The complementarities between Infomation and Communication Technologies Use, New Organizational Practices and Employee's Contextual Performance: Evidence from Europe in 2005 and 2010

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The Complementarities between Information Technologies Use, New Organizational Practices and Employees' Contextual Performance: Evidence from Europein 2005 and 2010*

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This article investigates the relationships between Information Technologies (IT), new organizational practices and workers' contextual performance in the European context. Our empirical results are based on data about more than 11000 employees from 16 European countries in 2005 and more than 16000 in 2010. First, our results underline asymmetric effects of IT use. Internet use is, indeed, positively related to all aspects of contextual performance in 2010, while computer use has been only positively associated with interpersonal contextual performance in 2005. Second, we find that most of the considered new organizational practices have a positive relationship with employees' contextual performance.

Contextual Performance - Information Technologies - New Organizational Practices - Employees

Lescomplémentarités entre l'usage destechnologies de l'information, les nouvellespratiques organisationnelleset la performancecontextuelledes employés : Analyses européennes en 2005 et 2010

Cet article analyseles relations entre lesTechnologies de l'Information(TI), les nouvelles pratiquesorganisationnellesetla performancecontextuelledes employésdans le contexte européen. Nos résultats empiriquessont basés surdes bases de données concernantplus de11000employésde 16 pays européensen 2005et plus de16000en 2010. Premièrement,nos résultatssoulignent des effetsasymétriques del'usage des TI.L'usage d'Internetest, en effet, positivement lié àtous les aspects dela performancecontextuelleen 2010, tandis que l'usagede l'informatiqueestassocié positivement seulement à laperformance contextuelleinterpersonnelle en 2005. Deuxièmement,nous constatons quela plupart desnouvelles pratiques organisationnellesconsidéréesontune relation positive avecla performancecontextuelledes employés.

Performancecontextuelle - Technologies de l'information - Nouvelles pratiques organisationnelles – Employés

Classification JEL: J81, M12, M54, L23

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1. Introduction

The objective of this article is to propose an economic analysis of Information Technologies (IT) usage (Internet and computer), New Organizational Practices (NOP) and employees' performance in Europe measured by contextual performance as defined by Coleman and Borman (2000). IT and NOP are generally viewed as complementary assets impacting firm performance (Ichniowski et al., 1997;Black and Lynch, 2001; Bresnahan et al., 2002; Askenazy and Caroli, 2010). As such, looking at the links between IT andemployees' performance, one needs to consider the adoption of NOP by firms.

Although several empirical researchers analysed the links between ITuse, NOPand the performance of the firm, research at the employee level are scarce[4]. One of the main explanations of this scarcity is related to the lack of individual measures for workers' efforts and performance. Our article contributes to this line of research by focusing on the organizational changes (NOP) adopted simultaneously with IT and their relationships withemployees' performance.

This work has three main novelties.First, while most of the related literature focuses on labour productivity as the main indicator of employees' performance, we propose in this paper an alternative research strategy by focusing on contextual performance of workers as a performance indicator. We argue that IT investments and NOP motivate workers and develop their behavioural performance[5]. IT, for example, mediates relations inside the firm and may induce self-improving behaviours. NOP, such as team work, are the support to interpersonal relations.Therefore, IT and NOP mainly influence the behavioural dimension of workers' performance.Second, our analyses are based on rich European data including the responses of 11098 European workers from 16 countries in 2005 and 16354 in 2010. This allows us to control for a very detailed set of workers, job, firms and country characteristics that enable us to properly isolate the links between IT investments, NOP and employees'contextual performance.Third, we provide new explanations on how firms have adjusted their organizational structure in order to harnessthe dividends from changes in IT uses. Behind IT there are several technologies with asymmetric links with performance. Our main findings show asymmetric links between IT use and NOP on workers' contextual performance. While Internet use is, indeed, positively related to all aspects of contextual performance in 2010, computer use was positively associated with contextual performance in 2005 but the link disappears in 2010.

The article is structured as follows. Section 2 reviews the literature related to IT use, NOP and employees' contextual performance. Section 3 presents the data. Section 4 presents and discusses the results. Finally, section 5 concludes.

[4]*e.g.*Barthélémy and Cette (2007) have considered the effects of IT and NOP on the paceand intensity of work in France. Their results suggest that workers are more involved outside their legal working-hours but have more autonomy and flexibility to do their assigned tasks.

[5]Although contextual performance is central concern for organizational researchers, they investigatedmainly individuals ignoring IT use and NOP.

2. Research background

This section discusses the analytical relationships between IT use, NOP and contextual performance.

Contextual Performance

During the lastdecades, advances have been made in clarifying and extending the concept of employees'job performance (Viswesvaran, 1993).One of the most accepted work in this area is theone of Borman and Motowidlo (1997). According to these authorsemployee's performance is made up oftask performance (in-role behaviour) and contextual performance (extra-role behaviour). Task performance is defined as "the effectiveness with which the job incumbent performs activities that contribute to the organization" (Borman and Motowidlo, 1997, p.99). Contextual performance includes "volunteering to carry out tasks and activities that are not formally part of the job and helping and cooperating with others in the organization to get tasks accomplished" (Borman and Motowidlo, 1997, p.99).

Contextual performance measuresare widely used nowadays in Human Resource Management (HRM) and help firms to appreciate theeffectivenessof their HRM policies. The most popular measure proposed by Coleman and Borman (2000) has three dimensions: Interpersonal Citizenship Performance (ICP), Organizational Citizenship Performance (OCP) and Job/Task Conscientiousness (JTC). ICP consists of helping others by cooperating, offering suggestions, teaching them useful knowledge or skills, directly performing some of their tasks and providing emotional support for their personal problems. OCP is related to organizational support, to represent the organization favourably by defending and promoting it, as well as expressing satisfaction and showing loyalty by staying with the organization despite temporary hardships, supporting the organization's mission and objectives, and suggesting improvements. JTC is related to conscientious initiative, it consists of makingextra effort, taking initiatives to do all that is necessary to accomplish objectives and developing own knowledge and skills by taking advantage of opportunities outside the organization using own time and resources.

IT use, NOP and contextualperformance

Many firms recently experienced a reorganization of their workplace with the adoption of new organizational practicessuch as job rotation, teamwork, just-in-time and total quality management (Osterman, 2000; Cappelli and Neumark, 2001). Van Reenen (2011) provides empirical evidence that suggests that changing management practices improve firms' productivity. Moreover, other papers show that performance associated with IT use depends strongly on the adoption of NOP (*e.g.*Greenan and Mairesse, 2000).

An important literature studied the consequences of these organizational changes on firms' performance and skill requirements (*e.g.*Ichniowski et al., 1997; Black and Lynch, 2001). Using either industry or firm-level data, they showa positive impact of new work practices upon firms' productivity and performance especially when they are combined with IT. Most of this literature assumes productivity as the main measurement of performance and assess

the question at the industry or firm level. But, to our knowledge, no applied empirical research has tried to examine whether the complementarity is also valid with contextual performance at the individual level.

Employees' behaviours within the firm differ from oneindividual to another. Thesebehaviours depend on the employee and theorganization's needs and dynamics. Organization's needs are affected by the speed of technological change. So, similar to productivity growth, contextual performance follows technological and organizational change. Management practices as complementary technologies modify the organizational practices inside the firms (Van Reenen, 2011). IT and associated NOP are recognized as a major source of improvements inside firms about, among others, communication, collaboration, exchange of information and ideas (Rubery and Grimshaw, 2001). More precisely, at least, Internet and Computer usecan be related to three main behavioural changes. First, IT use may induce more cooperative behaviour. Second, IT use may impact organizational citizenship behaviours within the firms. Third, IT use may induce self-improving behaviours. HRM practices are recognized to be positively linked with workers' organizational commitment (White and Bryson, 2013).HRM practices enhance worker involvement, make the work design less rigid and permit to decentralize managerial tasks.

3. Data

We use theEuropean Working Condition Survey (EWCS) data collected by Eurofound in 2005 and 2010. As we aim to analyse the contextual performance of employees within firms, we exclude self-employees, employees in one-person firms and those with less than one year of seniority in the firm. We also restrict the sample to 16 countries with comparable living and working conditions, that is to say, countries that belong to the Euro Zone in 2005, Nordic countries and the United Kingdom. The number of employees in 2005 is 11098 and 16354 in 2010.Weights are constructed in order to ensure that the distribution by region, locality size, gender, age, economic activity and occupation is representative of the active population (based on the Labour Force Survey - Eurostat).

A data mining technique is used to form groups of workers relatively to their behavioural proximity on the three dimensions of workers' contextual performance described above. 8binary or ordered variables are used to construct the Interpersonal Citizenship Performance - ICP index, 16for the Organizational Citizenship Performance - OCP index and 3for the Job/Task Conscientiousness- JTC index.[6]We perform a Multiple Correspondence Analysis (MCA) followed by a cluster-analysis. The cluster-analysis permits to regroup individuals in classes that are the most homogeneous according to their similarities with respect to all variables.[7]The indexes are ordered from the lowest "performing" group of worker to the best one (Table 1).

[6]All of the variables used are available upon request from the corresponding author.

[7] The classification is based on individuals' coordinates obtainedwiththe MCA. The hierarchical clustering method uses the Ward index to measure the distance between classes. The choice of the number of classes has

Table 1. Descriptive statistics of the contextual performance indicators

		2005		2010	
		Mean (%)	Std. Dev.	Mean (%)	Std. Dev.
ICP	1	18.15	0.39	17.38	0.38
	2	14.97	0.36	19.81	0.4
	3	30.55	0.46	30.07	0.46
	4	7.71	0.27	8.58	0.28
	5	28.63	0.45	24.16	0.43
OCP	1	11.05	0.31	9.52	0.29
	2	23.51	0.42	32.12	0.47
	3	52.52	0.5	46.67	0.5
	4	5.08	0.22	4.94	0.22
	5	7.84	0.27	6.75	0.25
JTC	1	73.49	0.44	65.82	0.47
	2	13.34	0.34	19.90	0.4
	3	4.55	0.21	6.16	0.24
	4	8.61	0.28	8.12	0.27
# obs.		11098		16354	

Weighted statistics.

For our analysis ofIT use at work, we retain the frequency of computer and Internet use.[8]The number of non-IT users decreased between 2005 and 2010 (Table 2).

To characterize the new organizational practices of firms we introduce two types of measures of workplace practices.First, to characterize new models of production such as Just-In-Time andTotal Quality Management, the following variables are introduced: 'work schedule fixed by employer','meeting precise quality standards' and 'information about health and safety risks'. The new models of production can modify the behaviour of workers as they have an impact on the time available to produce anddeliver products or services, on the quality of outputs, and on worker environment and safety. Wealso controlfor the degree of non-painful workingconditions facedby workers ('Quality of the job environment').Second, to characterize the Human Resources Management (HRM)practices of firms, we introduce variables capturing practices that enhance worker involvement, make the work design less rigid and permit to decentralize managerial tasks. We also introduce a variable that captures the resort to 'formal assessment' used by managers to give feedback and rewards. 'Job rotation' and 'telework' are introduced to capture a less rigid work design that can strengthen employees' performance(Bloom et al., 2011).Finally, the variable 'team work' is included to capture a well-developed workplace practice that permits jointdecision makingandincreases the involvement of workers (Jones and Kato, 2011). Firms implement more of all forms of NOP in 2010 compared to 2005 (Table 2).

been determined according to 4 rules: pseudo T-squared, pseudo-F, Cubic Clustering Criterion and the dendrogram'sshape.

[8] The use of Internet concerns the professional use of Internet and e-mails whatever the IT support.

Table 2. Descriptive statistics of IT use and NOP

	2005		2010			
	Mean	SD	Mean	SD	Min	Max
Frequency of IT use						
Internet use	2.45	1.61	2.70	1.65	1	5
1. Never	46.77	0.5	39.55	0.5		
2. Almost never	11.33	0.32	11.82	0.32		
3. Around 1/4 of the time	12.63	0.33	13.12	0.34	0	100
4. Around half of the time	8.86	0.28	10.04	0.3		
5. Almost all of the time or all of the time	20.41	0.4	25.47	0.44		
Computer use	2.55	1.57	2.73	1.57	1	5
1. Never	38.14	0.49	32.01	0.47		
2. Less than 1/4 of the time	19.77	0.4	20.60	0.41		
3. Less than 3/4 of the time	12.05	0.33	13.31	0.34	0	100
4. Almost all of the time	8.92	0.29	10.70	0.31		
5. All of the time	21.12	0.41	23.38	0.42		
NOP						
Work schedule fixed by employer	16.79	0.37	22.02	0.41	0	100
Meeting precise quality standards	76.01	0.43	76.67	0.42	0	100
Information about health and safety risks	2.24	0.69	2.35	0.66	1	3
Quality of the job environment	4.33	1.61	4.40	1.55	1	6
Formal assessment	40.20	0.49	43.42	0.5	0	100
Job rotation	48.82	0.5	50.36	0.5	0	100
Telework	7.57	0.27	11.02	0.31	0	100
Team work	61.24	0.49	64.51	0.48	0	100
# obs.	11098		16354			

Weighted statistics.

Different control variables are introduced in our analyses and are related to several characteristics of employees, their job, the firm and the country.These controls allow us to properly isolate the links between IT investments, NOP and workers contextual performance.[9]Regarding employee's characteristics, the EWCS survey provides information about gender, age, level of education and marital status.The survey also provides informationon the job characteristics. We have information on the income, on the nature of the contract (permanent, full time), onseniority in the firm, on occupation (8 groups) and on commuting time between the house and the workplace. It is important to note that during their commuting time employees have, especially in 2010, the possibility to use their Smartphone or Tablets to work.Regarding the firm's characteristics, 8 economic sectorsand 4 firms' size are used. With respect to the specificities of the 16 countries,we consider the country growth rate, the country unemployment rate and the percentage of post-secondary educated people.

[9]Descriptive statistics of our control variables are availableupon request from the corresponding author.

4. Results

Table 3 gives the results of our analyses obtained with ordered probit models. We find that IT uses have significantly positive linkswith workers' contextual performance, but these links depend on the nature of the IT considered.

First, our results show strong evidence that Internet useispositively associated with all the facets of the contextual performance (except for ICP in 2005). The more workers use Internet the higher is their Organizational CitizenshipPerformance (OCP) and Job/Task Conscientiousness (JTC)in 2005 and 2010. While in 2005 Internet has no significant link withInterpersonal Citizenship Performance (ICP), the picture changed and we find a positive relationship in 2010. Internet is modifying the way people are working and interacting inside the firm and is allowing more flexibility in the way the tasks are done by workers. It is enhancing cooperative behaviours, citizenship behaviours and self-improvement behaviours. Second, our results show an interesting result for computer usage. In fact, computer usage has a positive link with ICP in 2005 but a negative one withJTC. However, these linksdisappear in 2010. One possible explanation is the fact that computersare an old and stabilized IT and the links with contextual performance depend on the age of the IT. An alternative explanation is that computer use can be considered more as a complement to Internet use in 2005than as a distinct effect, a complementarity that disappears with new devices allowing access to Internet such as Smartphones, Tablets.

The results about new organizational practices are in line with recent research focusing on HRM and organizational commitment (*e.g.*White and Bryson, 2013). We find that NOP are positively related to workers' contextual performance. All the studied new organizational practices have at least one positive relation with contextual performance – except for the case of the work schedule determined by the employer that has a negative link with contextual performance. At the same time, NOP have a differentiated association with the three facets of contextual performance.Formal assessment has a significant link with all the facets of contextual performance in 2005 and we find the same conclusion in 2010. Job rotation has only a significant and positive link with ICP (and no relations with OCP and JTC). This is the case in 2005 and 2010.Our results also reveal that the more employees are involved in telework the greater aretheir contextual performances in 2010. While in 2005 telework had a positive association only with JTC and a negative one with ICP. Teamwork has a positive link with the three dimensions of contextual performance in 2010, but no significant link in 2005, except a positive one with ICP. A firm that provides "information about health and safety risks" and non-painful working conditions seem to favour the performance of workers in terms of ICP and OCP in 2005 and in 2010. In 2010, these NOP are negatively related with JTC.While 'Meeting precise quality standard'was initially positively associated with two contextual performances (ICP and OCP) in 2005 we find only one positive association with OCP in 2010.Moreover, our results show that organizational practices which are based on certain rigidity, like a work schedule fixed by the employer, have a negative link with contextual performance. This negative association changes over the years. While, this

practice is negatively related to OCP and JTC in 2005, we find that the negative links appear with ICP and OCP in 2010.

Table 3. Ordered probit models

	2005			2010		
	ICP	**OCP**	**JTC**	**ICP**	**OCP**	**JTC**
Frequency of IT use						
Internet use	-0.001	0.065***	0.144***	0.024*	0.046***	0.08***
	(0.024)	(0.01)	(0.03)	(0.014)	(0.016)	(0.031)
Computer use	0.062***	0.024	-0.068***	0.005	0.014	-0.001
	(0.017)	(0.024)	(0.020)	(0.019)	(0.016)	(0.022)
NOP						
Work schedule fixed by employer	-0.049	-0.096***	-0.352***	-0.102*	-0.112*	-0.011
	(0.057)	(0.034)	(0.067)	(0.062)	(0.064)	(0.045)
Meeting precise quality standards	0.084***	0.108**	0.018	-0.032	0.117***	0.022
	(0.027)	(0.05)	(0.051)	(0.037)	(0.027)	(0.052)
Information about health and safety risks	0.191***	0.342***	-0.055	0.240***	0.302***	-0.052***
	(0.012)	(0.019)	(0.037)	(0.032)	(0.032)	(0.018)
Quality of the job environment	0.054***	0.056***	-0.022	0.032***	0.05***	-0.049***
	(0.015)	(0.011)	(0.022)	(0.007)	(0.01)	(0.006)
Formal assessment	0.19***	0.12**	0.086**	0.099**	0.081*	0.105***
	(0.041)	(0.052)	(0.041)	(0.039)	(0.041)	(0.032)
Job rotation	0.246***	0.058	0.026	0.128***	0.03	0.045
	(0.044)	(0.042)	(0.073)	(0.013)	(0.041)	(0.033)
Telework	-0.08*	-0.007	0.677***	0.085**	0.214***	0.664***
	(0.048)	(0.062)	(0.088)	(0.038)	(0.065)	(0.054)
Team work	0.222***	0.005	-0.039	0.189***	0.075***	0.083***
	(0.028)	(0.04)	(0.064)	(0.033)	(0.018)	(0.032)
Employee charac.		Included			Included	
Job charac.		Included			Included	
Firmscharac.		Included			Included	
Country charac.		Included			Included	
Cut 1	0.448	0.016	0.981	0.078	-0.149	1.045***
	(0.303)	(0.259)	(0.651)	(0.439)	(0.465)	(0.327)
Cut 2	0.967***	0.935***	1.611**	0.733	1.045**	1.847***
	(0.308)	(0.301)	(0.650)	(0.455)	(0.473)	(0.365)
Cut 3	1.829***	2.641***	1.922***	1.552***	2.577***	2.266***
	(0.34)	(0.28)	(0.647)	(0.461)	(0.477)	(0.336)
Cut 4	2.065***	2.958***		1.82***	2.905***	
	(0.35)	(0.284)		(0.452)	(0.476)	
Observations		11098			16354	
Pseudo R-squared	0.053	0.0721	0.164	0.0352	0.0581	0.127
Log Lik.	-20924	-17263	-10349	-32812	-26518	-18738

Robust standard errors adjusted for 16 clusters (countries) in parentheses. Weighted estimations. Coefficients *significant at 10%; ** significant at 5%; *** significant at 1%.

Our study confirms that information technologies are contributing to the setting of a new productive model associated with higher results in the areaof contextual performance. The new organizational model using team work, telework, job rotation and intensive use of Internet induce higher contextual performance of workers. Management of European firms is changing in order to adjust to technology and to improve workers' contextual performance(Van Reenen, 2011).

Sensitivity analyses

We conduct additional sensitivity analyses in order to gauge the robustness of the resultsconcerning IT use.[10]We estimate a trivariate ordered probit model using a technique developed by Roodman (2011) to take into account the potential correlations between contextual performances. The correlations show independence except a positive dependence between ICP and OCP. Despite this correlation, the results are very similar with the ones obtained with our three independent ordered probit modelsshownin Table 3.Moreover, in order to take into account as much as possible the potential endogeneity or a reverse causality of IT use, we estimate simultaneously the frequency of Internet use (or the frequency of computer use) and one of the indexes of contextual performance (via bivariate ordered probit models, Roodman, 2011). In the estimates of the frequency of IT use, we introduce the same variables as earlier and two variablesobtained from Eurostat that explain the frequency of IT use but not the indexes of employees' contextual performance: the average rate of high bandwidth Internet connection in firms in the countryand the average percent of people in the country able to perform five of six IT activities. The results are in line with those presented in Table 3.

5. Conclusion

Existing literature focuses mainly on the impact of IT use and NOP on firms' performance (*e.g.*Ichniowski et al., 1997; Black and Lynch, 2001) and research on employees'performance is scarce. Studying the relationships between IT use, NOP and employees' behaviours inside the firm is important as employees are at the heart of the success of an organization (Pfeffer, 1994).Moreover, while most of the related literature focuses on productivity as the main indicator of workers' performance, we propose an alternative research strategy by focusing on workers' contextual performance. Although contextual performance is central concern for organizational researchers, research effort concentrates on individuals characteristics, ignoring recent organizational changes and IT use. We argue that employees using IT and working in firms providing NOP may develop behaviours that benefit the organization.

Our resultsconfirmedthat IT usesarepositively associated with contextual performance and are in line with previous research showing that IT ispositively related with workers' motivation and involvement (*e.g.*Barthélémy and Cette, 2007; Martin, 2011). Furthermore, our findings contribute to the literature about IT impact by proposing an alternative measurement of performance and rely on the asymmetric effects of IT. The links between IT

[10]The results are not reported here but are available upon request from the corresponding author.

useand workers' contextual performance depend strongly on the considered technology. In 2010, while Internet use is positively related to all the facets of contextual performance, we find that computer use has no significant link with contextual performance dimensions.Our analysesalso confirmed that New Organizational Practices are positively associated with workers' contextual performance and are consistent with the literature on high-involvement work practices underlyingincreases in labour productivity and worker's commitment (*e.g.*Osterman, 2000; WhiteandBryson, 2013).More precisely, most of the considered NOP have at least one positive link with at least one aspect of contextual performance.

Our article provides several contributions to the existing literature. First, our article contributes to the debate about the complementarities between IT and NOP and provides an analysis at the employee level that is needed in a literature that is almost limited tothe firm level. We show how IT useismodifying the behaviour of workers, and how managersuse NOP as "complementary technologies". A new industrial and organizational model seems present in Europe resulting in higher workers performance. Second, we resort to richand large databases that permit to provide robust analyses. Third, our analyses arebased on organizational research, HRM research and industrial organization literature in order to enrich these research areas.

Our paper is, of course, not without limitations. First, the European data were collected at two points in time on two samples of employees. It allows us to find significant associations between variables, but no final conclusions about causality can be drawn. Second, because the survey was not defined specifically for our analyses, deepened richer picture may be obtained by examining other types of IT uses in order to have better understanding of the impact of specifics IT useson workers' contextual performance. For example, further research could analyze other data that contain information on other well diffused technologies within firms such as Enterprise Resource Planning or social networks.

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