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Innovative work practices, ICT use and employees' motivations*

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Abstract

I investigate the impact of innovative work practices and of Information and Communication Technologies (ICT) on employees' motivations. While the existing literature assumes that their positive effects on performance are due to employees' motivation but only assess related concepts, this paper directly analyses employees' motivations. The data come from a cross-sectional survey conducted in 2013. The paper provides new and interesting results on how firms can build a motivational environment shaped by work practices and ICT. I resort to an original empirical framework that permits one to take into account the potential reverse causation between, on the one hand, the voluntary participation in innovative work practices and the use of ICT and motivations on the other. Within this framework, I modify what previous analyses reveal about quality circle and training participation. The results confirm the positive role of work practices such as teamwork, quality norms, formal appraisals, management recognition and family-friendly policies on employee's positive attitudes. Moreover, I introduce a large range of ICT compared to existing research and find that the ICT that most contributed to the development of a motivational environment are those that facilitate access to information and knowledge such as workflow, Internet and e-mail.

Keywords: Innovative work practices; Information and communication technologies; Employees' motivations

JEL classification codes: J81 ; L23 ; M12 ; M54

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1 Introduction

To increase the performance of their firm, employers need to design an organization of work that motivates employees. In a long-standing tradition within labour economics, firms exist in a large part to provide the proper incentives to obtain the optimal provision of employees' effort. To reduce the agency problem the employer resorts to pay-for-performance and closer monitoring with sanctions when substandard work is observed. The development of human resources management literature permits one to broaden the analysis of the human resources tools employers have to motivate their employees. In the literature, there is no consensus on the scope of human resources work practices and this paper analyses a large range of practices covering 'high performance work organization' practices (such as teamwork, quality management), 'high-commitment employment practices' or 'human resources management' practices (personnel policies such as trainings, consultancy, appraisal and family-friendly policies). The work environment is shaped by these work practices but also by the diffusion of Information and Communication Technologies (ICT such as ERP, Internet...). The literature underlines that technologies investments and work practices impact on the structure of the firm (Bloom et al., 2014; Garicano, 2000; Garicano and Rossi-Hansberg, 2006) and improve the performance measured at the firm level (Black and Lynch, 2001; Bresnahan et al., 2002; Brynjolfsson and Hitt, 2000), the industry level (Atrostic and Nguyen, 2005; Jorgenson and Stiroh, 2000) and the country level (Jorgenson, 2001).

These positive effects of technologies and work practices on performance underlined in the literature are often explained by assuming positive effects on employees' motivations but most of the time only related concepts are analysed. An important body of work does indeed reveal that a well-designed work organization permits an increase in individual job performance through the encouragement of positive employee attitudes such as job satisfaction, organizational commitment or citizenship (see Becker and Huselid, 2006; Boxall and Macky, 2009, for reviews). In most of the existing literature, the focus is put on innovative work practices and technologies are largely neglected (*e.g.* Gallie et al., 2001; Godard, 2001; Mohr and Zoghi, 2008; White and Bryson, 2013). When ICT are introduced only a small range of the ICT currently available at work is studied (such as computer and Internet in Askenazy and Caroli, 2010; Cappelli and Neumark, 2001; Martin and Omrani, 2015). Moreover, the potential reverse causation due to behavioural correlation between, on one hand, the voluntary participation in innovative work practices and the use of ICT and, on the other hand, employee attitudes are, to my knowledge, never taken into account.

As motivations are the drivers of employees' performance it is important to analyse motivations as such directly. The relationships between the innovative work practices, ICT and motivations are little studied and when it is the case the measure of motivations is aggregated (Godard, 2001) or limited to parts of motivations such as intrinsic ones (Martin, 2011).

This work is, to my knowledge, the first that assesses the whole continuum of employees' motivations as defined by social psychologists following the original work of Deci (1975). This continuum of motivations draws on the Motivation at Work Scale (MAWS) developed by Gagné et al. (2010) following the Self-Determination Theory (SDT) of Gagné and Deci (2005). Motivations are the drivers of employees to make an effort and to maintain this effort until they achieve the goals fixed by the employer. Employees exert effort because of the tasks themselves (intrinsic motivations), because of values and goals sharing with the employer (identified regulation), because of self-worth contingencies (introjected regulation) or because of the rewards (external regulation).

The aim of this paper is to investigate if the benefits to employees (in terms of job discretion, continuous learning...) of participating in innovative work practices and using ICT, exceed the costs (in terms of work stress, time famine...) and thereby motivate employees to exert effort.

To provide insights on employees' motivations, I use survey-based Luxembourgish data for the year 2013. The data constitutes a large representative sample of 14 685 employees working in the Grand-Duchy of Luxembourg across establishments employing 15 persons and more, in all range of private sectors. Hence, the paper gives results on employees working in a continental Europe service economy and includes not only Luxembourgish employees but also French, Belgian, German and some other nationalities. A drawback of the data is that it is a single cross-section. However, it includes a variety of items capturing the continuum of individual work motivation that is not commonly observed in representative samples. Moreover, the richness of the data allows me to control for a broad set of individual, job and establishment characteristics. Thus, the data makes it possible to model the impact of a large range of innovative work practices and ICT on employees' motivations. The paper does indeed provide interesting results on how employers can design a motivational work environment. The original empirical framework that permits one to take into account the potential reverse causation between, on one hand, the participation in innovative work practices and ICT uses and, on the other hand, motivations, points out that the existing evidence about quality circle and training participation are modified. The results confirm the positive role of work practices such as teamwork, quality norms, formal appraisal, management recognition, or family-friendly policies on employees' positive attitudes and the positive role of pay incentives. Employees using ICT that facilitate information and knowledge access such as workflow, Internet and e-mail are more motivated than others.

The article proceeds as follows. Section 2 reviews the literature and develops hypotheses related to innovative work practices, ICT use and employees' motivations. Section 3 describes the data, the variables and the estimation strategy. Section 4 presents and discusses the results. Section 5 concludes.

2 Conceptualisation and related literature

2.1 The motivation concept

The concept of motivation, *i.e.* the willingness to exert effort, studied in this article covers all its facets. This continuum of motivations is defined in social psychology by the Motivation at Work Scale (MAWS) of Gagné et al. (2010) based on the Self-Determination Theory (SDT) of Gagné and Deci (2005). It covers the controlled motivations: external regulation and introjected regulation and the autonomous ones: identified regulation and intrinsic motivation.

At the lower end of the continuum, there is the external regulation that appears when employees' behaviours at work are regulated by a high level of pay and by obtaining rewards. Introjected regulation refers to the regulation of behaviours due to self-worth contingencies. Workers are internally pressured and do an activity because of guilt or because they want to maintain their self-worth. Identified regulation drives employees' behaviours when they do a job because they identify with its value or meaning or because of its consistency with personal goals. At the upper end of the continuum, there is intrinsic motivation, which refers to the fact that doing an activity is driven by emotions. This motivation is well defined by Deci (1975): "one is said to be intrinsically motivated to perform an activity when one receives no apparent reward except the activity itself" (Deci, 1975, p.105). The activity is, indeed, done for its own sake because it is interesting and enjoyable.

In terms of behaviours, autonomous motivations (identified regulation and intrinsic motivation) are assumed to induce more information sharing, more cooperation, more intra and extra-role performance, lower absenteeism and lower turnover intentions. Gagné et al. (2010) show that autonomous motivations are positively related to positive employee outcomes such as organizational commitment and job satisfaction. Committed employees identify themselves with their work, team and/or firm. They internalise the goals fixed by the employer thus changing their norms and values. The achievement of these goals generates positive feelings such as contentment and pride. Satisfied workers are more productive than others (Böckerman and Ilmakunnas, 2012) and have lower turnover intentions (Böckerman and Ilmakunnas, 2009). Conversely, controlled motivations (external regulation and introjected regulation), even if not necessarily bad, are not the most valuable for the firm, as they are unrelated to positive employee outcomes except continuance commitment (Gagné and Deci, 2005; Gagné et al., 2010).

2.2 Innovative work practices and positive employee attitudes

To define a motivational environment and obtain a high level of performance from their employees, employers need to invest in innovative work practices (see Becker and Huselid, 2006; Boxall and Macky, 2009, for reviews). In the existing literature, there is no consensus on the

scope of these innovative work practices. I retain a large range of innovative work practices designed to favour employees' positive attitudes. They cover the way the work is organised (such as teamwork, quality circle, total quality management), the personnel policies (such as trainings, consultancy, appraisal) and family-friendly practices (such as telework).

The relationships between these innovative work practices and the continuum of motivations defined by Gagné et al. (2010) have not hitherto been studied but the relationships with related concepts has been the object of previous research. From this body of work, we know that a well-designed work organization permits the increase of individual job performance through the encouragement of positive attitudes in employees. Taken as a bundle, it appears that innovative work practices are positively linked with related concepts such as organizational commitment, job satisfaction and citizenship (Godard, 2001; Macky and Boxall, 2007; Ramsay et al., 2000; White and Bryson, 2013).

Taken one by one, work practices are not always significantly and positively related to positive employee attitudes (Appelbaum et al., 2000; Gallie et al., 2001; 2012; Godard, 2001; 2010; Mohr and Zoghi, 2008). Teamwork and job rotation are highlighted to be two of the most important work practices to encourage employees to exert effort (Appelbaum et al., 2000; Jones and Kato, 2011; Gallie et al., 2012; Mohr and Zoghi, 2008). These practices are indeed a good way to enrich the work of employees. Tasks and roles become interchangeable between those employees working in teams or related through a job rotation scheme. It permits giving more responsibilities to individuals through the decentralisation of decision-making. It also gives to individuals more discretion and flexibility. Nevertheless, at the same time it also increases peer pressure that can lead to a decrease of positive attitudes, as shown by Godard (2001) for job rotation. The participation in a quality circle (or problem-solving group) allows employees to be actors of the changes affecting their jobs. The relationships with employee attitudes are positive for Godard (2010) and Mohr and Zoghi (2008) but non-significant for Gallie et al. (2001). Quality control of production, worker environment and safety in the framework of the Total Quality Management (TQM) approach is also adopted to favour the involvement of employees. The association is positive with job satisfaction for Martin and Omrani (2015) but non-significant with a large range of employee attitudes for Godard (2001). On the contrary, an organization of work based on just-in-time makes the job close to a 'Taylorized' one and decreases the richness of tasks and the responsibilities given to employees at lower levels. As shown by Godard (2001), just-in-time is negatively correlated with job satisfaction and commitment. At the same time, tailored work is often compensated financially.

Moving on to consider personnel policies, downward communication and staff consultations through meetings, surveys or suggestion programs also appear as important work practices through which employers favour employee attitudes. They permit communication within the firms on *e.g.* the objectives pursued by the firm and its salary and reward policy. They are

also channels for the voice of employees (Gallie et al., 2001; Godard, 2010; Mohr and Zoghi, 2008). Development of employees' skills through trainings, performance appraisals and feedbacks values employees and is supposed to increase their self-esteem. These practices are, thus, important practices for employees' commitment (Appelbaum et al., 2000; Gallie et al., 2001). Moreover, performance appraisals are used by managers to decide appropriate rewards.

Prior work looking at the association between family-friendly policies and employee attitudes has found positive associations (Ernst Kossek and Ozeki, 1998). At the firm level, (Bloom et al., 2011) show positive relationships between family-friendly policies and firm labour productivity, but these relationships disappear when they control for other innovative work practices.

Grounded on previous evidence, the following hypotheses about the relationships between innovative work practices and employees motivations are formulated:

Hypothesis 1a: Teamwork, personnel policies and family-friendly policies are expected to have positive effects on motivations.

Hypothesis 1b: Just-in-time is expected to have negative effects on autonomous motivations and positive ones on controlled motivations.

Hypothesis 1c: The effects of job rotation, participation in a quality circle and TQM on motivations are expected to be positive or non-significant.

2.3 Incentives and positive employee attitudes

In line with the principal-agent model, employers can also resort to incentives through the two options of 'carrot' and 'stick': a positive incentive (contracting on output through performance pay) and a negative one (a control on input by monitoring). The effects of incentives on motivations need to be assessed.

As shown by Frey and Jegen (2001), monetary incentives increase or 'crowd in' the provision of effort. Prior empirical works on the relationships between the 'carrot' and employee attitudes do reveal a positive link with extra-effort (Martin and Omrani, 2015) but a negative link with commitment (Gallie et al., 2001), while non-significant links with commitment and job satisfaction are also shown (Godard, 2010; Martin and Omrani, 2015). The direct supervision of employees is likely to become counter-productive and negatively influence the provision of employees' effort as highlighted by the 'crowding out' hypothesis (Frey, 1993; 1997; Frey and Jegen, 2001). The diffusion of technological tools that instantly provide indicators of work performance modifies the role taken by the supervisor. It helped managers to develop 'longer distance' forms of control between an employee and his or her supervisor based on performance appraisal. In the new management design view, the role of the supervisor is much more a 'leadership' one than a disciplinary one (Gallie et al., 2001). Therefore,

the following hypotheses are formulated:

Hypothesis 2a: Pay incentive is expected to have a positive effect on motivations.

Hypothesis 2b: Traditional front-line forms of monitoring are expected to have negative effects on motivations.

2.4 Information and Communication Technologies use and positive employee attitudes

Information and Communication Technologies also participate in the definition of a motivational environment but, as for innovative work practices, the relationships with employees' motivations have not hitherto been studied. However, evidence concerning related concepts exists. The assessment of the effects of ICT on positive employee attitudes in prior work focuses on a narrow range of technologies (*i.e.* computer and Internet use). Thus, it captures only a part of the technologies used at work. For example, computer use reveal non-significant links with commitment (in 1992 and 1996 in Gallie et al., 2001), social support, job satisfaction and extra-effort (in 2005 and 2010 in Martin and Omrani, 2015) and positive links with labour productivity (in the period 1977-1996 in Cappelli and Neumark, 2001).

Bloom et al. (2014), Di Maggio and Van Alstyne (2013), Garicano (2000) and Garicano and Rossi-Hansberg (2006) show that the consequences of information and communication technologies uses by employees in their work life are various and can have opposite consequences on their discretion and responsibilities. First, technologies that facilitate information access inside the firm, such as ERP (Enterprise Resource Planning), are associated with more autonomy and an increase in performance. Reducing the cost of collecting, sharing and acquiring information makes learning cheaper and facilitates horizontal collaborations (Askenazy and Caroli, 2010; Despres and Hiltrop, 1995; Rubery and Grimshaw, 2001). It also permits employees to handle more of the problems they face without asking others. Superiors have better access to information that facilitates their supervision and increases their span of control (*i.e.* the number of employees they supervise) and, at the same time, increases the length of distance of their control over employees. Thus, technologies that facilitate information access push decisions down and have an empowering effect. Second, technologies that reduce internal communication costs, such as, for example, groupware, facilitate access to the relevant information and knowledge from others at a higher level in the firm. It favours specialisation, decreases the variety of tasks performed by each employee, decreases the knowledge content of their work and increases the reliance on others, implying that more problems are solved at higher levels of the hierarchy. Technologies that reduce internal communication costs push decisions upwards and employees are thus less empowered. Third, there also exist types of ICT that are not restricted to the internal access of information and knowledge, such as Internet, emails or web-conference tools used for work purposes. On one hand, these technologies re-

duce internal and external communication costs. On the other hand, they permit the acquisition of knowledge available outside the firm that might improve getting hold of the relevant knowledge for each decision. In previous work, Internet use appears to be positively linked with social support, job satisfaction and extra-effort (Martin and Omrani, 2015) and with intrinsic motivations (but only for loyal employees in Martin, 2011).

Grounded on these previous works, the following hypotheses about the relationships between ICT uses and employees' motivations are formulated:

Hypothesis 3a: Technologies that facilitate internal information access are supposed to have positive effects on motivations.

Hypothesis 3b: Technologies that reduce internal communication costs are supposed to have negative effects on motivations.

Hypothesis 3c: The net effects on motivations of technologies that facilitate internal and external knowledge access are indeterminate.

3 Data and method

The analyses are based on an original cross-sectional survey collected in Luxembourg by LISER (formerly CEPS/INSTEAD) on behalf of the National Ministry of Social Security. The aim of the 'Survey on working conditions and quality of work life' is to provide an overview of the state of quality of work and employment in the private sector in Luxembourg. The dataset is representative of people at work in the private sector in Luxembourg whether they are resident (about 47% of the active population) or cross-border workers (about 53% of the active population). The sample was drawn in September 2012 from employees aged at least 15 years on the data register of social security of Luxembourg. A stratified sampling strategy was used in order to recruit at least one employee in all enterprises of the private sector with at least 15 employees. Employees working in small establishments are excluded from the sample. The non-compulsory survey was conducted online between March and June 2013 and was available in French, German and English. Around 60 000 employees working in private organizations with at least 15 employees were included in the sample and around 26 percent participated. Because of job switches between the times of the sample selection and the conduct of the survey and information missing for a large number of survey items for some respondents, the final sample size comprises 14 685 employees with at least six months of tenure in their current organization. Many items used in this study have some missing values but these are few which is a good indication of data quality. The few missing values on each item were imputed using the median value of non-missing data on the same item in the sampling strata of the missing respondent. The non-response, together with the survey design probabilities, were used to generate appropriate weights to be used in the analyses. The

weights ensure that the distributions by country of residence, nationality, gender, age, white and blue collar workers, economic activity and size class of the organizations in which the employee works, are representative of people at work in the private sector.

3.1 Outcome variables

The variables of interest in this analysis are the components of the continuum of motivations: (1) external regulation; (2) introjected regulation; (3) identified regulation; (4) intrinsic motivation. Each motivation measure is a standardized scale created on the basis of the included survey items described in Table 1. By construction, each motivation measure is continuous and unit free. The consistency of Cronbach's alpha¹ is good for identified regulation and intrinsic motivation and acceptable for the external regulation and introjected regulation (Hair et al., 2006). On average in the sample, the highest levels of employees' motivations are due to introjected regulation and intrinsic motivation.

Table 1. Motivations measures

| | <i>Measurement</i> | <i>Average</i> |
|--|---|----------------|
| (1) External regulation $\alpha=0.60$ | Because of the pay-check; Because it allows me to get rewards (bonuses or promotion) | 5.20 |
| (2) Introjected regulation $\alpha=0.66$ | Because I have to prove to myself that I can do it; Because otherwise I feel bad about myself; Because my reputation depends on it | 6 |
| (3) Identified regulation $\alpha=0.79$ | Because it allows me to reach my personal goals; Because this job fulfils my career plans; Because this job fits my personal values | 4.95 |
| (4) Intrinsic motivation $\alpha=0.8$ | Because I enjoy this work very much; Because I have fun doing my job | 5.88 |
| Observations | | 14 685 |

Notes: descriptive statistics are prior to standardisation. The items included in each motivation are shown in the measurement column. The related question in the survey is "Using a scale from 0 to 10, please indicate from the following statements to what extent they apply to you. I dedicate myself to my work...".

¹Cronbach's alpha is a function of the number of items included in the score, the average covariance between item-pairs and the variance of the total score.

3.2 Explanatory variables

The main explanatory variables in the analyses are innovative work practices, incentives and ICT uses. Appendix Table A1 gives the measurement and descriptive statistics of these variables.

First, to account for innovative work practices, the analysis includes variables about work organization measured at the employee level about working in a team; with a job rotation scheme; participating in a quality circle; having to meet quality norms; working with just-in-time. The participation in the downward communication policy of the organization; undergoing formal assessment(s) by the hierarchy; receiving management consideration; the participation in training(s) are included to characterise personnel policies. Flexible work time and telework allowed by the employer are included to characterise family-friendly policies. Second, as employees' motivations can be strengthened by the organization incentive scheme, two variables are included: one for pay incentive and one for monitoring. As argued above, the monitoring has been largely modified by ICT. In order to capture the traditional front-line forms of monitoring that can be counter-productive, the survey asks if the control exerted by the supervisor is weighty (or, on the contrary, stimulating). Third, for ICT, the uses by the employee of ERP and of workflow are studied to capture technologies that facilitate internal information access. For technologies that reduce internal communication costs, the use by the employee of groupware² and of an intranet are included. The uses for work purposes of Internet, of email and web conferencing are introduced to measure the uses of technologies that facilitate internal and external knowledge access. Fourth, interaction variables between the intensive participation in innovative work practices (endogenous and exogenous ones) and the intensive use of ICT that can have an additional effect on employees' motivations are included.

3.3 Control variables

The analysis controls for a series of employee, job and organization characteristics to capture the heterogeneity of employees and properly isolate the role of work practices and technologies in employees' motivations. Appendix Table A2 reports descriptive statistics. First, for employees' characteristics: gender, age (3 categories: less than 30 years, 30-49, 50 and over), nationality (6 categories: Luxembourgish, German, French, Belgian, Portuguese, other nationalities), living with partner (yes/no), children (yes/no), education (3 categories: less than secondary, secondary, higher than secondary), commuting time (variable split into 8 increments from less than 10 minutes to 1 hour and more). The included job characteristics are: permanent contract (yes/no), part time (yes/no), tenure (in months), tenure squared, unionised (yes/no),

²Groupware can be used to control the performance.

painful working conditions (a score from 0 to 4), occupations (7 categories: Professional and managers; Associate professionals; Administrative and clerical; Sales and service personnel; Craft; Plant operatives; Non-qualified operatives). The organization characteristics are: size (4 categories: 15-49 employees; 50-99 employees; 100-249 employees; 250 employees and more), sector of activities (7 categories: Manufacturing; Construction; Trade, accommodation and food services; Transportation and storage; IT and communication; Finance; Other services).

3.4 Estimation strategy

In order to take into account the correlation between the four employees' motivations (m) and the potential endogeneity of the individual participation in certain innovative work practices and the use of ICT, the following system of equations is estimated:

$$\left\{ \begin{array}{l} \text{motivations}_m = \alpha_m + \mu'_m \widehat{\text{endo. work practices}}_j + \tau'_m \text{exo. work practices} \\ \quad + \beta'_m \text{incentives} + \omega'_m \widehat{\text{endo. ICT}}_k + \delta'_m X + \gamma'_m J + \theta'_m O + \varepsilon_m \\ \\ \text{endo. work practices}_j = \alpha_j + \vartheta'_j \text{WP diff.rate} + \varphi'_j \text{ICT diff.rate} + \pi'_j \text{ICT int.} \\ \quad + \delta'_j X + \gamma'_j J + \varepsilon_j \\ \\ \text{endo. ICT}_k = \alpha_k + \vartheta'_k \text{WP diff.rate} + \varphi'_k \text{ICT diff.rate} + \pi'_k \text{ICT int.} \\ \quad + \delta'_k X + \gamma'_k J + \varepsilon_k \end{array} \right.$$

As each motivation measures ($m=1; \dots; 4$) are continuous, they are estimated using Maximum Likelihood Estimators (MLE). The estimation of each motivation equation includes four potentially endogenous work practices due to the fact that taking part in these work practices is the choice of the employee and can be reinforced by his or her motivations: the participation in a quality circle; the participation in downward communication; the feeling about management consideration; the participation in training(s). Thus, in the system of equations presented above there are four equations for the potentially endogenous innovative work practices ($j=1; \dots; 4$) and the fitted values (*endo. work practices*) obtained from these four equations estimated using binary probit models are included in the motivation equations. The estimation of each motivation equation also includes seven exogenous work practices (*exo. work practices*) for which the participation is constrained by the employer: working in a team; having to meet quality norms; working with a job rotation scheme and working in just-in-time; the use of formal assessment by the hierarchy; flexible work time and telework allowed by the employer. Furthermore, in the estimation of each motivation equation two variables measuring incentives

are included (*incentives*). The estimation of each motivation equation also includes the seven ICT types (*endo. ICT*) presented above. The uses of these ICT are potentially endogenous because of the fact that the most motivated employees can also be the biggest users of ICT. Thus, in the system of equations presented above there are seven equations for the potentially endogenous ICT ($k=1; \dots; 7$) and the fitted values ($\widehat{\text{endo. ICT}}$) obtained from these seven equations estimated using binary probit models are included in the motivation equations. Interaction variables (high *endo. IWP* * high ICT and high *exo. IWP* * high ICT), a constant (α); control variables about employees' characteristics (X); job characteristics (J) and organization characteristics (O) are also included. ε represents random error terms normally distributed.

Because of the potential behavioural correlations between participation in innovative work practices, using ICT and being motivated, an instrumenting strategy is implemented. Identification and consistent estimation of each motivation depend on the lack of correlation between, on the one hand, potentially endogenous work practices and ICT uses and, on the other hand, the error terms of motivation equations, or on the availability of instruments correlated with potentially endogenous variables and uncorrelated with the error terms of motivation equations. Short of instruments like the participation in work practices by the employee and ICT uses in the past, due to the use of cross-sectional data, only imperfect instruments are proposed. However, the choice of these instruments has, at least, empirical appeal. Technological and organizational changes by competitors raise the need for a firm to also invest, - and make available work practices and ICT to their employees, - in order to be reactive and avoid the threat of being overtaken (Askenazy et al., 2006). It is equally unlikely that the diffusion of innovative work practices and ICT at the competitor level would directly factor into employees motivations independently of how these practices and technologies modify the investment of employers in a motivational environment. To capture the competitor level of adoption of work practices and ICT, data obtained at the industry and size class level are included as instruments. To do so, I use another database collected at organization levels at the beginning of 2013³ that permits the construction of variables (*WP diff.rate* and *ICT diff.rate*) that measure the diffusion of each work practice and each type of ICT in the strata of the organizations in which the employee works (28 strata: 4 size categories * 7 sector categories). Moreover, in order to capture to which each employee is a 'technophile', a measure of the intensity of use of ICT for work purposes (*ICT int.*) is introduced. It is difficult to see why the technophilia of employees would have a direct effect on motivations independent of the indirect effect through the propensity to use the ICT offered by the employer. A constant (α); control variables about employees'

³It is the 'Enterprises organizational and managerial practices survey - Luxembourg - 2013' collected by LISER (formerly CEPS/INSTEAD). The response rate was about 56%. It includes information about innovative work practices and ICT used in organizations.

characteristics (X); job characteristics (J) are also included.⁴ ε represents random error terms normally distributed. Appendix Table A3 shows construction details and descriptive statistics of these instruments.

In order to estimate simultaneously the four equations about employees motivations and the equations introduced to take into account the potential endogeneity of the individual participation in certain work practices and the use of ICT, I use the Geweke-Hajivassiliou-Keane (GHK) simulated maximum likelihood estimator implemented in Stata by Roodman (2011).

4 Results

Table 2 gives the results of the estimates of motivations. All regressions of motivations include the variables that control for a very detailed set of employees, job and organization characteristics (the estimates of these variables for the IV system are provided in Appendix Table A8). Columns (1) to (4) are baseline estimations obtained without the control of reverse causation.

Columns (5) to (8) are estimations obtained with the control of reverse causation, *i.e.* with the inclusion of the estimations of endogenous innovative work practices and ICT uses equations as shown in the system of equations presented above. Appendix Tables A4 and A5 give the results of the estimate of the instrumenting equations. Following Antecol and Cobb-Clark (2009), the validity of the exclusion restrictions are explored by using 2SLS to estimate the linear probability specification of each motivation separately using the instruments: the diffusion rate of all work practices and all ICT at the organization strata level as well as the measure of the degree of being a ‘technophile’ employee. Appendix Table A6 provides indicative tests concerning the non-weakness and validity of the instruments for the equations of motivations. The F statistic from the first-stage regressions of instrumenting equations exceed 10 (with two exceptions)⁵ and are thus indicative that weak instruments are not a particular concern (Staiger and Stock, 1997). The overidentification tests reveal that the excluded instruments are not incorrectly omitted from the estimation equations of motivations (Baum et al., 2007). The correlations between the error terms of the four motivation equations, reported in Appendix Table A7, stress the positive relations between the four facets of motivations. The lower relation is, not surprisingly, observed for external regulation and intrinsic motivation, the two that have an opposite position on the studied continuum of motivations. The two facets of motivations that composed autonomous motivation are the two that are the more tightly correlated.

⁴As instruments are based on strata constructed using organization characteristics (O), these variables are not included in the instrumenting equations.

⁵The exception concerns downward communication and management consideration. However, for management consideration, the results without and with the control of reverse causation are similar.

Table 2. Results of the effects of innovative work practices, incentives and ICT on employees' motivation

| | External regulation | Introjected regulation | Identified regulation | Intrinsic motivation | External regulation | Introjected regulation | Identified regulation | Intrinsic motivation | |
|--|---------------------|------------------------|-----------------------|----------------------|---------------------|------------------------|-----------------------|----------------------|--|
| | MLE System | | | | IV System | | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | |
| Endogenous innovative work practices | | | | | | | | | |
| Participation in a quality circle ^a | 0.07*** (0.02) | 0.08*** (0.02) | 0.17*** (0.02) | 0.14*** (0.02) | -0.10 (0.09) | -0.38** (0.17) | -0.46*** (0.05) | -0.98*** (0.06) | |
| Downward communication ^a | 0.12*** (0.02) | 0.13*** (0.02) | 0.23*** (0.02) | 0.25*** (0.02) | 0.52*** (0.16) | -0.40*** (0.11) | 0.05 (0.08) | 0.30 (0.29) | |
| Receiving management recognition ^a | 0.19*** (0.02) | 0.13*** (0.02) | 0.30*** (0.02) | 0.36*** (0.02) | 0.65*** (0.08) | 1.09*** (0.04) | 0.43*** (0.09) | 0.21*** (0.06) | |
| Participation in training(s) ^a | 0.10*** (0.02) | 0.05*** (0.02) | 0.13*** (0.02) | 0.13*** (0.02) | -0.03 (0.33) | -0.22 (0.78) | 0.15 (0.63) | -0.04 (0.25) | |
| Exogenous innovative work practices | | | | | | | | | |
| Teamwork | 0.07*** (0.02) | 0.03* (0.02) | 0.07*** (0.02) | 0.03* (0.02) | 0.06*** (0.02) | 0.03* (0.02) | 0.07*** (0.02) | 0.04** (0.02) | |
| Having to meet quality norms | -0.01 (0.02) | 0.05*** (0.02) | 0.05*** (0.02) | 0.06*** (0.02) | -0.01 (0.02) | 0.05*** (0.02) | 0.05*** (0.02) | 0.06*** (0.02) | |
| Job rotation | 0.01 (0.02) | -0.08*** (0.02) | -0.02 (0.02) | 0.02 (0.02) | 0.01 (0.02) | -0.08*** (0.02) | -0.02 (0.02) | 0.01 (0.02) | |
| Just in time | 0.08*** (0.02) | 0.04** (0.02) | 0.01 (0.01) | -0.05*** (0.02) | 0.07*** (0.02) | 0.04** (0.02) | -0.00 (0.01) | -0.06*** (0.02) | |
| Formal appraisal by the hierarchy | 0.11*** (0.02) | 0.04** (0.02) | 0.07*** (0.02) | 0.06*** (0.02) | 0.10*** (0.02) | 0.03** (0.02) | 0.06*** (0.02) | 0.05*** (0.02) | |
| Flexible work time | 0.00 (0.02) | 0.00 (0.02) | 0.07*** (0.02) | 0.07*** (0.02) | -0.00 (0.02) | -0.00 (0.02) | 0.06*** (0.02) | 0.07*** (0.02) | |
| Telework allowed | 0.02 (0.02) | -0.01 (0.02) | 0.10*** (0.02) | 0.11*** (0.02) | 0.02 (0.02) | 0.00 (0.02) | 0.11*** (0.02) | 0.11*** (0.02) | |
| Incentives | | | | | | | | | |
| Pay incentive | 0.19*** (0.02) | 0.02 (0.02) | 0.05*** (0.02) | 0.05*** (0.02) | 0.20*** (0.02) | 0.03** (0.02) | 0.05*** (0.02) | 0.05*** (0.02) | |
| Front-line control | -0.06** (0.03) | -0.02 (0.02) | -0.23*** (0.02) | -0.31*** (0.03) | -0.07*** (0.02) | -0.03 (0.02) | -0.23*** (0.02) | -0.31*** (0.03) | |
| Endogenous ICT uses | | | | | | | | | |
| ERP ^a | 0.01 (0.02) | 0.04** (0.02) | 0.05*** (0.02) | 0.04* (0.02) | -0.04 (0.30) | 0.03 (0.17) | 0.18 (0.24) | 0.24 (0.15) | |
| Workflow ^a | 0.03* (0.02) | -0.00 (0.02) | 0.00 (0.02) | 0.00 (0.02) | 0.36 (0.32) | 0.26** (0.10) | 0.37 (0.23) | 0.27** (0.13) | |
| Groupware ^a | 0.01 (0.02) | 0.03** (0.02) | 0.02 (0.02) | 0.03 (0.02) | -0.37*** (0.13) | -0.28** (0.14) | -0.29*** (0.09) | -0.46*** (0.09) | |
| Intranet ^a | 0.01 (0.02) | 0.01 (0.02) | 0.02 (0.02) | 0.02 (0.02) | 0.00 (0.06) | 0.06 (0.05) | 0.08 (0.06) | 0.10* (0.06) | |
| Internet ^a | 0.01 (0.02) | 0.01 (0.02) | 0.06*** (0.02) | 0.03* (0.02) | 0.53*** (0.17) | 0.33*** (0.10) | 0.41** (0.17) | 0.33*** (0.12) | |
| Email ^a | 0.01 (0.03) | 0.08*** (0.03) | 0.11*** (0.03) | 0.07*** (0.03) | -0.02 (0.09) | 0.24*** (0.09) | 0.18* (0.09) | 0.22** (0.09) | |
| Web conference ^a | -0.01 (0.02) | -0.03* (0.02) | 0.01 (0.02) | 0.03 (0.02) | -0.30 (0.19) | -0.09 (0.10) | -0.36*** (0.09) | 0.16 (0.10) | |
| High endo IWP * high ICT | -0.04 (0.02) | -0.06*** (0.02) | 0.01 (0.02) | 0.01 (0.02) | -0.02 (0.02) | -0.04 (0.03) | 0.03 (0.02) | 0.04 (0.03) | |
| High exo IWP * high ICT | 0.00 (0.02) | 0.01 (0.02) | -0.05** (0.02) | -0.08*** (0.02) | 0.01 (0.02) | 0.00 (0.02) | -0.05** (0.02) | -0.07*** (0.02) | |
| Employee characteristics | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | |
| Job characteristics | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | |
| organization characteristics | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | |
| Log pseudo-likelihood | | -59621.339 | | | | -119181.41 | | | |
| Wald chi2 | | 9757.94*** | | | | 111613.42*** | | | |
| Observations | | 14685 | | | | 14685 | | | |

Source: Survey on working conditions and quality of work life - Luxembourg - 2013.

Notes: Beta coefficients * significant at 10%; ** significant at 5%; *** significant at 1%. Robust standard errors adjusted for 2254 clusters (working in the same organization) in parentheses. Weighted estimations. ^a Variables that are innovative work practices and ICT uses treated as endogenous in the system of equations and estimated using binary probit models.

4.1 Analysis of the effects of innovative work practices on employees' motivations

For the endogenous innovative work practices, conversely to the positive link between participation in a quality circle and employee attitudes underlined by Godard (2010) and Mohr and Zoghi (2008), the results reveal a negative significant association of this practice with all motivations except external regulation. One reason is due to the control for potential reverse causation (columns (5) to (8)). The estimates of motivations without the control of potential reverse causation report positive links (columns (1) to (4)). Thus, it seems that not taking into account this potential reverse causality induces spurious correlations. This result suggests that the most motivated employees participate in quality circle and their participation decreases their motivations. The participation of the employee in the downward communication policy reveals a positive association with external regulation that suggests a participation in order to be aware of salary evolution and reward policy. Conversely, the results reveal that the participation in the downward communication activities tends to curb the pressure due to guilt and self-worth. It may be due to the fact that employees can be reassured by managers' communication on the objectives to be achieved and thus relax their internal pressure. The findings that receiving management recognition is positively linked with all motivations are in line with previous work and participate in the building of a motivational environment. Trainings are expected to affect all motivations. However, there is no significant association with motivation measures. This result underlines that trainings count at least to help worker to reach their career goals. But this leaves the question of why firms pay for trainings if they have no apparent effect on employees' intrinsic motivation. The estimate results of motivations without the control of potential reverse causation report a positive link. It suggests that the most intrinsically motivated employees are those that participate in trainings. Thus, providing trainings is valuable for firms.

For exogenous innovative work practices, the positive expected link between teamwork and motivations finds support in the regressions. Working in a team influences positively the controlled motivations (external regulation and introjected regulation) and the autonomous motivations (identified regulation and intrinsic motivation). . This result supports the fact that teamwork, first, induces potential group rewards and thus increases external regulation; second, favours peer pressure and thus has an effect on introjected regulation; third, gives responsibility through decentralization of decision making and makes the work more enjoyable and thus contributes to improve autonomous motivations. Concerning job rotation, it appears that being 'interchangeable' with another employee decreases introjected regulations. This result is in line with the one of Godard (2001), showing a negative association between job rotation and organizational citizenship. The results underline that the quality norms, implemented by the TQM policy in order to improve the quality of the production and also employee envi-

ronment and safety, are positively related to all motivations except external regulation. This result is in line with a positive association of TQM and job satisfaction in Martin and Omrani (2015). An organization of work based on just-in-time is used by firms to shorten delivery time and to eliminate unnecessary stocks. It puts pressure on employees and at the same time is often compensated by bonuses when a highly productive amount of work is done. Thus, it is not surprising to observe a negative association with the intrinsic motivation and a positive association with the controlled motivations (external and introjected regulations). In line with previous work, formal appraisal is positively linked with all motivations. The magnitude of the coefficient of formal appraisal with external regulation is the biggest. This result supports the fact that the annual appraisal is often the time for the manager to decide a bonus or a promotion. Finally, as regards family-friendly policies, as suggested by Bloom et al. (2011), firms choose to implement such practices in order to enhance the well-being of their workforce and especially the work-life balance. Supporting this view, the results underline that the two policies studied are positively associated with higher autonomous motivations (identified regulation and intrinsic motivation).

These findings have practical managerial implications for firms. The results can be put in perspective with the three basic psychological needs of autonomy, competence and relatedness that must be fulfilled to motivate employees. Gagné and Deci (2005) show that these basic needs are affected by relationships with managers, the way the work is organised and financial compensations. My results of formal appraisal and management recognition sustain their view. My results for the way that work is organised are useful to specify a motivational work environment. Moreover, it appears that autonomous motivations, that are the most valuable for firms, are strengthened by teamwork and total quality management. Family-friendly policies also help firms to create a motivational work environment. Conversely, just-in-time is not valuable for firms in terms of motivating their employees and need to be compensated for by pay incentives or an improved working environment.

4.2 Analysis of the effects of incentives on employees' motivations

In line with hypothesis 2a, the positive incentive favours all motivations. Not surprisingly, the magnitude of the coefficient is higher for the external regulation than for other motivations. As has been identified by the crowding-out theory (Frey, 1993; 1997; Frey and Jegen, 2001) and in line with hypothesis 2b, traditional front-line forms of monitoring are associated with lower motivations and especially autonomous ones (identified regulation and intrinsic motivation).

In a practical managerial view, and in line with Gagné and Deci (2005), the results underline that the monetary compensation designed by firms motivates employees but mostly the external regulation.

4.3 Analysis of the effects of technologies on employees' motivations

The results underline a positive association between technologies that facilitate internal information access and employees' motivations (except external regulation) only for the use of a workflow. More precisely, it appears that the favoured coordination between employees based on workflow tools increases the pressure due to guilt and self-worth and makes the tasks more interesting. This result gives support to hypothesis 3a. Using an ERP is not associated with an increase in motivations contrary to what is supposed by Bloom et al. (2014). It suggests that omitting a large set of ICT uses at the workplace and innovative work practices may lead to an over-estimation of the association between certain technologies and employees outcomes.

For technologies that reduce internal communication costs, I find a negative link between using groupware and all motivations. As argued by Bloom et al. (2014), the use of a technology that reduces internal communication costs leads employees to be less empowered and thus decreases their motivations. Moving on to consider Intranet, the results underline that, controlling for a large set of numeric tools that can be implemented in the Intranet (as groupware), the positive effect on intrinsic motivation revealed by the model suggests that the remaining effect of Intranet captures the diffusion of general information inside the firm much more than information closely related to employees' work that may be diffused through meetings.

The use of the Internet allows employees to find information and knowledge easily and permits the increase of all motivations. This result is in line with recent works studying the links between the Internet and positive employee attitudes such as Martin and Omrani (2015). In the same vein, email use appears to increase all motivations except external regulation. Web conference tools are negatively related to identified regulation. Thus, for this motivation, the effect of a reduction in internal communication costs dominates the effect of an increase in the access to more information and knowledge. To further investigate the combined effects of innovative work practices and use of ICT, interaction variables are added. The results show a negative effect of an intensive participation in exogenous innovative work practices and an intensive use of ICT on autonomous motivations. It may indicate that for intensive participation in those practices and ICT use the costs in terms of stress and time famine exceed the benefits.

As regards the practical managerial implications for firms, the results underline the positive effects of technologies that facilitate internal information access (workflow) and those that facilitate internal and external knowledge access (Internet and email) as well as of Intranet on autonomous motivations (identified regulation and intrinsic motivations). Groupware that reduces internal communication costs has negative effects on all motivations. Web conference tools motivate employees intrinsically but at the same time decrease identified regulation.

5 Conclusion

Positive links between innovative work practices, technology investments and firm performance have been extensively studied at the country, industry and firm levels. These links have often been explained by assumed positive associations with employees' motivations. Research at the employee level focuses on employee attitudes such as job satisfaction, commitment or citizenship, but, to my knowledge, no one has assessed employees' motivations directly. Moreover, types of ICT that intervene largely in employees' daily work are often ignored or only a narrow range is studied.

This paper analyses the impact of innovative work practices and technologies used by employees on their motivations at work. The continuum of motivations studied draws on the work of social psychologists. It goes from external regulation (exerting effort because of pay and rewards), introjected regulation (being motivated by guilt or by maintaining self-worth), identified regulation (exerting effort because of values and goals sharing with the employer) to intrinsic motivations (being motivated by because the tasks are interesting and enjoyable).

The results are obtained on survey-based data of employees working in establishments with at least 15 persons of a continental Europe service economy through an estimation strategy that permits control for the correlations between motivations. It also allows one to control as much as possible the potential reverse causation between voluntary participation in certain work practices and the use of ICT on the one hand, and motivations on the other. While the behavioural correlation between innovative work practices, ICT uses and employee attitudes have not been, to my knowledge, considered in previous works, the results modify what previous papers have said about quality circle and training participation. The results confirm the positive role of work practices such as teamwork, quality norms, formal appraisal, management recognition, or family-friendly policies in the definition of a motivational environment. With respect to ICT, the results underline that the types of ICT that contribute the most to the development of a motivational environment are those that facilitate internal information access (workflow) and those that facilitate internal and external knowledge access (Internet and e-mail). My findings have practical managerial implications for firms. In order to obtain higher performance levels from their employees, managers need to design a work environment that fosters autonomous motivations above all (identified regulation and intrinsic motivation). These motivations are indeed highly valuable for employers as they induce more information sharing, more cooperation, more intra- and extra-role performance, less absenteeism and lower turnover intentions. The results confirm the hypothesis that a motivational work environment presupposes a resort to teamwork and total quality management. In terms of personnel policies, consideration from the superior and formal appraisals are highly valuable. Family-friendly policies also help firms to create a motivational work environment. As regards financial rewards, the results show that pay incentive motivates employees but mostly the external regulation. Moving on to consider

ICT, the result underlines positive effects of technologies that facilitate internal information access and internal and external knowledge access. Conversely, technologies that reduce internal communication costs (groupware), front-line forms of monitoring and just-in-time are not valuable for firms in terms of motivating their employees.

The main limitation of this paper is the use of a single cross-section. Therefore, I am unable to analyze the dynamics of technological and organizational changes and their consequences on employees' behaviors. This limitation can be overcome by future research using panel data.

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Appendix

Table A1. Definition and descriptive statistics of innovative work practices, incentives and ICT variables

| | <i>Definition</i> | <i>Average</i> |
|---|--|----------------|
| Endogenous innovative work practices | | |
| Work organization | | |
| Participation in a quality circle | The employee is involved in a group which meets regularly to identify and resolve problems related to his or her work (quality groups or quality circles) and participates in decisions concerning major changes within the firm when consulted = 1; otherwise = 0 | 22.35% |
| Personnel policies | | |
| Downward communication | Attending meeting(s) between the management board and employees and/or participating in internal survey(s) organized by the management board and/or finding that e-newsletters of the management board are valuable | 36.92% |
| Management recognition | Agree or strongly agree about the fact that the value of his or her work is truly recognized by the management and about the fact that when he or she makes suggestions they are most often taken into account by the management = 1; otherwise = 0 | 58.11% |
| Participation in training(s) | Attended training(s) related to his or her work during the year before the survey = 1; otherwise = 0 | 41.50% |
| Sum of endogenous IWP | Sum of endogenous innovative work practices = 0; ...; 3 and more | 1.53 (1.03) |
| High endo. IWP | Participation in a number of endogenous innovative work practices above the average of the sample = 1; otherwise = 0 | 49.54% |
| Exogenous innovative work practices | | |
| Work organization | | |
| Teamwork | Working in a team including at least 5 people = 1; otherwise = 0 | 77.24% |
| Job rotation | When absent for one week, he or she must catch up less than half of his or her tasks when he or she returns = 1; otherwise = 0 | 52.25% |
| Quality norms | Must comply with quality standards (ISO,...) = 1; otherwise = 0 | 58.75% |
| Just-in-time | The work of the employee is rated by an automatic pace and/or his or her amount of work is decided by the hierarchy = 1; otherwise = 0 | 46.37% |
| Personnel policies | | |
| Formal appraisal | Has at least one appraisal interview during the year before the survey = 1; otherwise = 0 | 57.62% |
| Family-friendly policies | | |
| Flexible work time | Has flexible working hours (<i>i.e.</i> decides him(her)self when he or she starts and stops work, taking into account certain daily fixed time slots) = 1; otherwise = 0 | 38.26% |
| Telework allowed | The firm company permits him or her to do teleworking from home = 1; otherwise = 0 | 10.05% |
| Sum of exogenous IWP | Sum of exogenous innovative work practices = 0; ...; 5 and more | 3.38 (1.17) |
| High exo. IWP | Participation in a number of exogenous innovative work practices above the average of the sample = 1; otherwise = 0 | 48.16% |
| Incentives | | |
| Pay incentive | Part of the pay is linked with performance = 1; otherwise = 0 | 33.18% |
| Front-line control | The control by the hierarchy is rather burdensome = 1; rather stimulating or does not affect = 0 | 14.22% |

...

...

| | | |
|--|--|------------|
| Endogenous ICT uses | | |
| Technologies that facilitate internal information access | | |
| ERP | Use Enterprise Resources Planning that is a tool for coordinating employees around the information system = 1; otherwise = 0 | 14.88% |
| Workflow | Use a Workflow that is a tool for coordinating employees around a business process = 1; otherwise = 0 | 15.09% |
| Technologies that reduce internal communication costs | | |
| Groupware | Use a Groupware that is an information exchange tool = 1; otherwise = 0 | 24.48% |
| Intranet | Use Intranet = 1; otherwise = 0 | 50.06% |
| Technologies that facilitate internal and external knowledge access | | |
| Internet | Use Internet for work purpose at least 25% of working time = 1; otherwise = 0 | 17.59% |
| Email | Use email for work purpose = 1; otherwise = 0 | 54.55% |
| Web conference | Use Web conference for work purpose = 1; otherwise = 0 | 15.54% |
| Sum of endogenous ICT | Sum of endogenous ICT = 0; ...; 5 and more | 1.87 (1.8) |
| High ICT | Use a number of ICT above the average of the sample = 1; otherwise = 0 | 53.29% |
| <hr/> | | |
| Observations | | 14 685 |

Source: Survey on working conditions and quality of work life - Luxembourg - 2013.

Notes: Weighted statistics. All innovative work practices, incentives and ICT uses are binary variables.

Table A2. Descriptive statistics of control variables

| | <i>Average</i> | | <i>Average</i> |
|-------------------------------------|---------------------|--|-----------------|
| Employee characteristics | | | |
| Male | 67.37% | Portuguese | 14.32% |
| Age less than 30 years (Omitted) | 17.21% | Other nationality | 8.47% |
| 30-49 years | 62.99% | Living with partner | 79.22% |
| 50 years and more | 19.80% | Children | 58.56% |
| Luxembourgish (Omitted) | 17.89% | Education less than Secondary (Omitted) | 18.13% |
| German | 12.97% | Secondary | 44.65% |
| Belgian | 15.05% | Higher than Secondary | 37.22% |
| French | 31.30% | Commuting time (1-8) ¹ | 4.12 (1.962) |
| Job characteristics | | | |
| Permanent contract | 93.18% | Associate professionals | 19.65% |
| Tenure (months) (6-590) | 119.51 -99.618 | Administrative and clerical | 14.61% |
| Tenure squared | 24206.79 (38023) | Sales and service personnel | 11.08% |
| Union | 31.30% | Craft | 15.16% |
| Part time | 11.77% | Plant operatives | 8.93% |
| Painful working conditions (0-4) | 1.56 (1.60) | Non-qualified opera- tives (Omitted) | 10.00% |
| Professional and managers | 20.57% | Quintile of hourly wage (1-5) | 3 (1.41) |
| organization characteristics | | | |
| 15-49 employees (Omitted) | 63.97% | Trade, accommodation and food services | 26.21% |
| 50-99 employees | 17.88% | Transportation and storage | 9.12% |
| 100-249 employees | 12.25% | IT and communication | 4.94% |
| 250 employees and more | 5.90% | Finance | 7.74% |
| Manufacturing (Omitted) | 10.20% | Other services | 14.68% |
| Construction | 27.12% | | |
| Observations | 14 685 | Observations | 14 685 |

Source: Survey on working conditions and quality of work life - Luxembourg - 2013.

Notes: Weighted statistics. Standard deviations are shown in parentheses for non-binary variables. organization characteristics are calculated at the organization level.

¹ Commuting time takes the value 1 if it takes the employee less than 10 minutes to go all the way from home to place of work (one-way only) to 8 if it takes 1 hour and more with responses ranged according to ascending 10 minutes increments.

Table A3. Definition and descriptive statistics of instruments

| <i>Variable</i> | <i>Definition</i> | <i>Average</i> |
|---|--|------------------|
| Quality circle at the organization strata level | Diffusion rate of quality circle including at least 25% of employees in the organization strata | 0.2932 (0.13) |
| Downward communication at the organization strata level | Mean of a downward communication score ¹ in the organization strata | 1.7518 (0.48) |
| Recognition system at the organization strata level | Diffusion rate of recognition system in the organization strata | 0.1851 (0.18) |
| Trainings at the organization strata level | Average percentage class ² of employees receiving trainings in the organization strata | 1.4509 (0.56) |
| Teamwork at the organization strata level | Average percentage class ² of employees working in a team in the organization strata | 0.8873 (0.28) |
| Job rotation at the organization strata level | Diffusion rate of job rotation in the organization strata | 0.9064 (0.10) |
| Quality norms at the organization strata level | Diffusion rate of quality control of the production in the organization strata | 0.8998 (0.09) |
| Just-in-time at the organization strata level | Diffusion rate of just-in-time in the organization strata | 0.4285 (0.24) |
| Formal assessment at the organization strata level | Average percentage class ² of employees that have an annual formal assessment in the organization strata | 1.9528 (0.69) |
| Flexible work time at the organization strata level | Average percentage class ² of employees that can decide at what time they start and stop working in the organization strata | 1.1168 (0.80) |
| Telework allowed at the organization strata level | Diffusion rate of allowing the work at home during working hours in the organization strata | 0.2493 (0.14) |
| Intensity of ICT use by the employee | Score of intensity use of the seven technologies used for work purpose by the employee ³ | 4.7050 (4.57) |
| ERP at the organization strata level | Diffusion rate of ERP (Enterprise Resources Planning) in the organization strata | 0.4320 (0.17) |
| Workflow at the organization strata level | Diffusion rate of workflow in the organization strata | 0.3631 (0.21) |
| Groupware at the organization strata level | Diffusion rate of groupware in the organization strata | 0.3909 (0.21) |
| Intranet at the organization strata level | Diffusion rate of Intranet in the organization strata | 0.7553 (0.21) |
| Internet at the organization strata level | Diffusion rate of Internet for work purpose of at least 6% of employees in the organization strata | 0.7929 (0.17) |
| Webmail at the organization strata level | Diffusion rate of webmail in the organization strata | 0.7053 (0.15) |
| Web-conference at the organization strata level | Diffusion rate of web-conference in the organization strata | 0.5204 (0.27) |
| Observations | | 14 685 |

Notes: Weighted statistics. Standard deviations are shown in parentheses.

¹ The score includes meetings, e-newsletters and internal survey(s).

² The values of the percentage classes are: 0: 0-5%; 1: 6-24%; 2: 25-74%; 3: 75-100%.

³ for ERP, workflow, groupware, Intranet and web-conference the intensities take the following values: 0: no use; 1: at least once a month; 2: at least once a week and 3: every day. For Internet use for work purpose, the intensity takes the following values: 0: no use; 1: up to 25% of working time; 2: between 25 and 50% of working time; 3: 50% of working time and more. For email use for work purpose: 0: no use; 1: up to one hour a day; 2: between one and two hours a day; 3: 2 hours and more a day. The small percentages of employees scoring 17 and above are merged with those with a score of 16.

Table A4. Instrumenting regressions of the endogenous innovative work practices

| | Participation in a quality circle | Downward communica- tion | Receiving management recognition | Participation in training(s) |
|---|---|--------------------------------|--|---------------------------------|
| Instruments (as defined in Table A3) | | | | |
| Quality circle at the organization strata level | 0.08 (0.27) | 0.46 (0.31) | -0.40 (0.28) | 0.05 (0.38) |
| Downward communication at the organization strata level | -0.52*** (0.15) | -0.26 (0.16) | -0.21 (0.16) | -0.41** (0.20) |
| Recognition system at the organization strata level | 0.61** (0.28) | 0.52* (0.27) | 0.63** (0.28) | -0.57 (0.41) |
| Trainings at the organization strata level | -0.21** (0.10) | 0.23* (0.12) | -0.04 (0.11) | 0.30* (0.16) |
| Teamwork at the organization strata level | 0.07 (0.10) | -0.11 (0.11) | -0.07 (0.10) | 0.37*** (0.13) |
| Job rotation at the organization strata level | 0.65* (0.36) | 0.55 (0.36) | 0.37 (0.34) | 0.98** (0.49) |
| Quality norms at the organization strata level | 0.24 (0.44) | -0.11 (0.56) | 0.25 (0.48) | -0.64 (0.63) |
| Just-in-time at the organization strata level | 0.13 (0.30) | -0.52* (0.28) | -0.23 (0.28) | 0.61 (0.39) |
| Formal assessment at the organization strata level | 0.28** (0.12) | 0.20 (0.14) | 0.18 (0.13) | 0.10 (0.17) |
| Flexible work time at the organization strata level | -0.08 (0.07) | -0.11 (0.08) | 0.01 (0.07) | -0.31*** (0.11) |
| Telework allowed at the organization strata level | -0.38 (0.24) | -0.09 (0.28) | -0.18 (0.23) | -0.36 (0.32) |
| Intensity of ICT use by the employee | 0.05*** (0.00) | 0.03*** (0.00) | 0.02*** (0.00) | 0.03*** (0.01) |
| ERP at the organization strata level | -0.00 (0.30) | -0.06 (0.33) | 0.23 (0.29) | -1.05** (0.42) |
| Workflow at the organization strata level | -0.12 (0.24) | -0.17 (0.25) | -0.11 (0.23) | 1.03*** (0.32) |
| Groupware at the organization strata level | 0.22 (0.21) | -0.02 (0.23) | -0.15 (0.23) | 0.64* (0.35) |
| Intranet at the organization strata level | 0.41 (0.45) | 0.62 (0.44) | 0.16 (0.40) | 0.13 (0.55) |
| Internet at the organization strata level | -0.72* (0.41) | -0.69* (0.41) | -0.21 (0.36) | 0.37 (0.50) |
| Webmail at the organization strata level | 0.01 (0.23) | 0.50* (0.30) | 0.27 (0.24) | 0.09 (0.36) |
| Web-conference at the organization strata level | 0.02 (0.31) | -0.94*** (0.30) | -0.11 (0.26) | -0.12 (0.36) |
| Employee characteristics | Yes | Yes | Yes | Yes |
| Job characteristics | Yes | Yes | Yes | Yes |
| Observations | 14 685 | 14 685 | 14 685 | 14 685 |

Source: Survey on working conditions and quality of work life - Luxembourg - 2013.

Notes: Robust standard errors adjusted for 2254 clusters (working in the same organization) in parentheses. Weighted estimations. Coefficients * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A5. Instrumenting regressions of the endogenous ICT use

| | ERP | Workflow | Group-ware | Intranet | Internet | Email | Web conference |
|---|--------------------|-------------------|-------------------|--------------------|--------------------|-------------------|--------------------|
| Instruments (as defined in Table A3) | | | | | | | |
| Quality circle at the organization strata level | 0.45 (0.42) | -0.46 (0.46) | -0.18 (0.36) | -0.28 (0.49) | 0.74** (0.32) | 0.42 (0.44) | 0.51 (0.48) |
| Downward communication at the orga. strata level | 0.06 (0.25) | -0.25 (0.30) | 0.50** (0.22) | -1.16*** (0.29) | 0.73*** (0.19) | 0.28 (0.26) | -0.25 (0.28) |
| Recognition system at the organization strata level | 0.80* (0.42) | 0.78 (0.56) | -0.26 (0.38) | 1.22** (0.50) | -1.81*** (0.37) | 0.27 (0.46) | 0.97* (0.50) |
| Trainings at the organization strata level | 0.23 (0.16) | -0.34* (0.20) | 0.18 (0.14) | -0.08 (0.19) | 0.07 (0.12) | 0.15 (0.17) | 0.03 (0.19) |
| Teamwork at the organization strata level | -0.59*** (0.17) | -0.46** (0.21) | 0.31** (0.15) | 0.22 (0.21) | 0.18 (0.13) | 0.01 (0.19) | -0.51*** (0.19) |
| Job rotation at the organization strata level | -1.01* (0.57) | 0.33 (0.71) | -1.18** (0.55) | 1.73** (0.78) | -0.69 (0.47) | 1.17* (0.71) | -1.19* (0.67) |
| Quality norms at the organization strata level | 1.40* (0.72) | 1.95** (0.82) | -0.94 (0.62) | 1.60** (0.79) | -1.67*** (0.60) | 0.35 (0.72) | 0.54 (0.85) |
| Just-in-time at the organization strata level | -0.17 (0.42) | -0.75 (0.56) | 0.68 (0.43) | -0.81 (0.54) | 1.14*** (0.38) | -1.22** (0.54) | -1.00** (0.51) |
| Formal assessment at the organization strata level | 0.60*** (0.21) | 0.04 (0.24) | -0.38** (0.17) | 0.19 (0.22) | -0.56*** (0.15) | -0.03 (0.17) | 0.20 (0.24) |
| Flexible work time at the organization strata level | 0.17 (0.11) | 0.04 (0.12) | 0.13 (0.11) | -0.28* (0.17) | 0.08 (0.09) | -0.16 (0.17) | -0.14 (0.12) |
| Telework allowed at the organization strata level | -0.00 (0.39) | 0.73 (0.52) | -0.44 (0.33) | 0.08 (0.42) | 0.36 (0.31) | -0.24 (0.35) | 2.02*** (0.51) |
| Intensity of ICT use by the employee | 0.24*** (0.01) | 0.26*** (0.01) | 0.29*** (0.01) | 0.42*** (0.01) | 0.16*** (0.01) | 0.28*** (0.01) | 0.19*** (0.01) |
| ERP at the organization strata level | 1.58*** (0.51) | 1.22** (0.51) | -0.89* (0.47) | -0.28 (0.67) | -0.72* (0.40) | -0.10 (0.61) | 0.79 (0.54) |
| Workflow at the organization strata level | -0.73** (0.37) | -0.64 (0.42) | -0.08 (0.33) | -0.22 (0.43) | 0.18 (0.30) | 0.52 (0.38) | -0.20 (0.40) |
| Groupware at the organization strata level | -1.02*** (0.38) | 0.10 (0.42) | 0.35 (0.35) | 1.70*** (0.54) | -0.04 (0.32) | -0.68 (0.49) | -0.80** (0.41) |
| Intranet at the organization strata level | -1.14* (0.68) | -0.25 (0.88) | -0.28 (0.60) | 3.20*** (0.79) | -0.95* (0.54) | -0.29 (0.71) | 1.62* (0.86) |
| Internet at the organization strata level | -2.28*** (0.69) | 0.01 (0.78) | 0.71 (0.54) | -0.25 (0.73) | 1.32*** (0.48) | -0.35 (0.60) | -1.46* (0.79) |
| Webmail at the organization strata level | 0.59 (0.37) | -1.13** (0.46) | 0.71** (0.32) | -0.92** (0.44) | -0.24 (0.30) | 0.99** (0.40) | -1.30*** (0.44) |
| Web-conference at the organization strata level | -0.83* (0.45) | 1.38*** (0.52) | -0.32 (0.39) | -0.70 (0.51) | 0.29 (0.32) | -0.58 (0.45) | 0.41 (0.48) |
| Employee characteristics | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Job characteristics | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 14 685 | 14 685 | 14 685 | 14 685 | 14 685 | 14 685 | 14 685 |

Source: Survey on working conditions and quality of work life - Luxembourg - 2013.

Notes: Robust standard errors adjusted for 2254 clusters (working in the same organization) in parentheses. Weighted estimations. Coefficients * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A6. Validity of exclusion restrictions

| First-stage F test (p-value) | | | |
|---|------------------------|-----------------------|----------------------|
| Quality circle | 15.01 (0.000) | Groupware | 228.83 (0.000) |
| Downward communication | 7.43 (0.000) | Intranet | 93.39 (0.000) |
| Management consideration | 4.03 (0.000) | Internet | 65.35 (0.000) |
| Training(s) | 10.46 (0.000) | Email | 27.13 (0.000) |
| ERP | 105.65 (0.000) | Web conference | 55.08 (0.000) |
| Workflow | 81.04 (0.000) | | |
| Overidentification test of all instruments - Hansen J statistic (Chi- square) | | | |
| External regulation | Introjected regulation | Identified regulation | Intrinsic motivation |
| 5.567 (0.6956) | 6.087 (0.6375) | 4.629 (0.7964) | 3.977 (0.8592) |

Source: Survey on working conditions and quality of work life - Luxembourg - 2013.

Notes: Weighted estimations with robust standard errors adjusted for 2254 clusters (working in the same organization). The instrumenting equations (identical for all motivations) includes the instruments (*WP diff.rate*, *ICT diff.rate* and *ICT int.*), a constant (α) and control variables about employees' characteristics (*X*) and job characteristics (*J*). The motivation equations include the four endogenous work practices (*endo. work practices*), the seven exogenous work practices (*exo. work practices*), the incentives (*incentives*), the seven endogenous ICT (*endo. ICT*), the two interaction variables (*high endo. IWP * high ICT* and *high exo. IWP * high ICT*), a constant (α) and control variables about employees' characteristics (*X*), job characteristics (*J*) and organization characteristics (*O*). These tests are indicative and obtained with 2SLS linear probability models on the four motivations estimated independently.

Table A7. Correlations between the error terms of the four motivations equations (IV system)

| | External regulation | Introjected regulation | Identified regulation | Intrinsic motivation |
|------------------------|---------------------|------------------------|-----------------------|----------------------|
| External regulation | 1 | | | |
| Introjected regulation | 0.362*** (0.037) | 1 | | |
| Identified regulation | 0.354*** (0.034) | 0.549*** (0.039) | 1 | |
| Intrinsic motivation | 0.199*** (0.041) | 0.346*** (0.041) | 0.913*** (0.095) | 1 |

Source: Survey on working conditions and quality of work life - Luxembourg - 2013.

Notes: Standard errors in parentheses. Correlation *** significant at 1%.

Table A8. Results of control variables (IV System)

| | External regulation | Introjected regulation | Identified regulation | Intrinsic motivation |
|-----------------------------|---------------------|------------------------|-----------------------|----------------------|
| IV system | | | | |
| Male | 0.08** (0.03) | -0.06* (0.03) | 0.04 (0.03) | -0.02 (0.03) |
| 30-49 years | -0.14*** (0.04) | -0.07 (0.08) | -0.07 (0.06) | -0.04 (0.04) |
| 50 years and more | -0.22*** (0.07) | -0.08 (0.13) | -0.08 (0.10) | -0.02 (0.06) |
| German | 0.06 (0.04) | -0.16*** (0.04) | -0.02 (0.04) | -0.07 (0.06) |
| Belgian | 0.14*** (0.04) | -0.11*** (0.04) | 0.11*** (0.03) | 0.07** (0.03) |
| French | 0.08** (0.03) | -0.08** (0.03) | 0.04 (0.03) | 0.05* (0.03) |
| Portuguese | 0.09* (0.05) | -0.10 (0.07) | 0.10* (0.05) | 0.04 (0.05) |
| Other nationality | 0.07 (0.05) | -0.21*** (0.05) | 0.07 (0.05) | -0.02 (0.05) |
| Living with partner | 0.01 (0.02) | 0.01 (0.02) | 0.05** (0.02) | 0.06** (0.02) |
| Children | 0.02 (0.02) | 0.05** (0.02) | 0.06*** (0.02) | 0.09*** (0.02) |
| Secondary | -0.09*** (0.03) | -0.00 (0.03) | -0.03 (0.03) | -0.03 (0.03) |
| Higher than Secondary | -0.09** (0.04) | -0.14*** (0.04) | -0.17*** (0.03) | -0.20*** (0.04) |
| Commuting time | -0.00 (0.01) | 0.00 (0.01) | -0.01** (0.01) | -0.01*** (0.01) |
| Permanent contract | 0.10** (0.04) | 0.04 (0.04) | -0.12*** (0.03) | -0.09** (0.04) |
| Tenure | 0.00* (0.00) | 0.00 (0.00) | -0.00*** (0.00) | -0.00 (0.00) |
| Tenure squared | -0.00** (0.00) | -0.00 (0.00) | 0.00** (0.00) | 0.00 (0.00) |
| Union | -0.03 (0.02) | 0.04* (0.02) | -0.01 (0.02) | -0.02 (0.02) |
| Part time | -0.09** (0.04) | -0.12** (0.05) | -0.15*** (0.05) | -0.18*** (0.04) |
| Painful working conditions | 0.04*** (0.01) | 0.08*** (0.01) | -0.01 (0.01) | -0.04*** (0.01) |
| Professional and managers | 0.02 (0.07) | 0.12 (0.11) | 0.42*** (0.09) | 0.47*** (0.07) |
| Associate professionals | 0.02 (0.07) | 0.05 (0.11) | 0.22*** (0.08) | 0.31*** (0.06) |
| Administrative and clerical | 0.00 (0.06) | -0.01 (0.07) | 0.11** (0.06) | 0.17*** (0.06) |
| Sales and service personnel | 0.01 (0.05) | 0.05 (0.07) | 0.18*** (0.06) | 0.26*** (0.06) |
| Craft | 0.00 (0.05) | 0.04 (0.07) | 0.29*** (0.06) | 0.39*** (0.06) |

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| | | | | |
|--|--------------------|-------------------|-------------------|--------------------|
| Plant operatives | 0.14** (0.07) | 0.18 (0.11) | 0.29*** (0.10) | 0.39*** (0.07) |
| Quintile of hourly wage | 0.08*** (0.02) | 0.02 (0.04) | 0.08** (0.03) | 0.09*** (0.02) |
| 50-99 employees | 0.01 (0.04) | -0.04 (0.05) | -0.05 (0.04) | -0.07** (0.03) |
| 100-249 employees | 0.05 (0.04) | -0.04 (0.06) | -0.06 (0.06) | -0.07** (0.04) |
| 250 employees and more | 0.08 (0.07) | -0.01 (0.13) | -0.05 (0.11) | -0.03 (0.06) |
| Construction | 0.06* (0.04) | 0.13*** (0.04) | 0.23*** (0.03) | 0.24*** (0.04) |
| Trade, accommodation and food services | 0.02 (0.04) | 0.08** (0.04) | 0.13*** (0.04) | 0.15*** (0.04) |
| Transportation and storage | -0.14*** (0.04) | 0.02 (0.06) | 0.04 (0.05) | 0.09* (0.05) |
| IT and communication | 0.05 (0.07) | -0.12* (0.07) | -0.15* (0.08) | -0.16*** (0.06) |
| Finance | 0.21** (0.09) | -0.06 (0.05) | -0.13* (0.07) | -0.23*** (0.06) |
| Other services | 0.03 (0.04) | 0.00 (0.04) | -0.01 (0.04) | -0.08* (0.04) |
| Observations | 14 685 | | | |

Source: Survey on working conditions and quality of work life - Luxembourg - 2013.

Notes: Robust standard errors adjusted for 2254 clusters (working in the same organization) in parentheses.

Weighted estimations. Coefficients * significant at 10%; ** significant at 5%; *** significant at 1%.

