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Computer use and pay for performance

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Abstract

Workplace digitalisation is a pervasive phenomenon associated to an increase in wage differentials between occupations. This paper analyses the relationship between computer use and pay for performance, whose incidence has also followed a positive growth pattern. More concretely, we examined three pay-for-performance schemes: productivity/piece rate, team and firm pay for performance. We also investigated the mediating role of job design in this relationship. The complementarity framework perspective and the economic theory of incentives were the theoretical approaches applied in the development of hypotheses. Data from four waves of the European Working Conditions Survey were used in the empirical analyses. A positive association was found between computer use and the three pay for performance schemes considered, particularly team and firm pay for performance. The results also indicated that this relationship was partially explained by changes in job design due to computerisation, such as higher job complexity, on-the-job training and teamwork.

KEYWORDS
computer, ICTs, incentive pay, job design, payment by results, performance related pay

Abbreviations: EWCS, European Working Conditions Survey; GDP, Gross Domestic Product; H, hypothesis; HRM, human resource management; ICTs, information and communication technologies; ISCO08, International Standard Classification of Occupations; IT, information technology; PFP, pay for performance; SBTC, skill-biased technical change; UK, United Kingdom.

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Practitioner Notes

What is currently known?

- The growing incidence of computer use and pay for performance is a trend across firms and occupations
- Digitalisation has a substantial impact on job design
- Job design is key in determining the suitability of pay for performance (PFP) as a motivation device

What this paper adds?

- A focus on the understudied implications of computers in the incidence of PFP
- A conceptual model integrating the complementarity framework perspective and the economic theory of incentives to explain the relationship between computers and PFP
- Empirical evidence revealing a positive association between computers and the use of PFP, particularly team and firm PFP
- Proving that job design variables mediate the positive association between computers and PFP

The implications for practitioners

- The effects of computers on job design require the adaptation of PFP practices to the new technological context
- When adopting information technologies, managers should evaluate the potential implications for employee attitudes and welfare derived from the modification of job design and pay practices
- Integration mechanisms between public policies promoting the adoption of IT and public policies that foster the diffusion of financial participation in firms should be developed

1 | INTRODUCTION

The adoption of information and communication technologies (ICTs) has had substantial consequences in the modern workplace. The use of computers, defined as jobs involving working with computers, is a trend seen across all occupations (Menon et al., 2020), because digitalisation allows both process flexibility and product personalisation. In line with this idea, early analyses have already shown (e.g., Bresnahan et al., 2002), that computers have a positive impact on firm productivity and performance.

These effects of computerisation at the firm level have come together with pervasive implications for jobs and employment. Empirical studies have identified how computer use within firms has not only affected the task content of jobs (Venkatesh et al., 2010), but also the labour demand for different occupations (Kristal, 2020). Some recent studies have gone beyond job characteristics and employment levels to analyse other key elements of the employment relationship and HRM, such as pay level or employee voice (Green, 2012). More concretely, empirical evidence points to an associated increase in wage differentials among different occupations within firms, derived from digitalisation (Böckerman et al., 2019), and a positive link between computer use and employee involvement practices (Bayo-Moriones et al., 2017).

Within this line of research about the implications of ICTs for work (Kim et al., 2021), our study examines the connection with pay for performance (PFP). More specifically, the research objective of the paper is twofold. First, we analysed the influence of computer use on the incidence of three different PFP schemes: piece rate/productivity PFP, team PFP and company PFP. Second, we investigated the role of job design in the relationship between computer use and PFP. There are strong theoretical arguments that support the existence of a potential relationship between computer use and PFP that takes place through job design. The complementarity framework approach (Milgrom & Roberts, 1990) establishes that computers increase information availability for workers, lead-

ing to the adoption of job design practices such as job autonomy, teams or task variety (Bayo-Moriones et al., 2017; Menon et al., 2020). This perspective is closely connected to the theory of skill-biased technical change (SBTC; Autor et al., 2003; Autor & Dorn, 2013), because it involves an increase in demand for skills. Simultaneously, these job practices are proposed by the economic theory of incentives as key factors in firm decisions about PFP adoption (Prendergast, 1999). Job design thus appears both to be affected by computers and to determine PFP use. We developed our analysis at the employee level using information provided by the European Working Conditions Survey from 2000 to 2015.

This paper contributes to the literature by widening the scope of research on the HRM implications of computerisation through the analysis of the link between computer use and PFP. A conceptual model integrating the complementarity framework perspective and the economic theory of incentives was developed to explain this relationship. This makes it possible to obtain a more complete perspective on how computers are affecting the incidence of HRM practices by highlighting the mediating role of job design in their influence on PFP incidence. This is particularly relevant because both computers and PFP have been found to have a substantial impact on firm performance and employee welfare (Ogbonnaya et al., 2017; Sung et al., 2017; Wang et al., 2020). Our study will also help to improve our understanding of the increasing adoption of PFP within European firms (Eurofound 2016) in a period that coincides with the growing use of computers.

2 | THEORETICAL FRAMEWORK AND HYPOTHESES DEVELOPMENT

In this section, we theoretically examine the association between computer use and PFP by highlighting the role of job design within this relationship. This involves examining the implications of computers for job design and the relevance of job design in the use of different types of PFP.

Our hypotheses will be grounded on two theoretical approaches. The complementarity framework perspective will be the theoretical foundation for the hypotheses linking computer use and job design, whereas the economic theory of incentives will be the theoretical framework for the association between job design and PFP.

The complementarity framework perspective (Milgrom & Roberts, 1990) indicates that the use of computers increases the attractiveness of certain job design characteristics (Bayo-Moriones et al., 2017). More specifically, the greater information available to employees brought about by computers promotes more flexible methods of work, decentralisation and teamwork since they are enabled to complete whole processes that used to be fragmented (Bresnahan et al., 2002). This is linked to the SBTC theory (Autor et al., 2003; Autor & Dorn, 2013) in that the new work practices demand more high-level skills.

On the other hand, the development of the hypotheses relating job design and PFP is based on the economic theory of incentives, where agency theory plays a central role (Gibbs et al., 2009; Kauhanen & Napari, 2012; Prendergast, 1999). This theoretical approach aims to explain the conditions under which PFP is an efficient incentive mechanism to elicit effort from employees as compared to alternatives such as direct control and dismissal threat or promotion (Marsden & Belfield, 2010). This personnel economics literature highlights the importance of the fit of PFP within the work context, so that aspects such as risk or costs of output and input monitoring, which are closely related to the characteristics of job design, determine the convenience of using PFP schemes (DeVaro & Kurtulus, 2010).

Several dimensions of the work contexts on which computer use might have an influence have been identified in the literature as explanatory variables of PFP use (Bayo-Moriones et al., 2013): the measurability of performance, controllable risk, uncontrollable risk, the firm value of job performance and teamwork. Figure 1 summarises the conceptual model that will be used as the framework for the development of hypotheses and the empirical analysis. Next, we explain how computer use might affect each of the job design dimensions and their effect on the suitability of PFP schemes as incentive mechanisms.

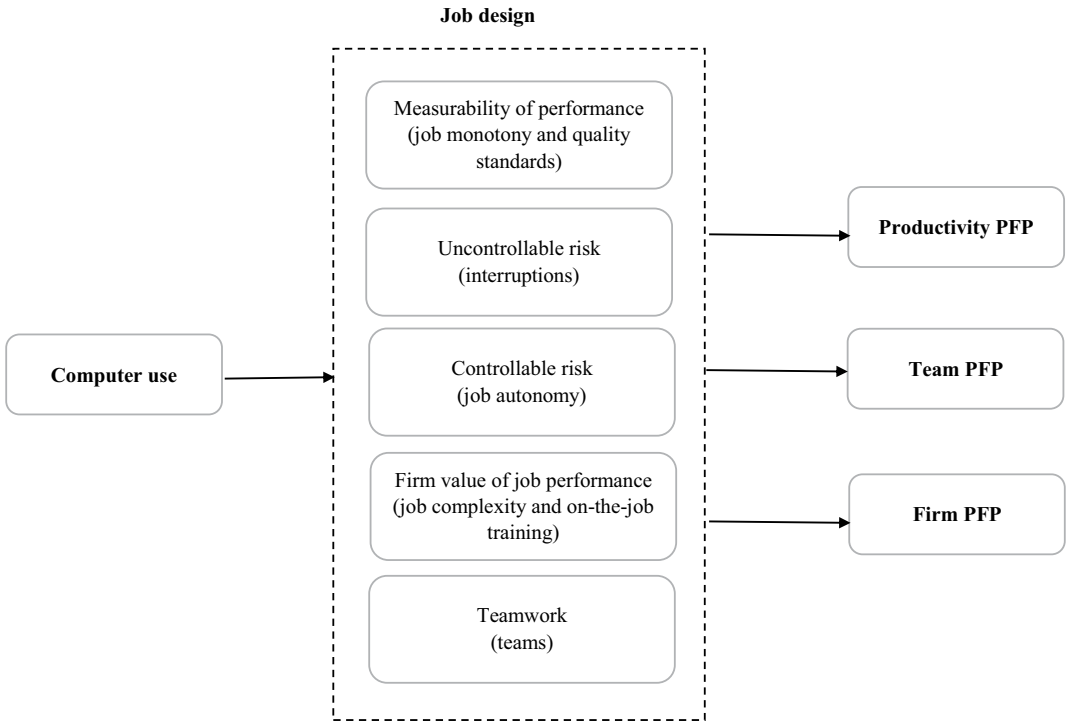

FIGURE 1 Theoretical framework: Conceptual model. PFP, pay for performance

2.1 | Measurability of performance

This variable refers to whether it is possible to obtain a reliable and valid measure of performance. Consequently, it is related to the costs and difficulties associated with measuring output compared to the costs of input measuring. The economic theory of performance measurement in incentive plans (Kauhanen & Napari 2012) highlights that the measurability of performance is relevant mainly at the individual and, to a lesser extent, team levels, because at the organisational level performance measures such as profit, revenues or costs are not as difficult to obtain.

The costs of monitoring individual input and output are strongly related to task variety or the number of tasks in the job. A related concept is job monotony, which refers to tasks characterised by repetitiveness or lack of variety (Tsai, 2016). The higher the level of job monotony, the easier it is for the firm to observe the effort put in by the worker (Ben-Ner & Urtasun, 2013). However, it is also easier to determine precise standards against which the performance of the workers is assessed, so it facilitates more accurate measurements of performance dimensions such as productivity and quality.

Another important implication of job monotony for performance measurability is related to distortion. This refers to circumstances in which worker decisions have different effects on the performance measure and firm value (Kauhanen & Napari 2012). When there are several tasks required in a job, performance measures are more likely to be distorted because their weights misallocate the efforts of workers across different tasks, as captured in the multi-task agency model (Hölmstrom & Milgrom, 1991). When several tasks must be rewarded, it is difficult to find a performance measure that captures the overall contributions of a worker to firm value (Jirjahn & Stephan, 2004). In these cases of low job monotony, performance is multidimensional, and the presence of differences among dimensions in the precision of measurements may lead to workers emphasising the aspects that are better measured, such as the number of units produced as opposed to quality (Prendergast, 1999). When quality is difficult to measure and

quality standards are difficult to define because of high task variety and low job monotony, incentivising productivity becomes counterproductive.

Computers are expected to have an influence on the measurability of job performance because of their effects on the costs of measuring both input and output, as well as on job monotony and the setting of standards. The impact on the cost of output monitoring is straightforward since electronic performance monitoring devices facilitate the measurement of worker outputs (Bhave, 2014). However, computers have also substantially improved the measurability of behaviours and actions through the use of devices such as video, email monitoring, phone tapping or tracking computer content and usage time (Jeske & Santuzzi, 2015). In relative terms, it seems that the positive impact has been stronger on the reduction of input monitoring costs than output monitoring costs since electronic performance monitoring is more oriented toward the accomplishment of the former.

Regarding task variety and the establishment of standards, the complementarity framework perspective suggests that the introduction of computers in the workplace involves new tasks on the job, such as those related to communication and information and the handling of computer equipment and applications (Dewhurst et al., 2003). In this line, SBTC theory indicates that ICTs tend to promote job enlargement because they simplify the workflow and reduce the amount of specialisation needed, thus allowing workers to embrace new tasks (Venkatesh et al., 2010). Bayo-Moriones et al. (2017) have pointed out that ICTs imply greater levels of multitasking behaviour because of the minimisation of spatial and temporal boundaries. This also hinders the establishment of accurate standards in performance dimensions such as quality.

H1a *Computer use is negatively associated with job monotony and quality standards.*

A basic premise of the economic theory of incentives is that the implementation of PFP requires that performance be measured in order to have a metric upon which to determine the earnings received by employees (Bayo-Moriones et al., 2013). The easier and less costly it is to measure output, compared to monitoring input, the more likely it is for PFP to be adopted (Lazear, 1986). The measure must not be subject to potential distortions, so that it adequately captures the contribution of the worker to the firm.

The standard prediction in this theoretical approach is that the more distorted the performance measure, the less individual PFP will be used (Gibbs et al., 2009). When workers are expected to perform different tasks, some of which are difficult to measure, firms will be less likely to offer productivity PFP since the opportunities for task misallocation are larger (Benčič & Norris, 2010). If both quantity and quality are parts of the job, output contingent pay is preferred over input pay if the cost of monitoring quality is low (Lazear, 1986).

These potential problems with productivity PFP when jobs include several tasks do not apply to PFP schemes based on firm performance, since the cost of measuring performance (e.g., cost savings or profits) is not affected by the number of tasks in the jobs. There is less scope for distortion since these measures are more directly related to firm value than individual productivity measures. Therefore:

H1b *Job monotony and quality standards are positively associated with productivity PFP.*
H1c *Job monotony and quality standards are positively associated with team PFP.*
H1d *Job monotony and quality standards are not associated with firm PFP.*

2.2 | Uncontrollable risk

Uncontrollable risk refers to the factors out of the control of workers that affect their performance (Kauhanen & Napari, 2012). Computers are expected to lead to more uncontrollable risks at the job level for those using them as part of their daily duties by generating interruptions in the workflows (Gonzalez & Mark, 2004), but not for the organisation as a whole. Some of these risks have their origins in technical problems. These can be caused either by malfunctioning

hardware or non-functional software; examples are computer crashes, networks going down, unresponsive software or incompatibility problems (Wang et al., 2020). When the technical problem is severe, this can lead to a complete stoppage of activities, whereas in minor setbacks it can cause a deceleration of employees' work speeds. Computer technologies may also generate interruptions in workflows by creating unforeseen tasks (Chesley, 2014). For example, the need to reply to an unexpected amount of incoming emails may create imbalances in the planned workload. Hence:

H2a *Computer use is positively associated with interruptions.*

Risk has been present as an explanatory variable of PFP incidence since the early economic theory of incentives (Hölmstrom, 1979), so that a core prediction of agency theory is a negative trade-off between uncontrollable risks and incentives (He et al., 2014).

PFP thus induces more effort from workers, but in the presence of uncontrollable risks it simultaneously introduces undesired uncertainty in their pay, so they bear a cost associated with it. In order to accept this uncontrollable risk in their earnings, risk-averse employees must be compensated (He et al., 2014). This involves larger labour costs for the company if the intensity and positive motivational effects of PFP are to be maintained (Pepper et al., 2013). Thus, firms react to greater degrees of uncontrollable risk associated to interruptions in production processes by decreasing the amount of PFP (DeVaro & Kurtulus, 2010). Since for workers interruptions take place at the job level, it does not need to be related to firm performance and, as a consequence, should not impact the adoption of firm PFP. Therefore,

H2b *Interruptions are negatively associated with productivity PFP.*
H2c *Interruptions are negatively associated with team PFP.*
H2d *Interruptions are not associated with firm PFP.*

2.3 | Controllable risk

Controllable risk refers to the extent to which workers can respond to uncertainty using their specific knowledge or private information; it is therefore strongly connected to job autonomy (Gibbs, 2012). Unlike uncontrollable risk in situations where employees cannot respond to uncertainty, in a situation of controllable risk they enjoy job autonomy and can respond, so their actions determine the final consequences of the unexpected event for the firm.

In spite of being measured mostly by a single scale, job autonomy has been conceptualised as being formed by several sub-dimensions (Brady et al., 1990). Among the majority of typologies there is consensus that control over work methods and time are two key aspects in job autonomy (DeSpiegelaere et al., 2016). In parallel, in the latter aspect a further distinction between sequence of tasks and work pace can be made (Lopes et al., 2017).

The complementarity framework perspective (Milgrom & Roberts, 1990) points to a positive relationship between computers and job autonomy because they increase information availability. Computers promote knowledge exchange and information flow and provide workers with more inputs to make better decisions. Firms employing decision making from front-line workers are better at using information in production, so this complements IT investments (Hitt & Tambe, 2016). Computerisation reduces information access and processing costs, boosting decentralisation and job autonomy, making workers face more situations where they have the possibility to make decisions (Bloom et al., 2014; Rasel, 2016). Consequently, job autonomy can be provided to workers in order to respond to uncertainty since they are better informed about the context and potential consequences of their actions (Bresnahan et al., 2002). Moreover, computers can enhance scheduling autonomy via teleworking or online collaboration (Wang et al., 2020). Hence:

H3a *Computer use is positively associated with job autonomy.*

In situations of high controllable risk, employees have specific knowledge that managers cannot obtain without cost, so the firm cannot define what actions should be taken (DeVaro & Kurtulus, 2010). In the presence of controllable risk, specific information is costly to communicate, hence the worker has to use that knowledge or nobody else in the organisation will use it because of the aforementioned communication costs (Kauhanen & Napari, 2012).

Firms might respond by delegating responsibilities and increasing job autonomy so that employees use their private knowledge. By adopting PFP to hold workers accountable for their decisions, they are directed towards previously defined organisational objectives (Ortega, 2009). The economic theory of incentives proposes that uncertainty related to workers' efforts becomes positively related to PFP since they enjoy an informational advantage; managers consider their actions as strategically uncertain and want to influence them through PFP (Ben-Ner & Urtasun, 2013). Whereas with uncontrollable risk the costs of PFP outweigh their benefits, the opposite is true with controllable risk. As a result, the relationship with PFP is expected to be negative for uncontrollable risk and positive for controllable risk (He et al., 2014).

Job autonomy is a central variable in the debate within agency theory on the relationship between risk and PFP. If the worker enjoys the discretion to act in a context of uncertainty, as with controllable risk, this should be associated with more PFP schemes of any kind. Hence, we hypothesise as follows:

H3b *Job autonomy is positively associated with productivity PFP.*
H3c *Job autonomy is positively associated with team PFP.*
H3d *Job autonomy is positively associated with firm PFP.*

2.4 | Firm value of job performance

This variable refers to the impact of job performance on the overall performance of the company. Not all jobs are equal in this dimension, however, since they differ in their value (Bayo-Moriones et al., 2013). This value of job performance is strongly connected to job complexity and on-the-job training.

Compared to simple jobs, complex jobs are characterised by task difficulty and a higher probability of making mistakes, causing variability in performance among incumbents. Whereas in simple jobs differences in the abilities and skills of the workers are unlikely to impact performance, in complex jobs these differences can give rise to substantial variations in firm value (Morgeson & Humphrey, 2006).

According to SBTC theory, computers are expected to lead to higher job complexity and skill demands, because they increase the use and transmission of information within firms (Hoogervorst et al., 2002). Like other technologies, computers increase labour productivity and, as a result, amplify the effects of human input on outputs, increasing the firm value of job performance (Aral et al., 2012). In addition, because of this amplifying effect differences in the efforts and abilities of workers have a larger impact on job and firm performance when ICT is adopted. Hence:

H4a *Computer use is positively associated with job complexity.*

The higher requirements for employee skills associated to computer use demand more training (Li et al., 2017). For tasks to be performed properly, workers must have the necessary skills and therefore need to be intensively trained (Albert et al., 2010). Among these skills, those specific to the job and the firm and acquired through on-the-job training by supervisors and peers contribute substantially to the firm value of job performance. Therefore, the positive effect of computers on the demand of different types of skills (Green, 2012) is expected to require more on-the-job training (Green & Henseke, 2019).

H5a *Computer use is positively associated with on-the-job training.*

The economic theory of incentives suggests that firms will be more interested in improving performance by eliciting more effort from employees through PFP in jobs where the firm value of job performance is significant (Hölmstrom & Milgrom, 1991). Consequently, jobs in which productivity is higher should be paid more by output and less by input (Raith, 2008). This higher variability in performance is associated with greater value of job performance for the firm (Cascio & Boudreau, 2015). As a result, complex jobs are more suitable for PFP since the firm values higher performance in complex jobs more highly than in simpler jobs.

Job complexity has other implications for PFP suitability related to the concepts subsequently mentioned, such as uncontrollable risk and job performance measurability. On the one hand, job complexity is positively associated with specific knowledge (Raith, 2008), since the worker is in a better position than the supervisor to determine the demands of a particular situation and how factors combine to determine the outcome of an action (Ben-Ner & Urtasun, 2013); this suggests a positive relationship with PFP. On the other hand, job complexity is negatively related to a more perfect performance measurement, which suggests the opposite relationship (Hölmstrom & Milgrom, 1991). The empirical evidence points to the prevalence of the former (Ortega, 2009). Therefore:

H4b *Job complexity is positively related to productivity PFP.*
H4c *Job complexity is positively related to team PFP.*
H4d *Job complexity is positively related to firm PFP.*

On-the-job training increases the human capital of the worker and, as a consequence, the impact of job performance on firm value. This makes it more convenient for the firm to adopt PFP schemes to motivate workers since the gains from eliciting more effort are larger when on-the-job training is present. PFP schemes might not only contribute to the worker being more motivated in carrying out tasks included in the job, but also in the process of accumulating human capital through on-the-job training. The literature on training effectiveness has highlighted the substantial impact of training motivation on training outcomes (Colquitt et al., 2000). The transformation of training investments in skills acquisition is not automatic and requires the active engagement of the participant. The worker will be more motivated to make the most of on-the-job training if he receives at least part of the gains resulting of improved skills and job performance (Guery & Pendleton, 2016). PFP schemes can serve as mechanisms to achieve this involvement of the worker in on-the-job training. Therefore:

H5b *On-the-job training is positively related to productivity PFP.*
H5c *On-the-job training is positively related to team PFP.*
H5d *On-the-job training is positively related to firm PFP.*

2.5 | Teamwork

Teamwork is expected to be affected by the introduction of computers. There are several arguments that support this statement derived from the complementarity framework perspective. First, ICTs imply the existence of more complex problems in the workplace and therefore require teamwork to find better solutions, leading to more demands for interpersonal skills, as indicated by the SBTC theory (Bayo-Moriones et al., 2017). In addition, computers reduce coordination costs, so the work of teams is facilitated since communications costs are reduced (Bloom et al., 2014; Rasel, 2016). Finally, computer-based technologies promote shared goals through information diffusion, which leads to employees working to meet collective objectives instead of individual targets (Gressgard, 2011). The empirical evidence has demonstrated that computerisation favours self-managed work teams (Bresnahan et al., 2002; Rasel, 2016). Hence:

H6a *Computer use is positively associated with teams.*

TABLE 1 Summary of hypotheses

	Computer use	Productivity PFP	Team PFP	Firm PFP
Measurability of performance: Job monotony and quality standards	H1a: −	H1b: +	H1c: +	H1d: 0
Uncontrollable risk: interruptions	H2a: +	H2b: −	H2c: −	H2d: 0
Controllable risk: job autonomy	H3a: +	H3b: +	H3c: +	H3d: +
Firm value of job performance: Job complexity	H4a: +	H4b: +	H4c: +	H4d: +
Firm value of job performance: On-the-job training	H5a: +	H5b: +	H5c: +	H5d: +
Teamwork: Teams	H6a: +	H6b: −	H6c: +	H6d: +

Abbreviation: PFP, pay for performance.

Theoretical developments in incentive theory indicate that the extent to which the job requires teamwork and cooperation among peers is expected to influence the incidence of PFP schemes (Drago & Garvey, 1998). When the production function is defined at the team level due to the existence of interdependencies and there are benefits to the interactions, it is difficult and costly to identify individual performance (Bayo-Moriones et al., 2013). This might lead to potential distortion effects of incentives if jobs offer many opportunities for the reallocation of efforts to more easily measurable activities such as productivity and that, as a result, are more likely to be included in the PFP scheme (Benčič & Norris, 2010). Thus, collective PFP seems to be more adequate than productivity PFP for promoting collaboration and helping behaviours, in particular in labour-intensive companies (Park et al., 2010). We therefore propose:

H6b *Teams are negatively associated with productivity PFP.*
H6c *Teams are positively associated with team PFP.*
H6d *Teams are positively associated with firm PFP.*

Table 1 summarises the hypotheses derived from the theoretical framework.

3 | METHODS

3.1 | Data

The data used in our empirical analysis come from the European Working Conditions Survey (EWCS) conducted by the European Foundation for the Improvement of Working and Living Conditions. More specifically, we use the data from the third, fourth, fifth and sixth waves of the survey, conducted in the years 2000–2001, 2005, 2010 and 2015, respectively. The EWCS provides repeated cross-sectional data; the rounds considered in the empirical analysis were administered to a new sample of interviewees in 2000–2001, 2005, 2010 and 2015. We therefore use data from these editions because they include information about all the variables relevant to our research purposes. Therefore, the sample includes observations from all the countries participating in these four rounds; that is, the 27 members of the European Union except for Croatia and including the United Kingdom.

The sample in the EWCS is representative of the people employed during the fieldwork period in each of the countries covered. Precisely, a multi-stage, stratified and clustered sample design was followed in each country with a 'random walk' procedure for the selection of the respondents during the last stage (Eurofound 2016). All interviews were conducted face-to-face in the respondent's own home. Given the nature of our research question, we will exclude self-employed workers from our analysis. PFP only makes sense for employees, as acknowledged in our own survey, namely because this does not pose questions about these schemes to self-employed workers. Workers in the armed forces are also excluded from the sample.

The EWCS has been widely used in the HRM literature and, more specifically, in research on incentive payments. Examples of this would be Ortega (2009) examining its relationship to employee discretion, Godeanu (2012) on its joint effects with job autonomy on pay satisfaction in teams or Eriksson and Ortega (2011) investigating its effect on working hours and non-work activities.

3.2 | Measures

3.2.1 | PFP variables

The three dependent variables are binary and capture the use of three PFP schemes: piece rate/productivity payments, payments based on the performance of a team/department and payments based on the overall performance of the company (e.g., profit sharing). As our sample comprises workers and not firms, binary variables are adequate to capture whether a PFP scheme is used or not, since the nature of the inclusion of these payments in earnings for an individual worker is dichotomous (Welz & Fernández-Macías, 2008). This is the reason why binary variables are the standard measures of PFP use (i.e., Bryan & Bryson, 2016; Jirjahn & Stephan, 2004). These three schemes accurately represent the main types of PFP according to both theoretical classifications and firm adoption (Bayo-Moriones et al., 2013; Ortega, 2009).

3.2.2 | Independent variable

The independent variable measures, on a scale ranging from 1 to 7, the frequency with which workers use computer technologies in their jobs, with 1 indicating they never use them, 2 almost never, 3 that they use them about a quarter of the time, 4 about half of the time, 5 about three-quarters of the time, 6 almost all the time and 7 all of the time. Computerisation has been used as a measure of ICT adoption in the workplace within firms in many studies (Chesley, 2014).

3.2.3 | Job design variables

Seven mediating variables referring to job design are included in the analysis. A binary variable measures whether the job involves monotonous tasks, whereas another binary variable is used to measure whether the job involves meeting precise quality standards. The frequency of interruptions to accomplish unforeseen tasks is captured with an ordinal variable, with 1 indicating *they never happen*; 2, *occasionally*; 3, *fairly often*; and 4, *very often*. Job autonomy is measured by an index constructed from three items capturing whether or not the respondent is able to choose or change the order of the tasks, the methods of work and the speed of work. As in Menon et al. (2020), where the same dataset and these items are used, principal component analysis with a polychoric correlation matrix is applied. The first component is used as the indicator for job autonomy. The proportion of variance explained by this component is 0.82. Job complexity is measured by a binary variable that takes the value one if the job involves complex tasks, whereas on-the-job training is measured by a binary variable that captures whether the respondent receives such training from co-workers and supervisors. Finally, teams are captured by a binary variable indicating whether the worker is part of a group or team that has common tasks and can plan its work.

For some of these aspects, binary variables are adequate measures, since the underlying concepts are dichotomous. This would be the case for on-the-job training, meeting quality standards or being part of a team. However, this does not hold true for the items measuring job monotony, job complexity and job autonomy, where a scale format would have been more appropriate since they can exist in different degrees. In spite of this limitation, previous research using these binary items from the EWCS survey indicates that from the comparison of findings between this

survey and other national surveys the results are not substantially affected by the response categories of the measures (Holman & Rafferty, 2018). Therefore, the validity of our results is not expected to be severely influenced by the binary response format of these variables.

3.2.4 | Control variables

Some of these relate to the worker, for example, gender, age and seniority in the company (Jones & Kato, 2011). Categories from the ISCO08 classification at the one-digit level are included to control for occupation (Bayo-Moriones et al., 2013). As far as industry is concerned, observations are classified as agriculture, manufacturing, public administration and other services (Gooderham et al., 2018), whereas workplace size is measured by an ordinal variable with four categories: 1 worker, 2–9 workers, 10–249, and 250 or over (Jaakson & Kallaste, 2014). National context is also controlled for by including the six Hofstede national culture dimensions (Hofstede Center, 2014), labour regulation (Botero et al., 2004) as well as stock of Foreign Direct Investment as percentage of Gross Domestic Product (GDP) and GDP per capita (Gooderham et al., 2018).

Finally, to control for the multi-year nature of the dataset, we have included the year as a control variable, so that the trend element is considered in the empirical analysis.

Table 2 includes the definitions of the variables, as well as their means and standard deviations, and Table 3 displays the correlation matrix for the computer use, PFP and job design variables.

Table 4 illustrates the frequency distribution for the different combinations of the three PFP schemes. The three dependent variables present positive correlations. As expected, the largest relationship is found for the collective schemes: 0.191 correlation coefficient between company and team PFP, followed by 0.089 correlation coefficient between productivity and team PFP and 0.130 between productivity and company PFP. All correlations are significant at the $p < 0.001$ level.

3.3 | Estimation methods

Two models are estimated for each of the three PFP schemes examined. The first model includes control variables and the frequency of computer use, whereas the job design variables are added in the second model. In order to examine the relationship between computer use and the job and organisation variables, probit models are estimated for the latter variables. As interruptions are not binary, a regression is estimated for this variable. Since the representativeness of the sample varies across countries, cross-national weights for country groups are used in all the analyses to control for this issue.

4 | RESULTS

Table 5 presents the results on the determinants of the job design variables with computer use as the independent variable, together with the control variables. The results show that computer use is associated with lower job monotony but is also linked to the setting of quality standards; hence, the relationship with the measurability of job performance is mixed and H1a cannot be accepted. The positive relationship with interruptions points to computer use leading to more uncontrollable risk, leading to the acceptance of H2a. There is a positive association with job autonomy, which means that computer use is associated with greater controllable risk, accepting H3a. Regarding the value of job performance, computers are positively related both to job complexity and on-the-job training, so H4a and H5a are accepted. Finally, the association with teams is also positive; therefore, H6a is accepted.

TABLE 2 Descriptive statistics

Variable		Mean	SD
Pay for performance			
Piece-rate/productivity	Thinking about your earnings from your main job, what do they include? Piece rate or productivity payments (yes = 1; no = 0)	0.126	-
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)	0.187	-
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)	0.111	-
Computer use	Please tell me, using the same scale, does your main paid job involve working with computers, laptops, smartphones, etc.?; Frequency of use: 1-never to 7-always	3.324	2.431
Job design variables			
Job monotony	Generally, does your main paid job involve monotonous tasks (yes = 1; no = 0)	0.452	-
Quality standards	Generally, does your main paid job involve meeting precise quality standards (yes = 1; no = 0)	0.714	-
Interruptions	Frequency of interruptions of a task in order to take on unforeseen tasks (1-never to 7-always)	2.208	0.941
Job autonomy	Score of the first component from the principal component analysis with polychoric correlation matrix of three binary items capturing whether the respondent is able to choose or change (i) order of tasks, (ii) methods of work and (iii) speed or rate of work.	0	1.104
Job complexity	Generally, does your main paid job involve complex tasks? (yes = 1; no = 0)	0.597	-
On-the-job training	Over the past 12 months or since you started your main paid job (in case you started less than 12 months ago), have you undergone on-the-job training to improve your skills? (yes = 1; no = 0)	0.350	-
Teams	Do you work in a group or a team that has common tasks and plans its work? (yes = 1; no = 0)	0.616	-
Control variables			
Gender	Male = 1; Female = 0	0.460	-
Age		41.656	11.744
Seniority	Number of years working for your current company	9.616	9.678
Occupation			
Managers	ISCO1	0.052	-
Professionals	ISCO2	0.156	-
Technicians	ISCO3	0.155	-
Clerical	ISCO4	0.126	-
Service and sales	ISCO5	0.172	-
Craft	ISCO7	0.128	-
Operators	ISCO6, ISCO8	0.086	-
Elementary occupations	ISCO9	0.124	-

TABLE 2 (Continued)

Variable		Mean	SD
Activity			
Agriculture	NACE Rev 2.0 a–c	0.021	-
Manufacturing	NACE Rev 2.0 d–e	0.249	-
Private services	NACE Rev 2.0 k–n, r–u	0.368	-
Public services	NACE Rev 2.0 o–q	0.361	-
Size of the company			
From 2 to 9 employees		0.285	-
From 10 to 249 employees		0.426	-
More than 250 employees		0.167	-
National context			
Cultural context	Hofstede cultural dimensions		
Power distance	Power distance index	52.968	21.005
Individualism	Individualism versus collectivism index	60.920	17.776
Masculinity	Masculinity versus femininity index	47.725	25.946
Uncertainty	Uncertainty avoidance index	71.578	22.495
Long term	Long-term orientation versus short term normative orientation index	59.076	16.712
Indulgence	Indulgence versus restraint index	43.415	18.613
Labour regulation	Employment and industrial relations laws index	1.578	0.373
Stock of FDI as % of GDP	Stock of foreign direct investment as % of GDP	50.577	41.351
GDP per capita	Log GDP per capita based on ppp (constant 2017 international $)	10.441	0.413
Time	Year of the survey		
2000		0.091	-
2005		0.238	-
2010		0.326	-
2015		0.345	-

Table 6 includes the results of the probit models with PFP schemes as dependent variables. The frequency of computer use has a significant relationship with productivity PFP. Furthermore, it is also positively associated with the inclusion of team PFP in earnings and with a greater likelihood of company PFP.

Several job variables are identified as significant in the different models in Table 6. Regarding job performance measurability, as expected, the requirement of meeting precise quality standards in the job and job monotony are positively related to productivity PFP, supporting H1b. No significant associations have been found between job monotony and team PFP and firm PFP. A weak positive relationship for meeting precise quality standards and these two PFP schemes has been detected, so H1c and H1d cannot be fully accepted.

With regard to uncontrollable risk, the frequency of interruptions whilst performing a task is negatively related to the incidence of productivity PFP and displays no association with the other PFP schemes. This involves the acceptance of H2b and H2d, as well as the rejection of H2c.

Regarding the variable capturing controllable risk, employees are more likely to be paid according to productivity, team and company performance when they enjoy more job autonomy. Therefore, our results show support for H3b, H3c and H3d.

The variables reflecting the value of job performance are significant in most of the estimations and display the expected positive coefficients. Complex jobs display a significant association with team PFP and company PFP, but

TABLE 3 Correlation matrix for computer use, PFP and job design variables

	Computer use	Productivity PFP	Team PFP	Firm PFP	Job monotony	Quality standards	Interruptions	Job autonomy	Job complexity	On-the-job training
Productivity PFP	−0.057	-	-	-	-	-	-	-	-	-
Team PFP	0.064	0.089	-	-	-	-	-	-	-	-
Firm PFP	0.157	0.130	0.191	-	-	-	-	-	-	-
Job monotony	−0.094	0.047	−0.020	−0.020	-	-	-	-	-	-
Quality standards	0.033	0.063	0.039	0.042	0.091	-	-	-	-	-
Interruptions	0.267	−0.047	0.050	0.067	−0.019	0.074	-	-	-	-
Job autonomy	0.227	−0.034	0.035	0.070	−0.131	−0.029	0.165	-	-	-
Job complexity	0.270	−0.003	0.074	0.089	−0.039	0.187	0.228	0.198	-	-
On-the-job training	0.189	0.015	0.085	0.099	−0.050	0.082	0.127	0.071	0.152	-
Teams	0.073	0.019	0.071	0.059	−0.018	0.133	0.162	0.040	0.163	0.160

Note: All correlations are significant at the 0.001 level.

Abbreviation: PFP, pay for performance.

TABLE 4 Frequency distribution in PFP schemes

Productivity PFP	Team PFP	Company PFP	Frequency	Percentage
Yes	Yes	Yes	806	1.36%
Yes	No	No	4622	7.79%
Yes	No	Yes	830	1.40%
No	Yes	Yes	1817	3.06%
No	No	Yes	3139	5.29%
Yes	Yes	No	1217	2.05%
No	Yes	No	7288	12.28%
No	No	No	39,642	66.78%
		Total	59,631	100%

Abbreviation: PFP, pay for performance.

TABLE 5 Probit estimations of computer use on job design variables

	Job monotony	Quality standards	Interruptions	Job autonomy	Job complexity	On-the-job training	Teams
Computer use	−0.010***	0.026***	0.072***	0.075***	0.128***	0.067***	0.021***
	(0.004)	(0.005)	(0.003)	(0.003)	(0.005)	(0.005)	(0.005)
Chi-2 (F)	1955.63***	1260.10***	135.26***	132.16***	4125.65***	1920.28***	1236.61***
Pseudo R	0.061	0.048	0.128	0.012	0.140	0.068	0.039
N	59,361	59,361	59,361	59,361	59,361	59,361	59,361

Note: Standard errors in brackets. Control variables include: year, gender, age, seniority, occupation, activity, size of the company and national context (six Hofstede dimensions, labour regulation, Stock of FDI as % of GDP and GDP per capita). Interruptions are job autonomy are estimated using OLS and figures correspond to F- and R-squared values. Due to space constraints, in this table we will not present information regarding control variables. Results are available from the authors upon request.

***$p < 0.001$.

not with productivity PFP. Therefore, H4b is not accepted, whereas H4c and H4d receive full support. On-the-job training received by employees reveals positive links with the three PFP schemes analysed. Therefore, H5b, H5c and H5d are accepted.

When work is organised around groups or teams with common tasks and they can plan their work, there is a higher probability of payment by team and company results. This means H6c and H6d are supported. Nevertheless, H6b cannot be accepted because no negative association has been found.

4.1 | Robustness checks

The robustness of our main results has been verified with further analyses. In 2015, Eurofound modified the question related to the use of computers to specifically include the use of laptops, smartphones and other hardware. Although according to Eurofound's methodological report this question is consistent across the four rounds considered in our paper, we have estimated the empirical models excluding the last round. The main results remain unchanged, with only very small differences in the significance and size of the coefficients.[1]

In addition, it has been confirmed that the results are not sensitive to different binary coding of the computer use variable. Two dichotomous variables were considered: the use or otherwise of computers and the using of computers

TABLE 6 Probit estimations of computer use on PFP schemes

	Productivity PFP		Team PFP		Company PFP	
	(1)	(2)	(3)	(4)	(5)	(6)
Computer use	0.012*	0.011	0.039***	0.023***	0.090***	0.073***
	(0.006)	(0.006)	(0.005)	(0.006)	(0.006)	(0.007)
Job monotony		0.087***		0.007		0.003
		(0.024)		(0.021)		(0.025)
Quality standards		0.157***		0.050*		0.060*
		(0.028)		(0.024)		(0.029)
Interruptions		−0.051***		−0.001		0.006
		(0.014)		(0.011)		(0.014)
Job autonomy		0.026**		0.052***		0.077***
		(0.011)		(0.010)		(0.012)
Job complexity		−0.039		0.129***		0.110***
		(0.026)		(0.023)		(0.029)
On-the-job training		0.126***		0.256***		0.283***
		(0.024)		(0.022)		(0.026)
Team		0.036		0.159***		0.126***
		(0.025)		(0.022)		(0.027)
Chi-2	1593.24***	1694.55***	1785.08***	2083.38***	2009.26***	2214.77***
Pseudo R	0.086	0.092	0.082	0.097	0.146	0.162
N	59,361	59,361	59,361	59,361	59,361	59,361

Note: Standard errors in brackets. Control variables include: year, gender, age, seniority, occupation, activity, size of the company and national context (six Hofstede dimensions labour regulation, Stock of FDI as % of GDP and GDP per capita). Due to space constraints, in this table we will not present information regarding control variables. Results are available from the authors upon request.

Abbreviation: PFP, pay for performance.

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

for more than 50 percent of the time in a working day. The results obtained were broadly aligned with the results presented in the tables.

5 | DISCUSSION

This paper has analysed the effects of computer use on the incidence of three incentive schemes linking pay to performance: piece rate or productivity PFP, team PFP and company PFP. Empirical analyses are based on the third, fourth, fifth and sixth waves of the EWCS (Eurofound 2016).

The main findings reveal a significant and positive association between computer use and PFP incidence. This relationship emerges for all the PFP schemes examined in the paper, although it is stronger for team and company PFP. These differences between productivity and collective PFP also appear with regard to the job design variables determining their adoption. As expected, the variables capturing the measurability of job performance (i.e., the setting of quality standards and job monotony) are related to productivity PFP, but hardly to collective schemes. The same holds true for the interruption variable, which is linked to uncontrollable risk. On the other hand, being part

of a team is positively related to team and company PFP, but not to productivity PFP. A similar result was found for the variables measuring the firm value of job performance (job complexity and on-the-job training), both of which display a much stronger association with collective PFP. The results for controllable risk (job autonomy) show that it is positively linked to PFP incidence.

The aforementioned differences between productivity PFP and team and firm PFP in the strength of their relationship with computer use can be interpreted in the light of the significance of some of the job design variables in explaining PFP incidence. In the case of teamwork, this positively affects team and firm PFP but not productivity PFP. One of the main consequences of computerisation is the increase in interactions between colleagues and the fostering of new networks within firms (Wang et al., 2020). Therefore, computer use is found to be closely associated with teamwork and, as a result, also with team and company PFP; however, teamwork is not found to be relevant with productivity PFP. A similar finding applies to job complexity: it is greater in the presence of computers and is positively related to team and firm PFP but not to productivity PFP.

Another relevant finding is that all the consequences of computers for job design point in the same direction and favour the adoption of both team and firm PFP; this is not the case for productivity PFP. Indeed, it is for this reason that the introduction of the job design variables reduces the coefficient of computer use substantially in the estimation of team and firm PFP but only slightly in the probit model for productivity PFP. In this case, there is a positive effect of computer use through the setting of quality standards, job autonomy and on-the-job training, but a negative effect through job monotony and interruptions. These two opposed effects compensate each other, so the coefficient of computer use remains almost unchanged when job design variables are controlled for.

5.1 | Implications for theory

Our findings on the influence of computers on job design are consistent with the complementary framework perspective (Milgrom & Roberts, 1990). The results support the skill-biased technological change argument and contradict the deskilling hypothesis (Martinaitis et al., 2020), thus confirming the evidence pointing to a positive effect of computers on aspects such as the control enjoyed by the employee over their work (Menon et al., 2020).

Our empirical results also confirm that the economic theory of incentives is a valid framework to better understand the relationship between computer use and PFP, because the job design variables proposed from this theory were able to explain part of this association. For example, job design aspects such as job monotony, quality standards, job autonomy, job complexity and on-the-job training are significant predictors of the incidence of PFP, as suggested by the economic theory of incentives. Our findings are consistent with those in previous empirical research using the economic theory of incentives (Gibbs et al., 2009; Ortega, 2009).

However, a substantial proportion of the relationship remains unexplained. This result calls for further research that may propose other explanations that could help to better disentangle the mechanisms through which computers are associated with the adoption of PFP schemes. We suggest this requires theoretical advancements in several directions.

Firstly, the complementarity framework perspective, and more specifically SBTC theory, when examining the impact of computers on the worker profile required by firms has focused exclusively on skills. However, worker characteristics include other aspects such as personality that, if incorporated to this framework, could provide a more complete explanation of the implications of computers for work. This directly points to additional complementarities in the HRM domain with recruitment and selection practices beyond job design. Advances in this area could help to understand the association between computers and PFP unexplained by job design in our empirical results insofar as PFP incidence has been found to be influenced by variables such as the risk aversion of the worker (Grund & Sliwka, 2010).

Secondly, the emphasis on incentives and motivation neglects other objectives PFP may pursue. One of these is the attraction and retention of productive and adequate workers (Jirjahn & Mohrenweiser, 2019); this potential

sorting effect of PFP should be explored in the context of ICT, since more productive workers have been found to be more likely to use computers in their jobs (Entorf & Kramarz, 1997). Another objective is labour cost flexibility. PFP promotes a closer link between wages and the economic situation of the firm (Long & Fang, 2015). The adoption of computers is therefore frequently justified by the need to become more flexible (Chen et al., 2017) and this is a point where computers and PFP may also converge.

Thirdly, our analysis, as based on the economic theory of incentives, takes place at the job level and does not pay attention to the context provided by the company. This means that, as important as job characteristics are for the relationship between computers and PFP, this does not happen in a vacuum but rather in the wider context of the entire firm (Gooderham et al., 2018). Differences at the firm level in aspects not considered here such as organisational strategy, which plays a relevant role for both PFP (Park & Kruse, 2014) and computer adoption (Gallego et al., 2015), could be helpful in accounting for the part of the association remaining unexplained.

5.2 | Implications for practice

Our findings have several practical implications. As regards firms, our results show that the adoption of computers requires them to revise their PFP practices. In addition to the well-known effects of IT on job content and the demand for skills, our article suggests that the implications for HRM also extend to the compensation domain. The effects of computers on job design introduces the need to adapt decisions on PFP practices to the new work context emerging from the adoption of these technologies. More concretely, computers change jobs in a direction that favours the use of team and firm PFP and, to a lesser extent, productivity PFP.

Our results suggest that when managers assess the implications of computer adoption for the benefit of employee attitudes and welfare, they should consider not only the direct effects but also those deriving from changes in job design and PFP practices. Such practices have been particular neglected in the delimitation of the HRM practices accompanying the adoption of computers in companies. Our research can provide managers with a framework to more comprehensively disentangle the consequences of computers for employees.

Along this line, one element of potential concern in our results is the positive association between computer use and productivity PFP. Although individual contingent pay schemes have been found to have positive effects on attitudes such as job satisfaction and commitment (Ogbonnaya et al., 2017), they also show negative effects on employee welfare through greater work intensification and job strain (Ogbonnaya et al., 2017; Williams et al., 2020). Therefore, in the adoption of PFP schemes associated with increased computer use, attention should be paid to design issues such as the definition of standards and the pay rate that guarantee a balance between the effort provided by the worker, the rewards received and the resources assigned to perform their tasks.

In relation to public policies, an implication of our results derives from the strong association found between computer use and firm PFP. These schemes include practices such as profit-sharing whose adoption by firms has been promoted by some public institutions in the aim of employee financial participation (Eurofound 2004). As mentioned previously, these efforts have taken place parallel to policies aimed at encouraging IT adoption by firms. Our findings suggest the need to develop integration mechanisms between both public policies, since computer use and PFP are not independent practices but are instead positively associated in their incidence. Public policies in both domains would benefit from coordination in the definition of objectives and design given the mutually reinforcing effects in the adoption of the practices they promote.

5.3 | Limitations

There are some limitations in this study. First, as indicated in research analysing the implications of computers for work and HRM with the same dataset, a limitation of the computer variable used is that it is not equally effective in

capturing the adoption and use of digital technology for all occupations (Menon et al., 2020). In addition, this variable does not allow distinctions to be made between the use of computers for information or communication purposes (Bloom et al., 2014), which is theoretically relevant for the incentive implications of this technology and could be helpful in understanding differences between occupations. Another limitation derives from the use of binary response categories in several of the job design variables. In spite of previous research pointing to the low relevance of response formats for findings (Holman & Rafferty, 2018), scale response formats would indeed be more appropriate from a methodological perspective.

The small proportion of the sample that used PFP might reduce the predictive accuracy of the probit models; however, in our research, we have not used probit estimations with this aim, but as explanatory models intended to identify variables with a meaningful and statistically significant relationship with the dependent variable (Greene, 2018). Therefore, our results are not affected by the small proportion of workers subject to PFP.

In our research, we have not analysed the role that wages may play in the relationship between computer use and PFP. Wages have been found to be related both to computerisation (Green et al., 2007) and PFP (Bryan & Bryson, 2016). Our results suggest that a potential mechanism of the association between these variables is that the impact of computer use on pay could be mediated by both job design and PFP. In order to disentangle these relationships, further research should thus be undertaken.

6 | CONCLUSION

The objective of this work is twofold. Firstly, it examines the influence of computers on the use of three PFP schemes: piece rate/productivity PFP, team PFP and company PFP. Secondly, the role played in this relationship by job design variables is investigated. In order to achieve these aims, the article proposes a theoretical model integrating the complementary framework perspective (Milgrom & Roberts, 1990) and the economic theory of incentives (Prendergast, 1999).

The empirical findings demonstrate the existence of a positive relationship between computer use and PFP incidence, especially for those schemes that link earnings to team and firm performance. This association is partly explained by the positive effects of computers on the adoption of job design practices oriented towards decentralisation and teamwork and leading to upskilling.

These findings are relevant since they recognise that the impact of computers on the employment relationship is not limited to job design but also extends to PFP, a core practice in HRM. The paper also identifies future directions for research by highlighting that the motivational function of PFP cannot fully explain its association with the use of computers.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available in the EWCS (European working conditions survey) from the European Foundation for the Improvement of Living and Working Conditions (https://www.eurofound.europa.eu/). Data are available upon request.

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ENDNOTE

[1] All the results referred to in this subsection are available upon request.

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