information diffusion, so that employees work to meet collective objectives instead of individual targets (Denton and Richardson, 2006; Gressgard, 2011).

2.6. Occupational differences

Occupation is a key factor in the analysis of the incidence of HRM because of the intrinsic differences in job contents among occupations (Bayo-Moriones et al., 2013). For that reason, it is expected that the pattern of determinants of PFP use is not the same for all occupational groups.

This would also apply to information and communication technologies. Several reasons might justify why the influence of computers on PFP adoption differs among occupations on PFP. On the one hand, the direct impact of computers on employment may differ by occupations. In the empirical evidence on this issue, computers have been found to substitute for routine jobs, but complement non-routine jobs (Akcomak et al., 2016; Ben-Ner and Urtasun, 2013). In addition, the effect of computers on work organization has been found to be moderated by occupation, so that it is stronger for skilled jobs (Bayo-Moriones et al., 2015).

3. Methods

3.1. Data

The data used in our empirical analysis come from the European Working Conditions Survey (hereafter, EWCS), conducted by the European Foundation for the Improvement of Working and Living Conditions[1]. More specifically, we use the data from the third, fourth, fifth and sixth waves of the survey, conducted in 2000-2001 2005, 2010 and 2015, respectively. We use data from these editions because they include the information about all the variables relevant to our research purpose. Therefore, the sample includes observations from all the countries participating in these four rounds, that is, the 28 members of the European Union except Croatia.

The sample in the EWCS is representative of the persons in employment during the fieldwork period in each of the countries covered. Concretely, a multi-stage, stratified and clustered sample design was followed in each country with a 'random walk' procedure for the selection of the respondents at the last stage (Eurofound, 2016). All interviews were conducted face-to-face in the respondent's own household. Given the nature of our research question, we will exclude self-employed from our analysis. Pay for performance only makes sense for employees, as acknowledged in the own survey,

[1] Data are available on https://www.eurofound.europa.eu/surveys/european-working-conditions-surveys

which does not ask questions about these schemes to self-employed. Workers in the armed forces are also excluded from the sample (García-Cabrera et al., 2019).

The EWCS has been widely used in the HRM literature and, more specifically, in research on incentive payment. Examples of this would be the paper by Ortega (2009) on its relationship with employee discretion, Godeanu (2012) on its joint effects with job autonomy on pay satisfaction in teams or Eriksson and Ortega (2015) on its effect on working hours and non-work activities.

3.2. Measures

Dependent variables. The four dependent variables are binary and capture the use of four pay for performance schemes: piece rate/productivity payments, payments based on the performance of team/department, payments based on the overall performance of the company (for example, profit sharing) and incomes from shares in the company. More specifically, respondents were asked whether their earning from their job included each of the previous schemes.

Independent variable. The independent variable measures on a 1 to 7 scale the frequency with which the worker uses computer technologies in her job, with 1 indicating she never uses them, 2 almost never, 3 that she uses them around ¼ of the time, 4 around half of the time, 5 around ¾ of the time, 6 almost all the time and 7 all of the time.

Mediating variables. Ten mediating variables referred to job design and work organization are included in the analysis. Most of them are binary and capture whether the job involves meeting precise quality standards, solving unforeseen problems on her own, monotonous tasks, complex tasks as well as whether the respondent is able to choose or change her order of tasks, her methods of work and speed of work, is part of a group or team that has common tasks and can plan its work and receives on-the-job training by co-workers and supervisors. The presence of interruptions when doing a task in order to take unforeseen tasks I captured with a categorical variable, with 1 indicating they never happen; 2, occasionally; 3, fairly often, and 4, very often.

These mediating variables are associated with the relevant theoretical concepts described in the theoretical section as follows. Measurability is captured by the existence of quality standards and job monotony; uncontrollable risks by interruptions; controllable risk by the job autonomy variables; the impact of workers performance for the company by job complexity and on the job training and the need of teamwork and cooperation by teams.

Control variables. Several control variables are included. Some of them relate to the worker such as gender, age and seniority in the company (Manning and Saidi, 2010; Jones and Kato, 2012). Categories from the ISCO08 classification at one digit level are included to control for occupation (Bayo-Moriones et al., 2013). As far as industry is concerned, observations are classified in agriculture, industry, public administration and other services (Bryson et al., 2017; Gooderham et al., 2018) whereas workplace size is proxied by a categorical variable with four categories: 1 worker, 2 to 9 workers, 10 to 249 and 250 or over. (Jaakson and Kallaste, 2014). Finally, country dummies are included (Dolvik and Nergaard, 2011; Frank et al., 2015).

Table 1 includes the definitions of the variables, as well as their means and standard deviations. Table 2 presents the correlation matrix between the independent and mediating variables.

INSERT TABLES 1 AND 2 ABOUT HERE

3.3. Estimation methods

Since our dependent variables are binary, probit models are estimated. Two models are estimated for each of the four pay for performance schemes examined. The first model includes control variables and the frequency of computer use, whereas in the second model the mediating variables are added. Since the representativeness all the sample varies across countries, weights are used to control for this issue.

4. Results

Table 3 includes the results of univariate probit models estimations. Findings show that men are more likely than women to have their earnings dependent on performance, especially when this is measured at the organizational level. Mixed results are obtained for age. No effect is found on productivity PFP, a negative effect on team PFP and positive ones on company PFP and income from shares. Results also indicate that most senior employees are more likely to receive pay based on team and company performances and income from shares. No significant relationship between years of work in the company and productivity PFP.

INSERT TABLE 3 ABOUT HERE

Occupation dummy variables are significant in all the models and, when this happens, all of them have negative coefficients. Since the omitted category in the analysis are managers, this involves that these are the employees more subject to pay for performance. The occupations with lower incidence of pay for performance vary depending on the specific scheme. For productivity PFP, these are clerical, service and sales workers and professionals; for team and company PFP, elementary occupations, craft, clerical and service and sales workers; and for income from shares of the company, elementary occupations, craft, service and sales workers and machine operators and assemblers.

Industry differences have also been found and point, as expected, to a lower diffusion of PFP in public sector services comparing to agriculture, manufacturing and construction and other services. Regarding size, medium-sized and larger firms are associated to a higher use of team PFP; for the rest of PFP there are no significant differences with small companies.

Differences by year are substantial, but do not follow a uniform pattern. The incidence of productivity PFP is lowest in 2015, reaching the maximum in 2000. For team PFP, the widest diffusion took place in 2005 and 2010, descending in 2015 to levels lower than those existing in 2000. Both company PFP and income from shares have grown in presence in the period, especially until 2010.

In spite of the positive sign of the coefficient, the frequency of computer use is found to have a significant but small effect on productivity PFP, when adding the variables on work organization. The frequency of computer use is positively associated to the inclusion of team PFP in earnings and to a greater likelihood of company PFP. Finally, computer use also affects positively the incidence of payments based in income from shares in the firm.

Several job design variables emerge as significant in the different models in Table 3. Nonetheless, it is worth mentioning that their explanatory power is lower when income from shares payments is analyzed. For example, as expected, the requirement of meeting precise quality standards in the job, is positively related to productivity PFP, team PFP and company PFP. The frequency of interruptions while doing a task is negatively related to the incidence of productivity PFP and displays no association with the other PFP schemes. In addition, when the employee must solve unforeseen problems on her own, she is more likely to be paid according to company performance. Monotonous jobs are more suitable to piece rate or productivity payments, but complex jobs display a higher incidence of team PFP, company PFP and income from shares. Job autonomy in determining the order of tasks is negatively related to productivity PFP. On the other hand, autonomy to change work methods is positively associated to productivity PFP, whereas autonomy to set the speed of work is positively related to productivity, team and company PFP. When work is organized around groups or teams with common tasks that can plan its work, there is a higher probability of payment by team and company results and income from shares. Finally, on the job training received by the employee shows a positive link with the four PFP schemes analysed.

A binary mediation test was carried out to exam the significance of the mediation effect of the job variables in the influence of computers on PFP adoption. Table 6 summarizes the results from these test. In fact, these results provide evidence to support the hypothesis that job practices act as mediators in the relationship between the use of information and communication technologies and pay for performance in the four schemes examined. Setting quality standards, job complexity, teams and on the job training were significant mediators for all types of PFP. Interruptions was significant for the four types but company PFP; autonomy to solve unforeseen problems for all but income form shares and order autonomy for all but team PFP. The indirect effect was also significant for job monotony and company PFP and income from shares; and speed autonomy for productivity and company PFP. Finally, method autonomy dis not display any significant effect. Notwithstanding this, the total indirect effect was significant in the four models.

INSERT TABLE 4 ABOUT HERE

Robustness checks

One potential problem with the estimations above could be that computer use is positively correlated to unobservable factors that have an impact on the probability that the employee is paid according to performance. An example of this unobservable factor could be the quality of the management in the firm where the employee works, that could lead to the adoption of both computers and pay for performance. If this were the case, the relationship found between computers and pay for performance should not be interpreted in terms of causality.

One way of controlling for these unobservable factors is allowing the error terms in the different equations to be correlated. In order to control for the potential existence of association between the different pay for performance schemes due to unobserved factors, we have estimated multivariate probit models for the four PFP schemes.

Table 5 shows the coefficients of the computer use and the job design variables if correlation between the error terms is allowed to be different from zero. If compared to findings in Table 3, there are very slight differences in the significance of the coefficients and their magnitude is very similar. The only changes are that in multivariate estimations positive associations emerge between quality standards and income from shares and autonomy to choose work methods and team PFP. In addition, the autonomy to solve unforeseen problems is not correlated with company PFP but is positively linked to team PFP incidence.

This similarity of results happens in spite of significant positive correlations between the error terms in the different equations. The largest correlation was found for company PFP and income from shares, followed by the correlation between team PFP with company PFP and income from shares. The smallest correlation was that between productivity and team PFP. These results suggest that to a certain extent the different PFP schemes tend to be adopted simultaneously.

Another potential problem with our results on the influence of computers on pay for performance has to do with the possibility of reverse causality, that is, that the coefficients of the computer variable are biased because they also capture a possible effect of pay for performance on computer use. We consider there are theoretical explanations that could justify this reverse association. Pay for performance requires measures that evaluate precisely and as completely as possible the performance of the employee. One possible method to improve the process of collecting data about employee performance can be the introduction of computer technologies in the job, so that they are used as a device of controlling performance. As a consequence, there would be a causality relationship from pay for performance to computer in the job.

This reverse causality problem is expected to be more relevant in the analysis of individual PFP since performance at this level demands more resources and efforts at the employee level. In collective PFP schemes measures are taken at the organizational level from variables such as profits or cost savings that do not demand performance to be measured for each employee and, therefore, make computers for individuals not no necessary.

In order to deal with this potential problem, we have used instrumental variables estimations. More concretely, the computer use variables has been instrumented with a variable capturing ICT infrastructure in the region where the employee works. This variable is the percentage of households with access to the internet at home. The information is provided by Eurostat (2019) at regional level in the EU-27 at the second disaggregation level according to the *Nomenclature d´Unité Territoriales Statistiques* (NUTs2) defined by Eurostat, with the exception of Germany, Greece, France, Poland and the UK, where available information is at NUTS1 level for the period under analysis.

According to the results of the tests of exogeneity, it can be concluded that there is not endogeneity problems in the cases of company incentives and incentives in shares, which confirms that the results are consistent (β=0.26*; Wald test: chi2(1)=1.21; Prob>chi2=0.27 for company incentives and β=0.14; Wald test: chi2(1) =0.14; Prob > chi2=0.7092 in the case of incentives in shares). Piece-rate and team incentives present endogeneity. Nevertheless, the sign of the use of incentives is also positive and significant in both cases (β=0.38***; Wald test: chi2(1)=12.25; Prob>chi2=0.0005 for piece-rate incentives and β=0.34**; Wald test: chi2(1) =4.13; Prob > chi2=0.0421 in the case of team incentives).

Differences by occupational groups

Table 6 shows the results of the probit estimations for four different occupational groups. We follow the classification made by Holman and Rafferty (2018), so that non-routine clerical occupations include ISCO 1 (Legislators, senior officials and mangers), ISCO2 (professionals) and ISCO3 (technicians); routine clerical occupations, ISCO4 (clerks) and ISCO5 (service and sales); non-routine manual occupations, ISCO7 (craft and related trades); and routine manual occupations, ISCO6 (skilled agricultural and fishery), ISCO 8 (plant and machine operators) and ISCO 9 (elementary occupations).

The estimations of the impact of computer use on productivity PFP differ substantially between occupations. Computers use is negatively related to the incidence of this scheme for non-routine clerical employees but positively for both routine clerical and manual occupations. No effect is found for non-routine manual occupations. Among the work organization variables only meeting precise quality standards is positively related to productivity PFP in the four subsamples, whereas job complexity and autonomy to set work pace lack significance in all cases. The frequency of interruptions is negatively associated for all the occupational groups but non-routine manual. Job monotony has a positive coefficient for non-routine manual employees and autonomy to solve unforeseen problems a negative one for non-routine clerical.

Autonomy to choose methods of work and on the job training have positive effects for clerical occupations. Autonomy to determine the order of tasks and on the job training are influential for manual jobs; the first negatively and the second positively.

For team PFP the positive impact of computer use is positive for manual occupations and non-significant for clerical. Teams and on the job training are the only variables with a positive effect on team PFP for the four occupational groups, whereas there is no effect for any occupation for frequency of interruptions, autonomy to solve unforeseen problems and order tasks and job monotony. Both the existence of quality standards to be met and autonomy for work methods have a positive effect in the non-routine clerical group. Job complexity is associated to higher incidence of team PFP for all occupational groups but non-routine manual and the autonomy to choose the rate of work has a negative effect for routine clerical.

The results for company PFP find a consistent positive effect of computer use across all occupational groups. As happened for team PFP, teams and on the job training are the only variables positively affecting pay for performance for the four occupational groups. Job monotony and autonomy to set task order lack significant effects in all occupations. Job complexity and frequency of interruption influence positively team PFP for routine clerical jobs. The positive effect of autonomy to solve unforeseen problems emerge for non-routine occupations, whereas in the case of quality standards this exists for routine occupations. Moreover, autonomy to choose work methods shows a positive association with team PFP in non-routine clerical occupations; the effects of autonomy in setting pace are negative in the non-routine manual group.

Finally, computer use is associated positively to income from shares schemes for all the groups except non-routine clerical. There is no variable with significant effects for the four subsamples. However, there is coincidence in absence of significance for frequency of interruptions, job monotony and autonomy to solve unforeseen problems, task order and method of work. The existence of quality standards to be met is positively related to income from shares for routine occupations, whereas a relationship of the same sign is found for job complexity in non-routine clerical positions. On the other hand, autonomy to choose speed has a negative influence for routine clerical and a positive for non-routine manual. Teams are positively related for routine clerical and on the job training for non-routine manual.

5. Conclusions

This paper has analyzed the of computer based technologies on four incentive programs linking pay to performance: piece rate, team PFP, company PFP and income from shares. Empirical analyses are based on the third, fourth, fifth and sixth waves of the European Working Conditions Survey (Eurofound, 2016).

Main findings show a significant effect of computer use on pay for performance incidence across Europe. This relationship is strong for the three collective PFP schemes considered in the paper. The use of computers in a job make more likely that earnings received by the workers depend on team performance, company performance and income form shares. However, the results are unclear for piece rate and productivity pay for performance, so that the existence of a general effect of computers on its incidence cannot be confirmed.

According to the results obtained, job characteristics play a mediator role in the relationship between information and communication technology and PFP. This holds especially when quality standards must be met, the job is complex, work is organized around teams and the workers receives on the job training.

Finally, the effect of computers on PFP differs by occupational group. This positive influence is larger for manual occupations than for clerical occupations and for routine than non-routine jobs.

TABLE 1. Descriptive statistics

Variable		Mean	SD
Payments for Performance			
Piece-rate	Thinking about your earnings from your main job, what do they include? Piece rate or productivity payments (yes=1; no=0)	.126	.323
Team performance	Thinking about your earnings from your main job, what do they include? Payments based on the performance of your team/working group/department (yes=1; no=0)	.187	.390
Company performance	Thinking about your earnings from your main job, what do they include? Payments based on the overall performance of the company (profit sharing scheme) where you work (yes=1; no=0)	.107	.310
Income from shares	Thinking about your earnings from your main job, what do they include? Income from shares in the company you work for (yes=1; no=0)	.024	.153
Use of ICTs	Frequency of use: 1-never to 7-always	3.289	2.421
Job practices			
Achieving precise quality standards	Yes=1; no=0	.714	.452
Interruptions	Frequency of interruptions of a task in order to take on unforeseen tasks: 1-never to 7-always	2.198	0.976
Solving unforeseen problems	Yes=1; no=0	.810	.392
Conducting monotonous tasks	Yes=1; no=0	.444	.497
Conducting complex tasks	Yes=1; no=0	.591	.492
Autonomy to order tasks	Yes=1; no=0	.669	.470
Autonomy to choose the methods of	Yes=1; no=0	.679	.467

work			
Autonomy to choose speed of work	Yes=1; no=1	0.722	0.448
Having common tasks in groups and planning their work	Yes=1; no=0	.575	.494
On the job training	Yes=1; no=0	0.322	0.467
Control variables			
Gender	Male=1; Female=0	.521	.499
Age		42.067	12.084
Seniority	Number of years working for the current company	9.873	9.838
Size of the company	1=self-employed; 5=more than 250 employees	2.633	.889
Occupation	4 occupational categories included		
Country	27 European countries included		
Activity	4 categories from NACE included		

TABLE 2. Correlations matrix for computer use and job variables

	Use of ICTs	Interruptions	Quality standards	Solving unforeseen problems	Job monotony	Job complexity	Order autonomy	Method autonomy	Team	On the job training
Interruptions	0.049									
Quality standards	0.260	0.086								
Solving unforeseen problems	0.196	0.147	0.194							
Job monotony	-0.085	0.086	-0.007	-0.036						
Job complexity	0.266	0.202	0.224	0.287	-0.016					
Order autonomy	0.208	-0.011	0.160	0.242	-0.108	0.162				
Method autonomy	0.144	-0.012	0.126	0.250	-0.124	0.158	0.580			
Speed autonomy	0.113	-0.005	0.068	0.185	-0.064	0.119	0.493	0.516		
Team	0.087	0.129	0.167	0.068	-0.006	0.153	-0.011	-0.010	-0.021	
On the job training	0.185	0.079	0.123	0.082	-0.038	0.136	0.028	0.020	0.011	0.191

All correlations are significant at the p<0.001 level

TABLE 3. Probit estimations of Pay for Performance schemes on Computer Use

	Productivity PFP		**Team PFP**		**Company PFP**		**Income from shares**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Constant	-1.030***	-1.119***	-1.079***	-1.543***	-1.232***	-1.774***	-1.954***	-2.215***
	(0.115)	(0.125)	(0.117)	(0.125)	(0.139)	(0.152)	(0.205)	(0.224)
Men	0.146***	0.146***	0.229***	0.203***	0.281***	0.254***	0.287***	0.272***
	(0.028)	(0.026)	(0.022)	(0.022)	(0.026)	(0.027)	(0.405)	(0.041)
Age	-0.014	-0.001	-0.008***	-0.007***	-0.003**	-0.002	0.001	0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
Seniority	0.000	-0.000	0.117***	-0.102***	0.010***	0.009***	0.104***	0.009***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
Professionals	-0.232***	-0.257***	-0.129**	-0.138**	-0.281***	-0.276***	-0.226**	-0.230**
	(0.062)	(0.063)	(0.053)	(0.053)	(0.055)	(0.056)	(0.077)	(0.350)
Technicians	-0.039	-0.061	-0.154**	-0.138**	-0.302***	-0.281***	-0.361***	-0.349***
	(0.059)	(0.060)	(0.508)	(0.051)	(0.052)	(0.052)	(0.072)	(0.072)
Clerical	-0.224***	-0.237***	-0.317***	-0.247***	-0.501***	-0.423***	-0.318***	-0.267**
	(0.062)	(0.062)	(0.053)	(0.054)	(0.054)	(0.054)	(0.077)	(0.077)
Service and sales	-0.244***	-0.252***	-0.273***	-0.215***	-0.591***	-0.523***	-0.452***	-0.405***
	(0.060)	(0.061)	(0.054)	(0.054)	(0.057)	(0.058)	(0.084)	(0.086)
Craft	0.059	0.013	-0.304***	-0.280***	-0.635***	-0.605***	-0.579***	-0.574***
	(0.061)	(0.062)	(0.058)	(0.054)	(0.060)	(0.061)	(0.088)	(0.090)
Operators	0.076	0.038	-0.177**	-0.090	-0.447***	-0.344***	-0.574***	-0.532***
	(0.063)	(0.064)	(0.058)	(0.059)	(0.061)	(0.062)	(0.087)	(0.090)
Elementary	-0.137**	-0.158**	-0.443***	-0.347***	-0.686***	-0.577***	-0.601***	-0.551***

occupations	(0.062)	(0.063)	(0.058)	(0.059)	(0.063)	(0.064)	(0.088)	(-0.084)
Manufacturing	0.021	0.007	0.109	0.116	-0.104	-0.009	-0.165	-0.166
	(0.070)	(0.070)	(0.084)	(0.085)	(0.095)	(0.097)	(0.138)	(0.140)
Private services	-0.089	-0.089	0.121	0.149*	-0.087	-0.072	-0.126	-0.112
	(0.070)	(0.070)	(0.083)	(0.084)	(0.093)	(0.095)	(0.137)	(0.139)
Public services	-0.411***	-0.413***	0.009	0.002	-0.921***	-0.953***	-0.775***	-0.782***
	(0.073)	(0.073)	(0.083)	(0.084)	(0.096)	(0.099)	(0.145)	(0.147)
2-9 workers	0.006	0.003	0.029	0.036	-0.028	-0.022	-0.018	-0.012
	(0.041)	(0.041)	(0.035)	(0.034)	(0.043)	(0.043)	(0.0616)	(0.061)
10-249 workers	-0.003	-0.004	0.077**	0.087**	-0.037	-0.029	-0.020	0.026
	(0.038)	(0.039)	(0.033)	(0.033)	(0.0417)	(0.041)	(0.058)	(0.058)
250 or over workers	-0.023	-0.023	0.084**	0.093**	-0.056	-0.048	-0.012	-0.006
	(0.044)	(0.044)	(0.039)	(0.039)	(0.047)	(0.048)	(0.067)	(0.067)
2005	-0.101**	-0.125***	0.604***	0.596***	-0.050	-0.067	0.086	0.068
	(0.045)	(0.046)	(0.043)	(0.043)	(0.056)	(0.056)	(0.109)	(0.110)
2010	-0.048	-0.085**	0.534***	0.505***	0.205***	0.173**	0.300**	0.282**
	(0.042)	(0.042)	(0.408)	(0.041)	(0.052)	(0.052)	(0.103)	(0.105)
2015	-0.121***	-0.158***	-0.143**	-0.191***	0.202***	0.162**	0.406***	0.379***
	(0.043)	(0.043)	(0.043)	(0.043)	(0.052)	(0.053)	(0.105)	(0.105)
Computer use	0.011	0.010*	0.040***	0.025***	0.089***	0.073**	0.049***	0.039***
	(0.006)	(0.006)	(0.005)	(0.006)	(0.006)	(0.030)	(0.009)	(0.010)
Quality standards		0.189***		0.068**		0.078**		0.067
		(0.029)		(0.024)		(0.030)		(0.047)
Interruptions		-0.050***		0.007		0.010		0.008

		(0.014)		(0.011)		(0.014)		(0.020)
Solving unforeseen problems		-0.047		0.047		0.097**		-0.167
		(0.031)		(0.029)		(0.037)		(0.057)
Job monotony		0.050**		0.009		-0.007		-0.028
		(0.025)		(0.021)		(0.026)		(0.039)
Job complexity		-0.003		0.094***		0.065**		0.121**
		(0.027)		(0.024)		(0.029)		(0.046)
Order autonomy		-0.077**		0.108		0.040		-0.012
		(0.030)		(0.027)		(0.034)		(0.053)
Method autonomy		0.064**		0.046		0.043		0.040
		(0.030)		(0.026)		(0.032)		(0.052)
Speed autonomy		0.066**		0.076**		0.117***		0.043
		(0.029)		(0.026)		(0.027)		(0.050)
Team		0.037		0.157***		0.130***		0.071*
		(0.025)		(0.022)		(0.027)		(0.041)
On the job training		0.133***		0.231***		0.257***		0.117**
		(0.025)		(0.022)		(0.026)		(0.040)
Country	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Chi-2	2,948.26***	3064.94***	2,491.65***	2,760.59***	2,704.28***	2877.86***	766.30***	808.03***
Pseudo R	0.111	0.117	0.096	0.108	0.165	0.179	0.129	0.134
N	68,167	68,167	68,130	68,130	68,055	68,055	68,046	68,046

Standard errors in brackets.
* p< .10; ** p< .05; *** p< .01

TABLE 4. Bootstrap results for indirect effects

	Productivity PFP		Team PFP		Company PFP		Income from shares	
	Lower bound	**Upper bound**	**Lower bound**	**Upper bound**	**Lower bound**	**Upper bound**	**Lower bound**	**Upper bound**
Quality standards	0.0043	0.0067	0.0008	0.0021	0.0012	0.0028	0.0013	0.0045
Interruptions	-0.0241	-0.0171	0.0014	0.0075	-0.0001	0.0066	0.0016	0.0147
Solving unforeseen problems	-0.0137	-0.0057	0.0048	0.0129	0.0081	0.0189	-0.0001	0.0215
Job monotony	-0.0078	-0.0050	0.0001	0.0021	-0.0013	0.0009	-0.0050	0.0001
Job complexity	0.0069	0.0148	0.0147	0.0220	0.0159	0.0249	0.0183	0.0379
Order autonomy	-0.0197	-0.0116	-0.0048	0.0028	0.0054	0.0150	0.0015	0.0206
Method autonomy	-0.0034	0.0022	-0.0018	0.0035	-0.0042	0.0020	-0.0024	0.0109
Speed autonomy	0.0058	0.0108	-0.0001	0.0044	0.0023	0.0079	-0.0051	0.0045
Team	0.0009	0.0028	0.0044	0.0067	0.0031	0.0054	0.0005	0.0050
On the job training	0.0045	0.0094	0.0138	0.0182	0.0169	0.0224	0.0040	0.0152
Total indirect	-0.0265	-0.0136	0.0517	0.0633	0.0694	0.0837	0.0589	0.0904
Direct effect	-0.1044	-0.0765	0.0366	0.0590	0.1838	0.2118	0.1890	0.2415
Total effect	-0.1227	-0.0969	0.0940	0.1145	0.2599	0.2855	0.2627	0.3125

95% bias-corrected confidence intervals

TABLE 5. Multivariate Probit estimations of Pay for Performance schemes on Computer Use

	Productivity PFP	**Team PFP**	**Company PFP**	**Income from shares**	**Productivity PFP**	**Team PFP**	**Company PFP**	**Income from shares**
Computer use	0.116*	0.040***	0.090***	0.052***	0.011*	0.025***	0.074***	0.042***
	(0.006)	(0.005)	(0.006)	(0.009)	(0.006)	(0.006)	(0.006)	(0.009)
Quality standards					0.188***	0.069**	0.092**	0.093**
					(0.029)	(0.024)	(0.030)	(0.045)
Interruptions					-0.048**	0.005*	0.009	0.004
					(0.014)	(0.012)	(0.038)	(0.020)
Solving unforeseen problems					-0.040	0.049*	0.094	-0.042
					(0.032)	(0.029)	(0.038)	(0.057)
Job monotony					0.050**	0.014	-0.002	-0.031
					(0.032)	(0.021)	(0.026)	(0.039)
Job complexity					-0.009	0.095***	0.062**	0.124**
					(0.027)	(0.024)	(0.030)	(0.047)*
Order autonomy					-0.069**	-0.002	0.048	0.013
					(0.031)	(0.027)	(0.034)	(0.053)
Method autonomy					0.067**	0.050*	0.414	0.028
					(0.031)	(0.027)	(0.032)	(0.054)
Speed autonomy					0.057*	0.083**	0.119***	0.030
					(0.029)	(0.026)	(0.032)	(0.049)
Team					0.035	0.155***	0.125***	0.074*
					(0.025)	(0.022)	(0.027)	(0.039)

On the job training		0.133*** (0.025)	0.234*** (0.021)	0.248*** (0.026)	0.104*** (0.040)
Rho productivity/team	0.154*** (0.014)	0.148***			
Rho productivity/company	0.204*** (0.164)	0.199***			
Rho productivity/shares	0.191*** (0.023)	0.1878***			
Rho team/company	0.337*** (0.015)	0.320***			
Rho team/shares	0.272*** (0.022)	0.263***			
Rho company/shares	0.531*** (0.019)	0.527***			
Chi-2	8,103.75***	8,688.9***			
N	67,473	67,473			

Standard errors in brackets. Control variables included
* p< .10; ** p< .05; *** p< .01

TABLE 6. Probit estimations of Pay for Performance schemes on Computer Use by occupations

	Productivity PFP				Team PFP			
	Non-routine clerical	**Routine clerical**	**Non-routine manual**	**Routine manual**	**Non-routine clerical**	**Routine clerical**	**Non-routine manual**	**Routine manual**
Constant	-1.268***	-1.556***	-1.521***	-1.152***	-1.728***	-1.484***	-1.728***	-1.707***
	(0.256)	(0.238)	(0.315)	(0.209)	(0.199)	(0.228)	(0.300)	(0.234)
Computer use	-0.026**	0.021**	0.004	0.056***	-0.004	0.106	0.089***	0.081***
	(0.010)	(0.009)	(0.020)	(0.015)	(0.008)	(0.008)	(0.018)	(0.015)
Quality standards	0.167**	0.176**	0.250**	0.195***	0.065*	0.036	0.142	0.075
	(0.052)	(0.053)	(0.096)	(0.054)	(0.038)	(0.042)	(0.100)	(0.053)
Interruptions	-0.046*	-0.058**	-0.027	-0.068**	0.008	0.012	0.024	-0.000
	(0.025)	(0.027)	(0.035)	(0.028)	(0.018)	(0.021)	(0.034)	(0.028)
Solving unforeseen problems	-0.144*	-0.056	0.053	0.015	0.022	0.041	0.027	0.079
	(0.074)	(0.055)	(0.072)	(0.055)	(0.056)	(0.052)	(0.075)	(0.055)
Job monotony	0.030	0.005	0.107*	0.056	-0.010	0.061	-0.017	0.032
	(0.048)	(0.045)	(0.057)	(0.048)	(0.036)	(0.039)	(0.055)	(0.047)
Job complexity	0.045	-0.052	0.003	0.053	0.106**	0.150***	-0.026	0.111**
	(0.053)	(0.049)	(0.066)	(0.050)	(0.041)	(0.042)	(0.065)	(0.050)
Order autonomy	-0.028	0.046	-0.121*	-0.162**	0.070	0.013	-0.009	-0.046
	(0.063)	(0.052)	(0.062)	(0.059)	(0.047)	(0.047)	(0.065)	(0.059)
Method autonomy	0.153**	0.110**	0.007	0.058	0.088**	0.040	0.076	0.002

	(0.058)	(0.055)	(0.065)	(0.060)	(0.044)	(0.046)	(0.068)	(0.060)
Speed autonomy	0.047	0.001	-0.059	0.015	-0.037	-0.057*	0.018	-0.043
	(0.032)	(0.036)	(0.044)	(0.048)	(0.026)	(0.030)	(0.050)	(0.053)
Team	-0.003	-0.047	0.124**	0.086*	0.122***	0.229***	0.199**	0.122**
	(0.048)	(0.045)	(0.061)	(0.048)	(0.037)	(0.039)	(0.060)	(0.047)
On the job training	0.142***	0.229***	0.124	0.068	0.229***	0.224***	0.186***	0.256***
	(0.044)	(0.047)	(0.059)	(0.052)	(0.033)	(0.040)	(0.061)	(0.050)
Chi-2	1020.04***	702.25***	716.29***	859.68***	1,030.35***	885.60***	379.64***	807.04***
Pseudo R	0.133	0.109	0.098	0.118	0.101	0.115	0.089	0.135
N	25,163	20,178	8,737	14,458	25,170	20,166	8,721	14,440

Standard errors in brackets. Control variables included
* p< .10; ** p< .05; *** p< .01

TABLE 6 (continued). Probit estimations of Pay for Performance schemes on Computer Use by occupations

	Company PFP				Income from shares			
	Non-routine clerical	**Routine clerical**	**Non-routine manual**	**Routine manual**	**Non-routine clerical**	**Routine clerical**	**Non-routine manual**	**Routine manual**
Constant	-0.203***	-2.510***	-2.409***	-2.430***	-1.936***	-2.799***	-2.768***	-3.508***
	(0.233)	(0.308)	(0.358)	(0.290)	(0.337)	(0.503)	(0.504)	(0.494)
Computer use	0.050***	0.078***	0.098***	0.114***	0.020	0.036**	0.077**	0.095***
	(0.010)	(0.009)	(0.019)	(0.016)	(0.015)	(0.016)	(0.025)	(0.020)
Quality standards	-0.137	0.118**	0.196	0.205**	-0.090	0.293***	-0.234	0.231**
	(0.047)	(0.049)	(0.121)	(0.066)	(0.069)	(0.076)	(0.157)	(0.107)
Interruptions	0.015	0.041*	-0.001	-0.026	-0.018	0.054	0.026	0.041
	(0.022)	(0.024)	(0.042)	(0.035)	(0.031)	(0.034)	(0.064)	(0.046)
Solving unforeseen problems	0.153**	0.067	0.195**	0.065	0.045	-0.059	-0.249	0.026
	(0.068)	(0.065)	(0.092)	(0.072)	(0.102)	(0.095)	(0.162)	(0.111)
Job monotony	-0.007	-0.045	0.005	0.054	-0.090	0.008	-0.103	0.068
	(0.044)	(0.047)	(0.066)	(0.058)	(0.065)	(0.072)	(0.092)	(0.087)
Job complexity	0.059	0.118**	-0.010	0.061	0.237**	0.028	0.146	0.110
	(0.051)	(0.050)	(0.082)	(0.061)	(0.079)	(0.087)	(0.121)	(0.088)
Order autonomy	0.100	0.071	0.102	0.019	-0.081	0.037	0.175	-0.133
	(0.061)	(0.059)	(0.077)	(0.070)	(0.090)	(0.090)	(0.125)	(0.101)
Method autonomy	0.136**	0.053	-0.008	5143	0.116	-0.077	0.179	-0.000
	(0.054)	(0.058)	(0.081)	(0.068)	(0.082)	(0.093)	(0.134)	(0.105)

Speed autonomy	-0.041	-0.027	-0.130**	0.052	-0.002	-0.230**	0.185**	-0.119
	(0.036)	(0.039)	(0.062)	(0.051)	(0.042)	(0.083)	(0.078)	(0.058)
Team	0.083*	0.126**	0.226**	0.153**	-0.008	0.127*	0.116	0.092
	(0.045)	(0.047)	(0.078)	(0.057)	(0.061)	(0.073)	(0.119)	(0.091)
On the job training	0.233***	0.190***	0.333***	0.287***	0.031	0.105	0.268**	0.226
	(0.040)	(0.047)	(0.070)	(0.060)	(0.059)	(0.077)	(0.112)	(0.086)
Chi-2	1416.81***	757.79***	465.99***	659.48***	451.01***	310.08***	147.17***	200.81***
Pseudo R	0.206	0.151	0.122	0.172	0.149	0.131	0.117	0.167
N	25,144	20,145	8,720	14,411	25,128	20,141	8,347	13,862

Standard errors in brackets. Control variables included
* p< .10; ** p< .05; *** p< .01

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