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Flexible pay systems and labour productivity: Evidence from Emilia-Romagna manufacturing firms[1]

Roberto Antonietti[2], Davide Antonioli[3] and Paolo Pini[4]

Abstract

The aim of this paper is to analyse the link between flexible pay systems (FPS) and labour productivity, with a close look at wage premium determinants as elements disclosing specific managerial strategies. The analysis was conducted on a sample of more than 500 manufacturing firms located in the Emilia-Romagna region, Italy. Results show that the adoption of flexible pay schemes is linked to union involvement and organizational changes within the firm, supporting the idea that flexible wages do not constitute merely an economic premium, but a more complex strategy aimed at increasing employees' flexibility and autonomy. Notwithstanding the positive effects on productivity, the relation with economic performance does not emerge as extremely innovative. On the one hand, it is driven by a traditional form of premiums (PRP) targeted to individual employees and linked to a simple "effort improvement and control" motivation and "ability to pay" of the firm. On the other, it is driven by premiums (PFP) provided ex-ante and aimed at developing employees' participation and competencies.

Keywords: performance related pay, pay for participation, organizational innovation, industrial relations, labour productivity

JEL Classification: J24; J33; J51

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1. Introduction

The rapid spread of information and communication technologies and the increasing globalization of production, among other factors, have made international competition fiercer than ever. In a more dynamic, uncertain and risky environment, firm performance depends even more on intangible assets and non-technical aspects of work such as flexibility (in its various forms: e.g. numerical or functional), recruitment, evaluation, training, employee-commitment schemes, and last but not least flexible pay systems (Eurofound, 2011a, b).

While there is a general consensus on the positive link between adoption of HRM practices and firm performance, a series of significant shortcomings have been identified in the recent empirical debate (Gritti and Leoni, 2012). Firstly, there is the lack of representativeness of many analyses, primarily based on case-studies and single sectors or countries. Secondly, a problem of endogeneity and reverse causation may arise if successful companies are more likely to introduce HRM practices than other firms. Thirdly, there is the question of comparison between firms adopting high-performance work practices and those not, known as the heterogeneity problem.

This paper investigates the labour productivity impact of different Flexible Pay Systems (FPS hereinafter), using an original firm-level dataset on Emilia Romagna, Italy, where flexible wages have been widely adopted since the 1990s (Cainelli *et al.*, 2002). In contrast to mainstream studies, we stress the importance of new work organization and practices as a key motivation underlying the adoption of flexible payment systems (Marsden and Belfield, 2010)[5],, in the form of Pay For Participation (PFP hereinafter) and Performance Related Pay (PRP hereinafter). According to our estimates, the productivity effect of wage premiums materialize where adoption of flexible premiums is part of a broader knowledge management system involving production, work and organizational change.

The analysis presents three elements of novelty. Firstly, a structural model is adopted, which helps to address the problem of self-selection in performance-related pay or pay for participation adoption. The use of a structural modelling approach implies the identification of the determinants of FPS adoption, among which industrial relations and employees' involvement are emphasized. Secondly, a wide series of HRM practices are distinguished, both in production and in labour management, while controlling for potential correlations across them all. Thirdly, different types of wage premiums are considered: *ex-post*, assigned on the basis of workers' past performance; *ex-ante*, based on the idea of the "competence model" in which the employees are rewarded according

[5] Marsden and Belfield (2010) stress the importance, too often neglected, of the institutional environment in influencing the adoption and the types of pay systems.

to their competence development; *individual*, *team-based* and *mixed* (i.e. assigned both individually and to teams).

The distinctions made between all these different types of wage premiums are important, because they reflect different HRM strategies. Ex-post and individual PRP systems are the most widespread types of wage premium; they are based on the ex-post evaluation of workers' performance on the job, and then assigned in the case of success in pursuing the expected objectives. These premiums are typically designed within traditional organizational models such as those based on the Taylor-Ford paradigm, where the work environment is relatively stable, rigid and hierarchically managed (Melotti, 2000; Crudeli, 2001). With respect to these traditional PRP schemes, based on effort-incentive mechanisms for workers and risk and profit sharing for the firm, PFP systems, like ex-ante, or team-based, wage premiums, rely on a different organizational model, characterized by a stronger role of industrial relations and social dialogue among workers, union representatives and managers, formal and informal worker participation in organizational innovation strategies, decentralization of decision-making procedures in work organizations and the development of worker competencies. The PFP schemes are generally less common, and are part of a more general work organization model based on organizational change and innovative flexibility (Killick, 1995; Mancinelli and Pini, 2000).

The remainder of the paper is organized as follows. Section 2 provides a literature review on the determinants of FPS adoption (2.1), its effect on firm performance (2.2), and draws research questions (2.3). Section 3 describes the empirical strategy (3.1) and the data (3.2). Section 4 presents the estimation results. Section 5 concludes.

2. Related literature and research questions

2.1 The literature on the economic effects of FPS adoption

Variable payment systems, such as PRP or piece-rate pay, are generally considered part of the broader set of HRM practices and one of the channels through which organizational change occurs at the firm level. The mainstream empirical literature on the economic impact of organizational change has recognized that firms adopting new work practices experience higher levels of productivity[6].

[6] Organizational changes seem to be also related to innovation activities in other strategic spheres (e.g. technological innovation): see on this point Pini and Santangelo (2005); Santangelo and Pini (2011).

Using data for thirty-six steel production lines in the US, Ichniowski *et al.* (1997) find that methods using innovative work practices, such as incentive pay, flexible job assignments, employment security and training, do achieve higher levels of productivity than methods adopting more traditional systems. Moreover, they also claim that a reverse causality effect may prejudice the interpretation of this result, if more successful and productive plants are more likely to adopt such high-performance work practices.

Black and Lynch (2001) use both cross sectional and longitudinal data for a representative sample of US manufacturing firms over 1987-1993 and show that unionized establishments adopting HRM practices that promote joint decision-making and incentive-based compensation have higher productivity than other similar non-unionized plants.

Cappelli and Newmark (2001) examine a longitudinal dataset on US firms and observe that work practices transferring power to employees raise labour compensation per employee, but have a weaker effect on actual labour efficiency, i.e. output per dollar spent on labour.

Relying on panel data for British and French establishments, Caroli and Van Reenen (2001) find that decentralization of authority, delayering of managerial functions, and increased multitasking lead to greater productivity increases when greater initial skills endowments are present. They show that organizational change is complementary with human capital and leads to a skill bias in labour demand.

Looking specifically at PRP, Fernie and Metcalf (1999) find that, for jockeys, incentive contracts generate performance superior to a non-contingent payment system. Similar results emerge in the study by Paarsch and Shearer (1996) on British Columbia tree-planting firms, where an estimated 22.6% raise in productivity is found for firms adopting PRP schemes. However, only part of this increase represents valuable output because workers become fatigued more rapidly and decrease quality.

Using data from satellite Glass Corporation, and controlling for reverse causality, Lazear (2000) shows that the switch from hourly wage schemes to piece-rate pay has a significant effect on average levels of output per worker (+44%): part of this effect results from the average worker producing more because of incentive effects, part results from the managerial ability to hire the most productive workers, and part from a reduction in quits among the highest output workers. Summing up, as average productivity rises, firms attract a more able workforce, and variance in output among individuals at the firm rises when the payment system shifts to piece rates.

Belfield and Marsden (2003) focus on the role of monitoring environments within the firm in filtering the PRP-performance relationship. Relying on cross-section and panel data on British

establishments, they find a strong and significant effect of PRP adoption on firm outcome, but this effect strictly depends on the structure of workplace monitoring systems.

With respect to employee stock ownership schemes adopted in British workplaces in 2004, Pendelton and Robinson (2010) find that stock plans play an independent positive effect on productivity, this effect being complementary to employee involvement schemes only when the take-up of ownership is not widespread within the firm or of little importance to the functioning of the workplace.

Other evidence concerning other forms of variable payment systems, such as bonuses and profit-sharing, come from Jones and Kato (1995) for Japan, Lee and Rhee (1996) for South Korea, Morton (1998) for Taiwan, Cable and Wilson (1989, 1990) for the UK and Germany, and many other studies not reviewed here.

All these studies are part of a wide empirical literature, historically well established, which assigns PRP the traditional incentive role for inducing workers to provide a greater effort on the job. In so doing, they do not consider that other reasons may encourage firms to adopt flexible payment systems, such as unions and workers' involvement, the industrial relations climate, organizational change and competence development. Moreover, they are primarily based on the US case, while a recent study based on the European Company Survey 2009 (Eurofound, 2011a) finds that the introduction of financial incentives (i.e. PRP: productivity incentive, profit-sharing and share-ownership) and organizational innovations (i.e. PFP: best work practices, competence development, and workers and union involvement) has a significant association with all the dimensions of firm performance. In particular, they are related to a 13% increase in the creation of a very good work climate, a 23% increase in the likelihood of having a very good economic situation and a 21% increase in the likelihood of labour productivity being a lot better than competitors, as perceived by managers interviewed across thirty European countries.

Despite more interest in FPS and firm performance after the 1993 July Agreement, the empirical literature on Italy remained scant during the 90s and the beginning of the new century, mainly because of the lack of suitable microeconomic data. However, some of the most recent analyses, based on richer data sources, provide interesting insights[7]. In particular, Bazzana *et al.* (2005) and Cristini and Leoni (2007), investigate the economic effects of the 1993 July Agreement and stress the key role of trade unions in determining and contracting wage premiums.

Using the methodological approach developed by Cristini and Leoni (2007), Origo (2009) evaluates the effects of PRP introduction on a set of economic performance variables for a sample of Italian

[7] Another interesting line of analysis concerns the relation between FPS adoption, efficiency gains and wages. On this point the work of Cristini and Leoni (2007) shows how, for a sample of firms located in the northern Italy, the elasticity of wages to efficiency gains, due to FPS adoption, is relatively small.

machine-tool firms in the period 1989-1997. The change in the institutional setting given by the July Agreement in 1993 enabled her to implement a propensity score matching approach and evaluate the effect of PRP using a counterfactual analysis. Due to the recognized role of trade unions in driving PRP adoption, estimates are also provided for the subsets of low (i.e. where the share of unionized workers is lower than 30%) and highly unionized firms. The results indicate a quite strong incentive effect of PRP introduction, which increases productivity by around 10-15% one year after the adoption and its effect also continues over time. However, the results hold for low unionised firms, while the same evidence is not supported by the results for highly unionised firms.

The positive effect of collective PRP adoption on productivity is illustrated in a more recent study by Lucifora and Origo (2012) who use a panel of machine-tool firms in 1998-99. However, the positive effect depends on the specific characteristics of PRP. Damiani and Ricci (2010) test the impact of PRP on economic performance by using data from two sources: the ISFOL Employer and Employee survey and AIDA bureau van Dijk. The merge of the two datasets enabled the authors to estimate the impact of PRP on the total factor productivity. Their results are in line with that of other previous empirical works indicating a positive impact of PRP on company productivity, although with considerably varying differences among sectors. The results reported above are in line with the previous empirical literature for Italy (Biagioli and Curatolo, 1999; Amisano and Del Boca, 2004)[8].

2.2 The literature on the determinants of FPS adoption

To fully understand how FPS can affect productivity, we need to identify the factors driving its adoption. As pointed out in the literature (Ichniowski *et al.*, 1997; Booth and Frank, 1999; Lazear, 2000; Caroli and Van Reenen, 2001) it may be that the best performing firms or workers (Dohmen and Falk, 2011) self-select into the adoption of HRM practices and financial incentive schemes. If this is the case, identifying the determinants of HRM practices may help the researcher in mitigating potential reverse causality effects in their relationship with company performance.

Since the seminal contributions by Holmström and Milgrom (1987) and Lazear (1995), the main economic motivation for linking compensation to performance is found in agency theory, and the impossibility for managers to directly observe the employees' effort on the job. As uncertainty increases, firms tend to delegate responsibility to workers, and use incentive pay schemes in order to limit their discretion. In this respect, one should expect that FPS schemes are more likely to exist

[8] For a review of this generation of empirical analysis, see Pini (2001).

when there is considerable employee discretion over work tasks. An empirical validation of this prediction comes from Barth *et al.* (2008). Using data on Norwegian establishments in 1998 and 2003, they found that FPS is more prevalent in firms where workers have a high degree of autonomy in their work organization, but less common in more unionized businesses, and where wages are determined through centralised bargaining.

Other empirical economic literature emphasises firm-level aspects related to size, age, foreign ownership, financial situation (i.e. *ability to pay*), industrial specialization and high-low skill wage differential in the region of location (Caroli and Van Reenen, 2001; Dohmen and Falk, 2011; Eurofound, 2011a,b) as well as the state of technology and human capital (Barth *et al.*, 2008).

The literature on work organization and human resource management indicates reasons from the management side. FPS schemes are adopted to reinforce communication of business goals, or to ensure management efforts in monitoring strategic goals, to improve work efficiency, effort and skill acquisition (Engellandt and Riphahn, 2010). In addition, FPS schemes are found to be complementary to the adoption of other organizational practices, such as those related to internal and functional flexibility, the use of flexible contracts, restructuring and teamworking (Eurofound, 2011b).

Finally, one important aspect which characterizes FPS-adopting firms is social dialogue and industrial relations (Booth and Frank, 1999; Arrowsmith and Marginson, 2009, 2011; Eurofound, 2011b). At present, union status is found to increase the coverage of performance pay in many countries. Although unions can be also against the adoption of PRP systems (Barth *et al.*, 2008; Eurofound, 2011b) [9], employee involvement, representation and voice and the existence of a social dialogue within the firm are found to be important predictors of firms' willingness to provide variable payment systems. This correlation varies with the type of collective bargaining scheme and the bargaining power of union representatives. Some types of work are suitable for single-employer bargaining (Nergaard *et al.*, 2009), other studies are suitable for multiple-employer bargaining (Traxler *et al.*, 2008; Arrowsmith and Marginson, 2009), while others are considered by trade unions as unsuitable for PRP adoption (Barth *et al.*, 2008). The results depend on the sector and the country under investigation.

As for Italy, Pini (2001) provides a critical overview of the determinants of FPS in the 90s. Among the other empirical studies, Cainelli *et al.* (2002) provide a comprehensive empirical study on FPS adoption for a sample of firms located in Emilia-Romagna with firm-level agreements. They find more than 60% of the companies where bargaining takes place adopt FPS and that the

[9] An interesting study by Trevor and Brown (2014) shows that even in the absence of unions and collective bargaining constraints it can be extremely difficult for firms to use pay systems aligned to strategic goals. The authors call into question the relevance and the actual feasibility of pay systems implementation to pursue strategic goals.

"quality" of the bargaining at firm-level impacts positively on increasing the explanatory power of the model of FPS adoption. A second work by Damiani and Ricci (2009) merges survey (RIL by ISFOL) and accounting data (AIDA Bureau van Dijk) to draw a profile of the firms adopting PRP. The results are not clear cut. According to the authors it is not possible to determine a particular firm profile for PRP adopters. Different firm characteristics are related to the willingness to adopt these schemes and such characteristics answer different general motivations behind such adoption: risk sharing, productivity improvement and rent division. Generally, the PRP adopters are more exposed to international competition, have a better economic performance in terms of value added, are unionized and have a higher share of fixed-term workers.

Finally, the work by Casadio (2010) based on an INVIND survey by the Bank of Italy, provides an overall description of PRP schemes and their extent in different Italian macro regions, with links to specific firm characteristics. The main findings are that PRP schemes are more common in the north than the south, they are adopted mainly by medium and large firms, they have become more common over time, but their effect on the total remuneration is quite small.

In contrast with most previous studies, there are works that emphasize the role of competences and skills in determining the wage setting. In this respect, we can rely on the concept of "competence-based pay", a relevant component of a pay for participation scheme. This can be broadly conceived as a payment assigned in accordance to the development and implementation of competencies and skills in performing the job: tasks that secure high performance of individuals, teams and organisations (Brown and Armstrong, 1999). The rationale of competence-based pay implementation is based on different needs for management and workers: the development of a broad workforce skill base and the search for a more flexible workforce, which determines a higher level of commitment and participation in the decision-making process of the workforce (Cainelli *et al.*, 2002; Leoni, 2013).

Taking into account all this literature, we do expect FPS schemes to result in higher performance (labour productivity gains in particular), as predicted by the standard PRP model. However, we cannot exclude *a priori* that, for specific types of firms, competence development and employee participation represent relevant factors related to the adoption of wage premiums in the form of PFP.

2.3 Research questions

Mainstream studies on the economic effects of wage premiums treat them as a price mechanism for inducing workers to make a greater effort on the job or to share financial risk. Once performance is accurately measured, as well as the firm's ability to pay, the variable payment becomes the reward for achieving the expected outcome of the firm. This type of wage mechanism is typically more common among firms adopting traditional work organization schemes, like those based on the Taylor-Ford paradigm, where tasks are easily programmed and the individual contribution to overall production identified (Crudeli, 2001). Still highly widespread among firms, this wage mechanism can be considered as part of a traditional organizational strategy based on numeric flexibility, i.e. on a cost-saving idea of price competitiveness.

In this paper we stress another reason underlying the decision to adopt flexible payment systems. The latter are not only driven by the need to share financial risk or to motivate workers on-the-job, but are the outcome of a broader and more complex knowledge management strategy which extends to worker (and union) involvement and adoption of new work practices.

In our view, the productivity effect of FPS adoption depends on the type of wage premium considered; this, in turn, depends on the organizational strategy of the firm and on the type of flexibility through which higher (price vs non-price) competitiveness is achieved. In particular, individual and ex-post wage premiums should be related to the firm's ability to pay, the ex-ante definition of goals for employees and adoption of performance evaluation schemes. In line with the competence model (Spencer and Spencer, 1993; Metcalf, 2003; Leoni, 2014), ex-ante and team-based type of premiums should be more closely related to flatter organizational schemes, the existence of knowledge-sharing mechanisms within the firm, job or task rotation, skill training, competence development and, last but not least, union involvement.

In this paper we answer the following research questions: is adoption of flexible payment systems related to higher labour productivity? If so, does this effect depend on the type of wage system adopted? And is the specific type of wage system adopted the outcome of a different work and production organization scheme? The answer to these questions requires a structural modelling approach, which enables us not only to address the empirical issues that are typical of cross-sectional studies, but also to identify a clear set of logical steps, as described in section 3.

3. Data and empirical strategy

3.1 Empirical strategy

The empirical strategy follows a two-stage approach. First, we estimate an "*FPS function*" in which, as dependent variable, we consider different types of FPS, while, as independent variables, we include a series of controls and a series of variables potentially influencing the scheme's adoption. From this equation, we extract the predicted value of FPS adoption and we use it as a regressor in the second stage productivity equation.

The first-stage equation (1) is modelled as follows:

[1] $Pr(FPS=1|X)_i = \Phi(Controls_i ; ORG\_CHANGE_i; TRAINING_i; WORKFORCE_i; PAST\_EC\_PERF_i; INDREL_i)$

where *i* identifies the firm and where FPS and the other covariates are measured over 2006-2008, while the past economic performance indicator is referred to 2003-2005.

We first estimate the relationship between FPS adoption and its determinants using a set of univariate probit models, one for each type of FPS. The questionnaire allows us to identify the following PRP schemes: (1) ex-post premium based on performance evaluation (FPS_POST); (2) ex-ante premium based on competence development (FPS_ANTE). For both kinds, we can distinguish whether the premium is assigned only to individual employees (FPS_IND), only to groups, or teams, of employees (FPS_TEAM) or to both of them (FPS_BOTH). Table A2 reports the adoption of every type of wage premium and that for an FPS of any kind. The most common ones are the ex-post types of premiums, adopted by roughly 50% of firms , while the ex-ante types are used in less than 20% of firms. The three alternative choices, FPS_IND, FPS_TEAM and FPS_BOTH, show a strong prevalence of individual schemes[10].

Once the factors related to the willingness to introduce FPS have been identified, we plug in the economic performance equation (2) the fitted values of FPS (FPS_FITTED). In addition, we include a set of controls and a series of innovation-related variables (INNO), which can potentially influence the economic performance of the firm.

[10] Given the structure of the questions, it can be that the decision to adopt a certain type of wage premium is not independent from the decision to adopt the other types of premium. Since the alternatives are not independent, and the error components among different specifications can be correlated, we also estimate equation (1) through a bivariate probit specification for FPS_POST and FPS_ANTE. We found that bivariate and univariate probit models provide similar results. For simplicity, when estimating the second-stage productivity equation, we use the predicted values of FPS adoption extracted from the univariate probit estimates.

The labour productivity equation (2) takes the following form:

$$(2)\ [LABPROD]_{i,09\text{-}11} = a + b_0[Controls2]_{i,06\text{-}08} + b_1[FPS\_FITTED]_{i,06\text{-}08} + b_2[INNO]_{i,06\text{-}08} + v_i$$

where LABPROD is a measure of labour productivity (i.e. value added per employee), 06-08 and 09-11 represent the time spans in which variables are measured. To take into account the fact that we included fitted values from equation (1), the estimation is based on OLS with bootstrapped standard errors. [11]

The estimation of equation (2) may suffer from a series of problems. The first is the high collinearity among the various predicted values of FPS adoption. In order to tackle this issue, we introduce each predicted term separately in different specifications.

The second issue concerns endogeneity. Due to the cross-sectional nature of our data, we cannot fully control for reverse causality and omitted variables. However, we try to mitigate endogeneity in two ways[12].

First, we use lagged independent variables and predicted values for reducing the simultaneity bias. The main reason why simultaneity occurs is because firms may self-select into FPS adoption: better performing firms may have higher financial and organizational capabilities for adopting variable payment systems, or it can be that larger firms – which generally are also more productive – adopt FPS schemes because they are more unionized. To address this issue, we estimate a first-stage FPS adoption equation, in which we check all the observed factors potentially related with it.

Secondly, we saturate the model with controls, especially concerning managerial attitudes, in order to reduce unobserved heterogeneity as much as possible.

3.2 Data and variables

Data come from an original dataset extracted from a unique firm-level survey on manufacturing firms with at least 20 employees located in the Emilia-Romagna (ER hereinafter) region, Italy. In 2009 a company specialised in polls and surveys carried out interviews on factors and activities

[11] We also estimated Equations 1 and 2 on the subsample of unionized firms. The first stage results are largely unchanged with respect to the whole sample. The differences are mainly in the labour productivity equation where the FPS fitted variables. For the unionized subsample the links between FPS and labour productivity are weaker than those that emerged for the whole sample. The analysis on the unionized firms would have called for a similar analysis on the non-unionized sample, which is too small to provide reliable and robust estimates. For this reason, we decided to stick to the whole sample results. Results for the unionized sample are available upon request from the authors.

[12] With this exercise, we are not able to identify clear causal relationships among variables, but robust correlations in a multivariate framework.

developed in 2006-2008, providing a CIS-like set of information and additional in-depth data on organizational structure, industrial relations and firms' characteristics. These data were merged with balance sheet information from the AIDA database, provided by Bureau van Dijk, and covering the 2003-2011 period. This made it possible to mitigate potential simultaneity bias when testing the FPS-productivity ratio, since in estimating equation (1) we control for past performance in 2003-2005.

The survey provides a representative sample stratified by size, sector and geographical location of the ER manufacturing firms "population" (see tab.A1 in Appendix). The datasets collect information on many firm-level activities, the most important of which pertain to innovation, managerial attitudes and industrial relations, which we use to address the unobserved heterogeneity that typically affects the empirical analysis based on firm-level surveys (for example, see Antonioli *et al*. 2013a; b).

3.2.1 Variables specific to Equation 1: FPS Determinants

FPS measures as dependent variables

Several dummies determining the different firm strategies in FPS adoption are used as dependent variables, as anticipated in the equation described above (1). First, we use a dummy to identify FPS adopters (FPS), then we refine this variable distinguishing firms adopting FPS_ANTE, which captures the introduction of payment for competence development, and FPS_POST, which tells us whether or not the firm introduced wage premiums on the basis of economic performance and productivity. In addition, the questions on FPS were addressed to determine whether the premiums involve only individuals (FPS_INDIV), only teams (FPS_TEAM) or jointly individuals and teams (FPS_BOTH).

Exploiting both survey and balance sheet information, we clustered the factors potentially related to FPS adoption into five groups: Organisational Change, Training, Workforce Composition, Past Economic Performance and Industrial Relations.

Controls1

In estimating equations (1) we include as controls a set of size dummies (20-49, 50-99 and 100-249 employees), two-digit industry dummies[13], a dummy capturing the location of the firm in the

[13] The classification follows the NACE Rev 1.1 classification of economic activities. We also aggregated some of the two-digit sectors in order to end up with a lower number of sectors. See table A2 for details..

centre of the region[14], which is the backbone of the ER industrial system (CentralReg). We also control whether the firm is foreign owned (ForeignOwn).

Organisational Change: production and work organisation

Two main sets of organizational changes are used as covariates in equation (1).

The first one refers to changes in production organization, which concern the introduction of team work, quality circle, just in time and total quality management. The additive index used (OrgProd_Index) provides evidence on the extended adoption of such practices. The number of practices adopted is divided by the total number of practices listed in the questionnaire survey.

The second set concerns the organizational practices that are more directly related to jobs and tasks (see tab.A2 in Appendix), such as widening of employee responsibility and autonomy in performing their tasks and delayering of the hierarchical structure. Since the FPS can be strictly related to the adoption of this kind of work organisational practices in a "complementary fashion" (Ramsay *et al.* 2000; EC 2002), we argue that changes in this organisational sphere contribute in a specific way to the adoption of FPS. For this reason we treated the work organisation variables in order to reduce their number to a smaller number of principal components. The four predicted components (tab.1) can be interpreted as follows: The first represents the widening of employee's autonomy and responsibility (EmpAutResp); the second mainly represents employee appraisal (EmpAppr); the third is the component of hierarchical layer reduction (Delayer); the last sums up the changes to improve employees' multi-functionality (EmpPolif). The principal components obtained are included in the first stage specification.

Training

Among the various HRM practices that each firm can adopt, training is crucial in determining the workforce knowledge base. The widening of the employees' knowledge base may lead the firm to delegate to them more responsibility and autonomy, with the need of FPS introduction in order to secure employees effort with a little amount of monitoring activity. We then use a dummy variable to capture the existence of training activity within each firm (Train).

TABLE 1 HERE

[14] This variable captures a distinctive feature of Emilia-Romagna's industrial structure: the concentration of districts and firms in the central region provinces (Parma, Modena, Reggio Emilia and Bologna). We include this control because district-based firms introduced wage premiums before the other firms.

Workforce Composition

The workforce composition is also important in influencing FPS adoption. In particular, we included in the specifications a variable measuring the percentage of workers with a fixed term contract (FixedTermEmp), as they are more likely to be excluded from wage premiums than their permanent counterpart (Cainelli *et al.*, 2002) or, if included, the flexible wage scheme is used by the management to motivate and increase the effort of this component of the work force (Cristini and Leoni, 2007).

Past economic performance

A further element that may influence the adoption of FPS is also the firm's past economic performance. This element is important because it provides evidence of the each firm's potential "ability to pay": the higher the past performance, the higher the probability to introduce FPS because of the available financial resources. Past performance is captured by the employee's productivity (VAEMP0305) over the period 2003-2005, just before the survey period of reference (2006-2008).

Industrial relations

Finally, we consider industrial relations at the firm level. As indicated by recent studies (Arrowsmith and Marginson, 2009) the role of unions and, above all, the role of firm-level relations between unions and management may influence FPS adoption. For this reason, we include two measures of participative industrial relations: the first concerns the degree of union involvement (information, consultation or bargaining) over specific innovation strategies (Union_Inv); the second regards the information and consultation of single employees over several innovation strategies pursued by the management (Emp_Inv).

3.2.2 Variables specific to Equation (2): FPS effect on firm economic performance

Firm economic performance

For the second stage of the analysis, we measure the firm economic performance through labour productivity, given by the average of the log of value added per employee (lnVAEMP0911)[15] over 2009-2011[16]

Controls2

In estimating equation (2) we include as controls the openness toward international markets using the share of turnover due to exports (Export), the belonging to a group (Group) and, as in equation (1), the set of size dummies and the average of the physical capital per employee (KEmp0608) over the years 2006-2008.

Innovation strategies

As shown by the literature on the determinants of firm-level productivity (e.g. Arvanitis, 2005; Giuri *et al.*, 2008; Hall *et al.*, 2012; Antonioli *et al.*, 2010; Mazzanti *et al*., 2006), innovation strategies and information and communication technologies (ICT) are crucial factors. As a further set of performance influencing factors, we include the adoption of product and process innovation (ProdInno and ProcInno) and the adoption of highly specialised ICT, such as Electronic Data Interchange (EDI) or Material Requirements Planning (MRP) (for a full list of items see tab.A2 in Appendix). Finally, an additional control for innovation strategy, environmental innovation (EcoInno), is included (see tab.A2 in Appendix for a description of the variables).

Flexible Pay System

The main variables of interest are the fitted values of FPS adoption extracted from equation (1). Different fitted probabilities are computed according to each dependent variable used in the first stage: $\widehat{FPS}$, $\widehat{FPS\_INDIV}, \widehat{FPS\_TEAM}, \widehat{FPS\_BOTH}, \widehat{FPS\_ANTE}$ *and* $\widehat{FPS\_POST}$ respectively. A positive and significant effect of such variables in equation (2) means that higher probabilities of adoption of FPS, mediated by the first stage covariates, are related to higher productivity gains for

[15] The problem of missing values in value added has been solved interpolating the missing information on the basis of the following firm characteristics with no missing information: size, sector, geographical location (9 provinces) and group..

[16] Econometric analysis has also been conducted on the productivity differential that each firm shows with respect to the average productivity of its own sector.. The averages are used in order to determine whether each firm outperforms the average sector level, identified by the two-digit Nace Rev 1.1 classification, differencing out the values lnVAEMP0911 for each firm by the sector average each firm belongs to.

each firm. The use of fitted values from the first stage equation should also account for the potential self-selection of firms into FPS adoption.

The main covariates included in our estimations do not seem to generate a problem of severe multicollinearity as emerges from the correlation matrix reported in Appendix, Table A3 and Table A4.

4. Estimation results

Table 2 presents the first-stage probit results for FPS adoption, while Table 3 the second-stage OLS results for labour productivity.

The control variables in Table 2[17] show some links with FPS adoption. There is evidence of industry-specific effects, while size effects are more ambiguous. Food and Machinery firms show greater willingness to adopt wage premiums of any kind of schemes, except for FPS_BOTH and FPS_IND. The Machinery firms are the pillar of manufacturing structure of the region, and are the most advanced in innovation strategies (Antonioli *et al.*, 2011). As far as size is concerned, the group of smaller firms (20-49 employees) and the medium ones (100-249 employees) are negatively related to the introduction of wage premiums jointly for both individual workers and for teams (FPS_BOTH) with respect to the largest firms (>250), the reference category for the size dummies. The lower propensity for FPS among small and medium size firms could be explained by the higher complexity of the wage premium applied to both individual and groups of workers at the same time, given the possible conflict in their management. The opposite holds instead for ex-ante and individual premiums, but only for the small firms (20-49 employees) where the willingness to adopt FPS is greater.. Maybe this could be interpreted as searching activity for a direct involvement of workers in the organizational innovation at shop floor level via wage premiums with these specific characteristics in small firms: individual premiums are a simple type of FPS, even easier to manage when applied to a small potential number of workers and the same holds with ex-ante premiums based on worker competences if these are well known by the owner and managers of the firm. The adoption of wage premiums of any kind (FPS) is positively affected by ownership characteristics, given that firms under foreign control are more likely to introduce FPS and particularly FPS based on previous economic and productivity performance. This could also respond to the ability to pay for these firms, in a context in which managerial styles are more favourable to flexible wages, in order to share the entrepreneurial risk with employees and to induce

[17] Results on controls are not reported due to lack of space, but they are available from the authors upon request.

less absenteeism and more effort of the workforce. The ex-post wage premiums respond to a traditional concept of pay for performance strategy, based more on incentive and effort mechanisms, and risk/profit-sharing than on investment on workers' capabilities.

TABLE 2 HERE

Looking at the organisational variables, we find a significant relationship between FPS and Organizational Change, in particular through the adoption of other work organization innovations. More in detail, the evidence suggests that while innovations in the organization of production mainly affect the propensity for FPS adoption for both individual and team wage premiums (BOTH_FPS), work organization innovations have larger impact on other wage premium schemes.

The component represented by the employee appraisal (EmpAppr) and that representing the hierarchical layer reduction (Delayer) affect positively almost all the schemes; the changes to improve employee polyfunctionality (EmpPolif) affect only team wage premiums, while the only component that does not affect probability to adopt FPS is that represented by the increasing of employee autonomy and responsibility (EmpAutResp). Significantly, the flexible wage scheme which is less affected by work organization practices is the individual wage premium, and this is noticeably the only one positively affected by the diffusion of fixed-term contracts within the firm.

The change in working practices emerges as an important factor which is linked to wage premiums: firms introducing more work organization practices are also more likely to introduce flexible pay schemes, and this holds for almost any kind of premium. This can be interpreted as a sort of complementary strategy to join organizational innovations with flexible pay systems. This result could be recognized as a positive awareness, by firms, of the relevance of complementarities among best work organization practices and worker salaries for the competitiveness of the firm.

These complementarities could be associated with the need to invest in the internal work force of the firm, using schemes not simply linked to incentive motivations for individual effort. Our interpretation could be supported by the evidence that the adoption probability of FPS, when strongly affected by organizational innovations, is not influenced by fixed-term employment contracts, which instead are relevant only for individual flexible pay systems less affected by organizational innovations. At the same time, past economic performance in terms of labour productivity does affect the adoption of flexible wage premiums addressed to individuals. The hypothesis of FPS adoption as past *ability to pay* effect seems robust to individual payment, while no effects emerge for team payment or when teams are involved (FPS_BOTH). Individual FPS seems to emerge as a traditional scheme influenced by the need to introduce monetary incentives, in

particular for workers with fixed-term contracts, and in firms where ability to pay motivation prevails. Significantly, the non-individual wage premiums emerge, instead, as complementary strategies linked to work organization innovations.

Finally, the strategy of FPS adoption seems to be supported by trade union policy. Union involvement via worker representatives (RSU)[18] within the firm on many topics, such as innovation strategies in organization and technology improvement, training policy, investment in green innovations, ICT, positively and significantly relates to the probability of FPS adoption of any kind and in particular for both simultaneous individual and team wage premiums and for ex-post flexible wages based on economic and productivity performance. Trade unions do not seem to discourage adoption strategies of the firm, but support them. Firms seem to look for involvement of trade unions more than they do directly with workers. Direct involvement of employees is never significant, signalling that the "road map" to adopt flexible wages is not through direct involvement of workers but through a dialogue with representatives elected by workers in a specific organism within the firm (RSU).

TABLE 3 HERE

As far as the second stage of the analysis is concerned, we tested different models, not all reported[19] here, as robustness checks. A first model included only the FPS fitted values, each at a time, and a constant; a second one a full set of controls, including also those used in the first stage, along with the FPS fitted values and the innovation variables; and a third one, the most balanced, only the controls excluded in the first stage, except the size and sector dummies, the FPS fitted values and the innovation strategy. The Akaike information criterion and that of Bayesian information criterion did not provide unambiguous insights, sometimes preferring a "saturated" model with the full set of controls and sometimes preferring the third model, with a more parsimonious specification. Our preference toward the third model, reported in Table 3, is also justified by the fact that the FPS fitted values "incorporate" all the information provided by the first stage covariates, so that the full inclusion of the latter in the second stage equations could be seen as redundant.

Turning now to the results, we notice, with regard to labour productivity (Table 3), expected results for some control variables. Size matters marginally as medium-large firms (100-249 emp.)

[18] RSU are representative organisms elected by the workers in each firm. RSU are present in 75% of the sample firms.
[19] The results are available from the authors upon request.

generally show higher productivity, with respect to the reference category of the large firms; firms belonging to different sectors (machinery, food, non-metallic mineral products and coke-chemical-rubber) outperform the textile firms, the reference category for sectors. Three other control variables are significant: the share of export on firm turnover, the group, and the capital intensity with respect to labour, are positively related to productivity as expected. These controls are highly significant for all the specifications. After taking into account size and sector effects included in the estimated equations, this evidence indicates that the openness of firms toward foreign markets, a group corporate structure of the firm, and a higher capital/labour ratio - indication of the technological intensity of the firm - are all factors positively correlated with higher productivity.

We also control for a number of innovation variables that existing literature proves to be associated to higher economic performance. At first, the result regarding the variable process innovation (ProcInno) should be stressed. Technological change in the form of innovation in the technics of productive process is correlated with productivity in four cases out of six, but in one of them the positive effects occur when the FPS does not show any significant effect on productivity. Firms seem to rely on complex strategies in order to increase their productivity gains.

We can argue that changes in process innovation, coupled with FPS schemes, mediated by the strong role of organisational changes, are all elements that, when jointly adopted in a consistent strategy, seem to add up in determining the firm's capacity to increase productivity. However, when we consider the possible effects of product innovations, innovation in ICT, and green innovations, it is worth noticing that there is no evidence of productivity gains. On the one hand, it can be that firms show a preference toward more traditional strategies, which do not involve ICT and green innovation, to achieve higher productivity levels. On the other hand, we should stress the important role of economic slowdown over the period 2009-2011 on firm performance. This negative shock may have hampered the ICT and green innovation capacity to increase labour productivity[20].

With respect to FPS, results from Table 3 point to a positive and statistically significant correlation between FPS adoption and labour productivity. However, this result is not general but depends on the specific flexible wage scheme adopted. It is worth noting that if we include the observed FPS values we do not have significant results. Hence, FPS 'impacts' on productivity only if it is used as a mediating factor between (mainly) organisational changes, labour contracts, institutional factors (non-conflictual industrial relations) and productivity.

Looking at Column 1, everything else being equal, firms adopting FPS schemes (of any kind) do benefit from a productivity premium. Roughly speaking, because we included in the specifications

[20] The crisis also modified the short term innovation strategies of the firm as a reaction to the exogenous shock (Antonioli et al, 2013).

the natural logarithm of the probability to introduce the different kind of premium, the productivity gains amount to a change of 3.1% (elasticity of VAEMP0911 to FPS) if the probability of introducing FPS doubles and holding all the other covariates constant. From Column 2, it clearly emerges that such a positive relationship holds particularly for the individual FPS case, where we register a strong and highly significant relation with productivity: doubling the probability to introduce individual premium raises productivity by about 5.4%. Finally, both post and ante premiums show a partial elasticity of around 0.03, which means that increasing the probability to introduce one of the two kind of premiums of 100% (doubling the probability) raises the productivity by about 3%. However, we do not find any statistically significant productivity effect for the other types of FPS, team wage premiums and the mix of individual and team wage premiums (FPS_BOTH): estimated coefficients are not statistically different from zero.

The evidence seems to indicate that the stronger specific effect of FPS on productivity is related to a quite traditional wage premium , individual FPS, linked to the firm's ability to pay on one hand, and to the "necessity" or "desire" to use flexible wages to stimulate the worker's effort with fixed-term contracts on the other, with limited interactions with the firm strategies in the sphere of work organization innovations and without any support from trade unions, as the first stage estimation shows. This is a very traditional *pay for performance* flexible scheme. In fact, an individual wage premium is the only flexible scheme which turns out to be little correlated to this organization innovation strategy, as emerges in Table 2 discussed above. Such types of schemes seem to be merely adopted in order to extract more effort from the employees in a way addressed to intensify the work pace, as indicated in a critical literature on organisational changes and work intensification (Green, 2004; Askenazy, 2004).

This does not mean that only traditional *pay for performance* flexible schemes related to productivity influence productivity performance within firms; and that organization innovations and non-individual pay for performance schemes, linked to organizational innovations and trade union involvement, do not influence productivity performance within firms. Indeed, the results show a quite robust relation between productivity gains with respect to the sector average and ex-ante wage premiums (FPS_ANTE). The latter are a form of less traditional flexible schemes and are based on some *pay for participation* characteristics: the commitment of employees to develop their skills and competencies in order to improve the firm's performance. This can be considered a win-win strategy, because it is beneficial both for workers, who widen and improve their human capital and possibly working conditions, in line with a literature supporting a positive perspective on organisational changes (see Handle and Levine, 2004, for a review) and for firms, which gain in

productivity. This strategy is also positively affected by worker representatives, i.e. unions, as the first stage shows.

5. Conclusions

This paper presents evidence on flexible pay system adoption and its productivity effects. Relying on an original firm-level dataset on manufacturing firms located in Emilia-Romagna, Italy, a structural model is estimated in order to account for potential endogeneity. A first stage equation on the likelihood of adopting FPS is estimated, and predicted values extracted for each type of FPS: individual, team, both, ex-ante and ex-post. Then, a second-stage productivity equation is estimated, where predicted values of FPS are separately included as regressors.

Results show that, once controlled for confounding factors, adopting FPS schemes is related to a higher level of labour productivity. However this result is not independent of the specific wage premiums adopted. The individual wage premiums seem more effective in terms of productivity gains whereas for other types of FPS, such as team wage premiums and the mix individual and team premiums, no significant effect is registered. This individual FPS scheme is very traditional. It shows weak relations in terms of innovation organization strategies within the firm, and with the adoption of best work organization practices, while it is influenced by the predominance of fixed-term labour contracts, and seems to respond to effort motivation and maybe control over this component of labour force in the firm. Industrial relations do not emerge as a sphere that affects the adoption of this scheme.

Different categories of FPS schemes, ex-post and ex-ante FPS, are instead explained by innovation in the sphere of work organizations, supported by trade union involvement, and not linked to fixed-term labour contracts: they do result in labour productivity increases. In this case, labour productivity seems also related to the adoption of process innovations in technology, probably in a complementary mode with wage flexibility. These results could indicate good managerial design of FPS schemes focusing on the involvement of workers at the shop floor level, based on past performance and on the competence model. In fact, the adoption of these schemes is positively affected by union involvement, which does seem to stimulate or at least support the adoption process, while individual wage premiums seem unaffected by trade union behaviour.

However, for more complex wage premiums, such as team and the mix of individual and team wage premiums, there is no evidence of productivity gains. These schemes seem to suffer from critical aspects in their managerial design. Possible difficulties could emerge because of the team

component, as this presents complexities in management given the necessary interactions with many dimensions of work organization changes, and this could be an indication of a lack in the necessary competences on the part of the management. The lack of impact on productivity may also be related to the timing in the management of complex wage premiums: productivity gains may emerge only some years after their adoption. We may also conclude that critical aspects arise from the fact that in a phase in which firms are hit by economic crisis and labour input is under-utilized, the management of complex flexible wage schemes is critical, whereas individual schemes based on past performance are quite elementary. In other words, the flexible scheme of working for productivity is a very traditional one and mostly designed as an individual *pay for performance* scheme, while the *pay for participation* one seems to suffer some design problems when focused on the team.

In the best case, with individual flexible wages, firm labour productivity gains are 0.054% for an increase of 1% in the probability of adopting the wage premium. At first sight, it does not seem a very great improvement. This may be the reason why only 34% of firms adopt individual wage premiums, although they are easier to manage. Productivity gains are somewhat lower for ex-ante wage premiums- 0.032% - but in this case they are adopted by only 17% of total firms. The cost of adoption and management of this type of wage premium can be quite high, and this may explain why it is less common. Ex-post wage premiums are instead adopted in 53% of total firms, despite their lower productivity gains (0.029%): the cost to implement and manage them may be lower given their simpler characteristics (related to past performance, profits, productivity, or very simple parameters such as absenteeism).

Our main results have, in synthesis, two important implications. With respect to the personnel economics literature, they increase our knowledge of the complementarity among different organizational practices and their role for increasing firm competitiveness. Moreover, they assign a further role to flexible payment systems: not just a mere mechanism for inducing greater workers' effort, but the tool by which the labour productivity effect of organizational changes materializes. From the policy perspective, they show that non-price incentives are as important as price incentives for achieving higher productivity targets. Firm competitiveness is not just the outcome of a higher worker effort and of lower labour costs, but also of the adoption of managerial and organizational innovations which stimulate skill development, learning and union involvement (Ricci, 2014).

This final consideration suggests a future line of analysis, such as a specific counter-factual study of the relative gains and costs of wage premium adoption, one which cannot be conducted at the

moment because of inadequate data. In addition, further insights on the effects of FPS adoption may be provided by the analysis of their relations with employee wages.

Appendix

Table A1 - Distribution by sector, size and geographical location of population and sample firms

Population								
Sectors	Freq.	Percent	***Size***	Freq.	Percent	***Provincia***^	Freq.	Percent
CokeChemical	130	3.2	20-49	2720	66.86	Out region	91	2.24
Food	382	9.39	50-99	726	17.85	BO	904	22.22
Machinery	1,387	34.1	100-249	414	10.18	FC	346	8.51
Metallurgy	883	21.71	250+	208	5.11	FE	196	4.82
NonMetallic	285	7.01				MO	891	21.9
PaperPrinting	197	4.84				PC	200	4.92
Shoes	236	5.8				PR	381	9.37
Textile	119	2.93				RA	229	5.63
WoodRubberPlasticOther	449	11.04				RE	667	16.4
						RN	163	4.01
Total	4,068	100		4,068	100		4,068	100
Sample								
Sectors	Freq.	Percent	***Size***	Freq.	Percent	***Provincia***^	Freq.	Percent
CokeChemical	28	5.05	20-49	208	37.48	Out region	20	3.6
Food	49	8.83	50-99	193	34.77	BO	115	20.72
Machinery	232	41.8	100-249	96	17.30	FC	40	7.21
Metallurgy	94	16.94	250+	58	10.45	FE	30	5.41
NonMetallic	42	7.57				MO	124	22.34
PaperPrinting	19	3.42				PC	25	4.5
Shoes	12	2.16				PR	49	8.83
Textile	23	4.14				RA	32	5.77
WoodRubberPlasticOther	56	10.09				RE	96	17.3
						RN	24	4.32
Total	555	100		555	100		555	100

Cochran Test

Margin of error θ

$$\theta = \sqrt{\frac{N}{(N-1)n} - \frac{1}{N-1}}$$

Interviewed firms vs. Population

0.039

Margin of error θ "usually" tolerated: 0.05. Restrictive test for small population: the smaller is N, the lesser the distance between N and *n* has to be in order to generate an acceptable θ.

^*Provincia* is a statistical geographical unit coded as NUTS3 level by EUROSTAT

Table A2 - Variables: descriptive statistics

	Mean	Std. Dev.	Min	Max	Construction
Equation (1) variables:					
Dependent variables					
FPS	0.55	0.5	0	1	1 if FPS of any type is adopted; 0 otherwise
FPS_IND	0.34	0.47	0	1	1 if only FPS for individual employees is adopted; 0 otherwise
FPS_TEAM	0.06	0.24	0	1	1 if only FPS for teams is adopted; 0 otherwise
FPS_BOTH	0.17	0.38	0	1	1 if FPS for both individual employees and teams is adopted; 0 otherwise
FPS_POST	0.53	0.5	0	1	1 if FPS based on performance is adopted; 0 otherwise
FPS_ANTE	0.17	0.38	0	1	1 if FPS based on competence development is adopted; 0 otherwise
Controls					
Size dummies(20-49 emp.; 50-99 emp.; 100-249 emp.; >250 emp (ref. category))	\	\	0	1	\
Sector dummies: Food, Machinery, WoodPaperOther, CokeChemicalsRubber, NomMetMineralProd, Metallurgy, TextileLeatherShoes (ref. category)	\	\	0	1	\
CentralReg	0.69	0.46	0	1	1 if the firm is located in one of the following central region provinces: Bologna, Modena, Reggio Emilia and Parma
ForeignOwn	0.12	0.32	0	1	1 for foreign ownership; 0 otherwise
Organisational Changes					
OrgProd_Index	0.48	0.33	0	1	Composite index: number of production organisation practices adopted divided by the total number of practices listed in the question (Quality circles, Team working, JIT, and Total Quality Management)
EmpAutResp	1.36	0.66	-0.17	2.18	Principal components capturing the changes in work organisation introduced by the firm (see section 3 for results coming from principal component analysis)
EmpAppr	1.13	0.71	-0.16	2.19	
Delayer	0.36	0.52	-0.31	1.76	
EmpPolif	0.76	0.55	-0.21	1.58	
Training					
Train_d	0.8	0.4	0	1	1 if firm adopted training programs of any kind; 0 otherwise
Workforce composition					
FixedTermEmp	0.75	0.13	0	1	Percentage of employees with a fixed-term contract
Past Economic Performance					
VAEMP0305	4.07	0.28	2.76	5.43	Average value added on the period 2003-2005 (log values deflated by industry price index)
Industrial Relations					
Union_Inv	0.98	0.92	0	3	1 if unions are informed; 2 if they are consulted; 3 if they bargain with management on decisions concerning the adoption of innovations in: technology, organisation, training, environment, ICT, internationalisation; 0 otherwise
Emp_Inv	1.18	0.56	0	2	1 if single employees are informed and 2 if they are consulted on decisions concerning the adoption of innovations in: technology, organisation, training, environment, ICT, internationalisation; 0 otherwise
Equation (2) variables:					
Dependent variables					
VAEMP0911 (log values deflated by industry price index)	3.40e-10	0.33	-1.62	1.13	Average value added per capita on the period 2009-2011 for firm j - Average value added per capita on the period 2009-2011 for

					the sector firm j belong to
Controls					
Export	0.33	0.31	0	1	Percentage of turnover made on international markets
Group	0.3	0.46	0	1	1 if firm belongs to a group; 0 otherwise
KEmp0608	50.64	52.69	-4.63	600.31	Average capital stock per capita on the period 2006-2008
Size dummies as in Equation (1)	\	\	0	1	\
Sector dummies as in Equation (1)	\	\	0	1	\
Fitted FPS variables					
$\widehat{lnFPS}$	-0.82	0.76	-3.46	0.00	Natural log of the fitted value (from first stage) of the probability to introduce FPS
$\widehat{lnFPS\_IND}$	-1.31	0.74	-3.82	-0.18	Natural log of the fitted value (from first stage) of the probability to introduce FPS_IND
$\widehat{lnFPS\_TEAM}$	-4.28	4.43	-26.50	-1.08	Natural log of the fitted value (from first stage) of the probability to introduce FPS_TEAM
$\widehat{lnFPS\_BOTH}$	-2.32	1.19	-6.36	-0.17	Natural log of the fitted value (from first stage) of the probability to introduce FPS_BOTH
$\widehat{lnFPS\_POST}$	-0.86	0.79	-3.66	0.00	Natural log of the fitted value (from first stage) of the probability to introduce FPS_POST
$\widehat{lnFPS\_ANTE}$	-2.40	1.37	-7.88	-0.28	Natural log of the fitted value (from first stage) of the probability to introduce FPS_ANTE
Innovations					
ProcInno	0.68	0.47	0	1	1 in firm introduced process innovation; 0 otherwise
ProdInno	0.7	0.46	0	1	1 in firm introduced product innovation; 0 otherwise
ICT	0.29	0.28	0	1	Index as average number of practices (management information system, EDI, MRP, SCM, CRM, ERP) introduced by the firm. Rescaled on interval (0,1).
EcoInno	0.2	0.4	0	1	1 if firm introduced ecoinnovations; 0 otherwise

Table A3 - Correlation matrix: main continuous covariates in equation (1)

		1	2	3	4	5	6	7
1	OrgProd_Index	1.00						
2	EmpAppr	0.37	1.00					
3	EmpAutResp	0.30	0.43	1.00				
4	Delayer	0.28	0.30	0.27	1.00			
5	Delayer	0.11	0.29	0.35	0.13	1.00		
6	FixedTermEmp	0.00	0.04	0.03	0.01	-0.02	1.00	
7	VAEMP0305	0.09	0.15	0.00	0.01	-0.09	0.02	1.00

Table A4 - Correlation matrix: main continuous covariates in equation (2)

		1	2	3	4	5	6
1	$ln\widehat{FPS\_IND}$	1.00					
2	$ln\widehat{FPS\_TEAM}$	0.36	1.00				
3	$ln\widehat{FPS\_BOTH}$	0.32	0.21	1.00			
4	$ln\widehat{FPS\_POST}$	0.79	0.38	0.77	1.00		
5	$ln\widehat{FPS\_ANTE}$	0.81	0.59	0.27	0.66	1.00	
6	KEmp0608	0.04	0.14	0.04	0.05	0.02	1.00

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TABLES

Table 1 - Principal Components: coring coefficients for orthogonal varimax rotation -sum of squares (column-loading) = 1

	Comp. 1 EmpAutResp	Comp. 2 EmpAppr	Comp. 3 Delayer	Comp. 4 EmpPolif
1 Task rotation and/or job rotation (with tasks unchanged)	-0.1773	0.0996	-0.0990	**0.8512**
2 Widening of the tasks and/or assignments	0.2935	-0.1079	0.1029	**0.4655**
3 Higher autonomy in performing tasks and assignments:	**0.6202**	-0.0194	-0.1127	-0.0953
4 Broadening of competencies	**0.4424**	-0.0126	0.0686	0.1855
5 Training associated to organisational needs	0.2024	**0.2715**	0.1214	-0.0227
6 Higher autonomy in problem solving	**0.4698**	0.1128	-0.0366	-0.0230
7 Structured discussion/confrontation on labour organisation and on quality of process/product	0. 1536	**0.3268**	0.1097	0.0152
8 Definition of goals for employees	-0.0170	**0.5839**	-0.0629	-0.0271
9 Employee performance evaluation systems	-0.1071	**0.6218**	-0.0494	0.0194
10 Reduction of hierarchical layers within the same business section	0.0066	-0.1360	**0.7347**	0.0827
11 Techniques to manage information, knowledge and competency exchanges	-0.0701	0.1965	**0.6228**	-0.0777
Variance	2.749	2.661	1.763	1.408
Difference	0.087	0.897	0.355	/
Proportion	0.249	0.242	0.160	0.128
Cumulative	0.249	0.491	0.652	0.780

Table 2 - Probit results of Equation (1)

	(1) FPS	(2) FPS_IND	(3) FPS_TEAM	(4) FPS_BOTH	(5) FPS_POST	(6) FPS_ANTE
Controls						
Size:20-49emp.	0.005	0.136*	0.016	-0.103**	-0.012	0.179***
	(0.071)	(0.074)	(0.039)	(0.052)	(0.070)	(0.057)
Size:50-99emp.	0.028	0.095	0.026	-0.019	0.019	0.055
	(0.065)	(0.065)	(0.034)	(0.045)	(0.066)	(0.052)
Size:100-249emp.	-0.057	0.085	0.035	-0.107**	-0.083	0.034
	(0.069)	(0.069)	(0.036)	(0.048)	(0.069)	(0.053)
Food	0.191**	0.095	0.493***	0.010	0.175**	0.219**
	(0.088)	(0.108)	(0.082)	(0.080)	(0.089)	(0.109)
Machinery	0.129*	0.125	0.456***	-0.013	0.122*	0.221**
	(0.072)	(0.091)	(0.075)	(0.066)	(0.072)	(0.099)
WoodPaper	0.035	0.077	0.425***	-0.057	0.015	0.142
	(0.086)	(0.107)	(0.079)	(0.082)	(0.086)	(0.108)
CokeChemicalsRubber	0.112	0.140	0.437***	-0.011	0.096	0.168
	(0.083)	(0.103)	(0.078)	(0.076)	(0.083)	(0.106)
NomMetMineralProd	0.099	0.102	0.408***	0.012	0.070	0.183
	(0.094)	(0.110)	(0.080)	(0.081)	(0.095)	(0.114)
Metallurgy	0.024	0.068	0.423***	-0.082	-0.005	0.183*
	(0.080)	(0.098)	(0.078)	(0.072)	(0.082)	(0.103)
CentralReg	-0.009	0.077*	-0.017	-0.048	-0.001	-0.016
	(0.039)	(0.042)	(0.020)	(0.030)	(0.039)	(0.032)
ForeignOwn	0.098*	0.003	0.031	-0.009	0.090	0.052
	(0.056)	(0.058)	(0.027)	(0.042)	(0.057)	(0.043)
ORG_CHANGE						
OrgProd_Index	0.016	-0.031	-0.021	0.101**	0.023	0.003
	(0.057)	(0.062)	(0.034)	(0.049)	(0.057)	(0.048)
EmpAppr	0.220***	0.212***	0.006	0.059**	0.223***	0.122***
	(0.027)	(0.030)	(0.017)	(0.025)	(0.027)	(0.026)
EmpAutResp	0.029	0.054	0.016	-0.023	0.019	0.026
	(0.029)	(0.034)	(0.018)	(0.025)	(0.030)	(0.025)
Delayer	0.170***	0.062	0.040**	0.060**	0.164***	0.146***
	(0.035)	(0.038)	(0.019)	(0.028)	(0.035)	(0.025)
EmpPolif	-0.023	-0.025	0.034*	-0.038	-0.033	-0.018
	(0.034)	(0.037)	(0.020)	(0.029)	(0.034)	(0.028)
WORKFORCE						
FixedTermEmp	0.189	0.264**	-0.021	-0.035	0.217	0.009
	(0.140)	(0.133)	(0.081)	(0.104)	(0.141)	(0.104)
TRAINING						
Train_d	-0.008	-0.047	0.021	0.064	0.003	0.004
	(0.047)	(0.054)	(0.029)	(0.049)	(0.048)	(0.042)
PAST_EC_PERF						
VAEMP0305	0.116	0.135*	-0.016	-0.029	0.099	0.079
	(0.071)	(0.081)	(0.031)	(0.059)	(0.072)	(0.054)
INDREL						
Emp_Inv	0.025	-0.003	-0.015	0.016	0.024	-0.045*
	(0.034)	(0.034)	(0.017)	(0.028)	(0.034)	(0.027)
Union_Inv	0.073***	-0.022	0.008	0.073***	0.077***	-0.017
	(0.023)	(0.023)	(0.012)	(0.016)	(0.023)	(0.017)
N	555	555	555	555	555	555
Pseudo R^2	0.270	0.129	0.118	0.193	0.268	0.197
Chi2 (d.f.=21)	165.937	86.328	564.456	83.874	164.990	98.432
Chi2 p-value	0.000	0.000	0.000	0.000	0.000	0.000

*; **; *** significant at 10%, 5%, 1% respectively; robust standard errors in parenthesis; Dummy variable reference groups: Textile for sectors; equal or more than 250 employees for size; Marginal effects reported.

Table 3 - OLS results of Equation (2): VAEMP0911 as dependent variable

	(1)	(2)	(3)	(4)	(5)	(6)
			VAEMP0911			
Controls						
Size:20-49emp.	-0.001	-0.030	-0.022	-0.008	0.000	-0.043
	(0.045)	(0.055)	(0.052)	(0.054)	(0.050)	(0.052)
Size:50-99emp.	0.024	0.011	0.025	0.022	0.025	0.020
	(0.044)	(0.051)	(0.055)	(0.040)	(0.044)	(0.047)
Size:100-249emp.	0.073	0.052	0.076	0.068	0.074	0.064
	(0.047)	(0.044)	(0.050)	(0.050)	(0.049)	(0.048)
Food	0.360***	0.354***	0.773**	0.388***	0.363***	0.304***
	(0.079)	(0.074)	(0.317)	(0.061)	(0.087)	(0.095)
Machinery	0.237***	0.215***	0.629**	0.259***	0.239***	0.165**
	(0.060)	(0.065)	(0.303)	(0.049)	(0.064)	(0.077)
WoodPaper	-0.058	-0.077	0.312	-0.044	-0.055	-0.114
	(0.073)	(0.084)	(0.282)	(0.076)	(0.085)	(0.078)
CokeChemicalsRubber	0.242***	0.223***	0.628**	0.263***	0.244***	0.185**
	(0.069)	(0.068)	(0.294)	(0.066)	(0.076)	(0.090)
NomMetMineralProd	0.183***	0.165*	0.551**	0.206***	0.187*	0.125
	(0.070)	(0.086)	(0.281)	(0.076)	(0.096)	(0.105)
Metallurgy	0.057	0.040	0.434	0.075	0.061	-0.012
	(0.062)	(0.059)	(0.291)	(0.052)	(0.067)	(0.073)
KEmp0608	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***
	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Export	0.138**	0.141**	0.137**	0.138**	0.138***	0.143**
	(0.055)	(0.058)	(0.054)	(0.057)	(0.048)	(0.060)
Group	0.093***	0.089**	0.103***	0.099***	0.094***	0.090***
	(0.032)	(0.037)	(0.030)	(0.032)	(0.033)	(0.034)
INNO						
ProcInno	0.058**	0.055*	0.063*	0.060*	0.058*	0.055
	(0.027)	(0.029)	(0.038)	(0.035)	(0.035)	(0.034)
ProdInno	-0.016	-0.019	-0.006	-0.012	-0.016	-0.017
	(0.030)	(0.037)	(0.030)	(0.040)	(0.027)	(0.030)
ICT	0.015	0.005	0.038	0.027	0.016	0.005
	(0.056)	(0.043)	(0.037)	(0.044)	(0.048)	(0.042)
EcoInno	-0.012	-0.014	-0.010	-0.009	-0.012	-0.015
	(0.031)	(0.032)	(0.039)	(0.040)	(0.037)	(0.035)
FPS (FITTED)						
$\widehat{lnFPS}$	0.031*					
	(0.018)					
$\widehat{lnFPS\_INDIV}$		0.054***				
		(0.018)				
$\widehat{lnFPS\_TEAM}$			-0.021			
			(0.017)			
$\widehat{lnFPS\_BOTH}$				0.004		
				(0.015)		
$\widehat{lnFPS\_POST}$					0.029*	
					(0.017)	
$\widehat{lnFPS\_ANTE}$						0.032***
						(0.012)
Constant	3.622***	3.713***	3.132***	3.580***	3.618***	3.760***
	(0.076)	(0.080)	(0.377)	(0.075)	(0.071)	(0.103)
N	555	555	555	555	555	555
Adjusted R^2	0.301	0.308	0.302	0.298	0.301	0.307
chi2(d.f.=17)	277.370	452.402	411.942	647.324	337.079	427.677
Chi2 p-value	0.000	0.000	0.000	0.000	0.000	0.000

*; **; *** significant at 10%, 5%, 1% respectively; bootstrapped standard errors in parenthesis; Dummy variable reference groups: Textile for sectors; equal or more than employees for size); missing values in the accounting variables interpolated.