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Innovation, Industrial Relations and Employee Outcomes Evidence from Italy

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The present work aims to provide further evidence on the relationship between firms innovation activities and working conditions. The literature on such a topic, although quite scanty, has proved to be lively recently, and it is mainly focused on the linkages between organizational innovation and workers' well being, given the increasing concern about the effects of 'new work practices' or 'high performance work practices' on working condition. During the 1990s several economists and managerial scholars pointed to the positive effects on workers from the introduction of new forms of work and production organization; however, some more recent studies highlight its potential negative effects. On this basis we mainly investigate the effects of organizational changes and firm level industrial relations climate on workers' well being for two Italian local production systems, Reggio Emilia and Modena, with the further aim of not to overlook other aspects of firms' innovation activity, often neglected in previous studies. The information used come from two unique datasets.

The empirical results point to a general positive impact of organizational changes on working conditions, although with some exception. Other innovation activities in training, ICT and technological areas are positively related, when significant, with the indexes of working conditions as well. Finally, we confirm the relationship between cooperative industrial relations at firm level and workers well being for both the local production systems.

Keywords: organizational innovations, working conditions, industrial relations, local production systems.

Research paper

JEL: L60, M54, O33, J51, J81

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1. Introduction

In the present work we intend to complement the widespread literature that investigates the effects of innovation on firms' economic outcomes providing evidences on the effects of innovation activities on employee outcomes.

The subject is not new, but is rather under-researched. However, the increasing diffusion of so called High Performance Workplace Practices (HPWP henceforth) and the contraction of the traditional Fordist-Taylorist organization of production have spurred a renewed interest in the consequences of 'new' forms of production organization for workers' conditions. A widespread endorsement of the HPWP benefits on workers emerged during the '90s, especially in the US context: wider discretion, greater opportunity for using their skills thorough job redesign, decreased level of control by management and greater worker involvement in decision-making processes were perceived as aspects that increased workers' well being (see Handel, Levine, 2004 for a review). However, some scholars (Gallie, 2005; Green, 2004; Brenner, Fairris, Ruser, 2004; Askenazy, Caroli, 2006) have highlighted that there are costs to workers associated with organizational changes: intensification of the working activity, reduction in working dead-times, psychological and physical pressures.

Firm's activities potentially influencing the working conditions cannot be bounded to the organizational changes, but they surely involve other forms of innovations and the specificities of the labour/industrial relations, such as cooperative relations between management and workers or their delegates. The latter issue has not received the deserved attention by a stream of literature that mainly analysed organizational changes/working condition relations in liberal market economies (Kalmi, Kauhanen, 2008). The present work shows results for local production systems, included in a market economy that shares characteristics belonging both to a coordinated and to a liberal market economy (Italy) and defined as Mediterranean economy by some scholars, with historical traditions of strong and active unionism.

The empirical work is grounded on the above considerations and it aims to verify the existence of robust linkages between working conditions, as dependent variable, innovation activities and cooperative industrial relations at firm level, as covariates. The data utilized come from two unique datasets, each of them for a single Local Production System (LPS henceforth) located in Northern Italy: Reggio Emilia (RE henceforth) and Modena (MO henceforth).

The paper is structured as follows. Section 2 reviews the existing literature in order to contextualize the present work. Section 3 outlines RE and MO LPSs in addition to data description and methodological issues. Section 4 provides the results of the analysis and section 5 concludes.

2. Related Literature

Notwithstanding the importance of the subject here investigated, the relations between working conditions and the innovation activities of the firm, it is relatively under-researched[1] (Askenazy, Caroli, 2006; Kalmi, Kauhanen, 2008), when compared to a widespread literature concerning the relation between the introduction of HPWP and firm outcomes (see among others Black, Lynch, 2001; Caroli, Van Reenen, 2001; Janod, Saint-Martin, 2004; Huselid, 1995; Huselid, Becker, 1996; Cappelli, Neumark, 2001; Ichniowski, Shaw, Prennushi, 1997; Ichniowski, 1990; Zwick, 2004; BLINDED; Leoni, 2008).

In this work we focus on the issue regarding the linkages between innovation activities, with a special attention on organizational innovations usually intended as enhancers of firm's economic outcome, and workers' well being, without neglecting to analyse the nexus between cooperative industrial relations and working conditions, which can be thought of as being complementary to the literature on the effects of innovation activities.

In the attempt of providing a brief systematization of the existing literature we can move the first step following a stream of works that recognizes in the introduction of HPWP a way for the management to strengthen control over workers' efforts and to intensify the pace of work (see Ramsay, Scholarios, Harley, 2000 for a review). According to this negative position (*intensification thesis*) self-managing teams, for example, are considered as instruments that substitute the hierarchical control with the peers control. In the same vein, worker participation is perceived as a method for co-opting workers into a managerial perspective in order to preserve hierarchical authority without bureaucratic control (Vidal, 2007). The work intensification that several economies have experienced during the 90s and in more recent years is explained, by some scholars (Green, McIntosh, 2001; Green, 2004; Askenazy, 2004; Fairris, 2004), as a result of the diffusion of HPWP.

Parallel to the critical view a positive position maintains that the adoption of HPWP increases workers' well being (*empowerment thesis*) through a multiplicity of channels (Handel, Levine, 2004; Askenazy, Caroli, 2006). In this perspective both management and workers gain from the introduction of organizational changes: the former obtain higher levels of productivity; the latter receive economic benefits (e.g. higher wages), enjoy higher levels of job satisfaction and are capable of fully exploiting their skills. The advocates of HPWP are used to stress the accent on the role of complementarities between such practices. A wide endorsement about the positive impact of

[1] Part of the literature is focused on the relation between changes in organizational practices and workers' wages (Black, Lynch, Krivelyova, 2004; Handel, Gittleman, 2004; Forth, Milward, 2004)

bundles of practices on firm performances (see Lynch, 2007 for recent evidence), rather than single practices adoption, leads us to expect the same when the outcome variables are measures of working conditions. Although, it is not necessarily true that the introduction of HPWP implies high level of workers involvement (Vidal, 2007); the adoption of bundles of HPWP may indicate the willingness of managers to deeply reconsider the production and labour organization structures in a way that may also alter the hierarchical structure and the equilibria among the firms constituencies.

The latter represent a key point to understand whether or not the implementation of organizational changes affects the workers well being. High commitment workplace practices may be used in the attempt to align management and workers' objectives, but in this respect the role that can play a cooperative and participative industrial relations climate cannot be neglected. Participatory industrial relations may be legitimately thought of as complementary aspects of innovation activities in influencing working conditions[2] and not only firm economic performance (Menezes-Filho, Van Reenen, 2003; Metcalf, 2003). In fact, unions are clearly concerned about the well being of their members, while management may be less sensible towards workers' well being and more focused on workers' efforts. If industrial relations are not poor, but driven by union/management cooperation[3], then the union presence may contribute to non-conflictual resolution of the partially divergent objectives of the two parties, ending up with advantages both for the firm and for the workers. International institutions have also recognized the importance of social dialogue in improving the workers' well being (Eurofound, 2007).

In addition to and interrelated with organizational changes and workers representation we also have to enumerate other innovation activities, which revolve around training policies (here intended as a separate element with respect to HPWP), technological changes and ICT adoption, that are potential sources of changes in working conditions (Antonioli, Mazzanti, Pini, 2009). For all the innovation activities, but for training, which is usually thought to have an unambiguous positive role on workers, may hold the dichotomous view that roughly synthesises the scholars positions about the effects of HPWP on working conditions. On the one hand, the increasing diffusion of ICT (Brynjolfsson, Hitt, 2000; Bresnahan, Brynjolfsson, Hitt, 2002) has been identified as a cause of stress among workers because of the possibility they provide to management to monitor and control workers more intensively (Green, 2004). On the other hand, ICT help in

[2] Within this line of empirical research the issue of reverse causality emerges (Renaud, 2002): the good quality of the dialogue between union delegates and management spurs workers well being, because management is more receptive to the union voice and consequently to the workers' needs, or instead, better quality working conditions promote less adversarial industrial relations?

[3] If unions are conservative (and likely operating in a poor industrial relations environment) they may be prone to adopt behaviours that hinder the introduction of innovations, both technological and organizational, independently by the interest of their members. Some empirical studies have pointed out that union power, usually "proxied" by union density variable, may exert a hindering effect on R&D expenditure and on profitability (Menezes-Filho, Ulph, Van Reenen, 1998; Betts, Odgers and Wilson, 2001)

improving information sharing, in spreading information about best safety practices, and providing workers with greater degrees of autonomy in their jobs (Askenazy, Caroli, 2006). The same reasoning may hold for innovation in processes or quality control. On the one hand, their introduction can increase mental strain for workers and reduce safety because the 'ever' changing production environment reduces the possibility of setting and learning safety procedures; on the other hand, the focus on quality, and especially in the processes implemented, can be thought of as improving occupational safety (Askenazy, Caroli, 2006).

3. Empirical framework and methodology

Two Northern Italy provinces in Emilia-Romagna, Reggio Emilia (RE) and Modena (MO), are the geographical locations of the manufacturing firms analysed in the present work. The two LPSs share some common features both in terms of industrial system structures and of institutional settings.

Both the LPSs are characterized by a predominant presence of Small and Medium Enterprises (SME)[4] as we can see by the population distributions in tables A1a and A1b in Appendix. A second characteristic of the RE and MO LPSs, which is linked to the prevalence of SME, is the existence of districts (Brusco, 1982; Becattini, 2004): non-electrical machinery and equipment and ceramic tiles for RE; ceramic tiles, wood processing machinery and biomedical for MO. The presence of districts that are usually constituted by networks of small firms and the institutional settings characterized by a strong social cohesion and by a traditional deep rooted unionism, make the two LPSs paradigmatic versions of the so called '*Emilian model*' (Amin, 1999; Brusco, 1982). The latter, indeed, is characterized by a well marked entrepreneurship spirit and an equally strong unionism, which coexists with a productive apparatus characterized by the presence of a district-like production system[5].

The empirical analysis is conducted using two different datasets. The first data source is a firm level survey conducted on the manufacturing firms located in RE[6]. The criteria we adopted for the identification of the population of 376 firms were: (a) firms with at least 20 employees; (b)

[4] According to the European Commission (Official Journal of the European Union, L 124, May 2003) a SME is defined as a firm with less than 250 employees. Table A.1 shows that in our local production system about 85% of the firms with union representatives are below this threshold.

[5] We especially refer to the role of CGIL, the left wing union. For an overview of the union history and the linkages with political parties we refer the interested reader to Baglioni (1998).

[6] Several official sources were used to construct the firm population of RE: Reggio Emilia Chamber of Commerce, Istat Census, Aida data bank, "Impero" data bank. For reasons of homogeneity and information availability the population refers to the year 2001.

firms belonging to manufacturing sectors according to the ISTAT ATECO 2002[7] classification; (c) presence of union representatives to be interviewed. The data for 2004 were provided by union representatives, through face-to-face interviews. The interviews led to 192 respondents, which constituted 51% of firms with union representation (UR) within the firm.

The second survey has been conducted on manufacturing firms located in MO province. The criteria for the identification of the population slightly differ from those used on RE firms. In fact, only the firms with at least 50 employees were used to select those having union representatives to be interviewed: 246 firms is the firm population identified in MO province and the usable respondents were 176. The data collected refer to the period going from 2004 to 2006[8].

As we can see in tables A.1a and A.1b only some minor distortions of the two samples of interviewed firms, with respect to the populations, emerge. A version of the Cochran Test (Cochran, 1977) for sample distortions shows acceptable results[9].

Both the two surveys are unique sources of information about firms' structural characteristics, workforce composition, innovation activities, working conditions and industrial relations. The information stemming from the two questionnaires has been selected in order to get identical data for both the LPSs.

The empirical model is based on the following regression function:

$$(1)\ \textit{Working Condition (WC\_EMP; WC\_SAFE)} = \beta_{0i} + \beta_{1i}[\textit{structural variables}] + \beta_{2i}[\textit{innovation activities}] + \beta_{3i}[\textit{industrial relations}] + \varepsilon_i$$

The variables in the above reduced form may be shortly described as follow, while for detailed information on their construction we remind the reader to the Tab.A2 in Appendix.

Dependent variables. The working conditions indexes are two. The index WC_EMP concerns the trend in items more akin to job content and it synthesises aspects related to the concept of *job empowerment*: the higher (lower) the index, the higher (lower) is the intensity of job enrichment and empowerment. The index WC_SAFE was constructed using the variables *stress* and *safety/security:* the higher (lower) the value of the index the higher (lower) the level of *safety/security* and lower (higher) the level of *stress*[10]. Because WC_SAFE assumes only few values

[7] The sectors are: food, textiles, wood, chemicals, non-metallic mineral products, machinery, other industries. The ISTAT ATECO classification coincides with the NACE Rev1.1 and thus with ISIC Rev3.1.

[8] For MO database we gratefully acknowledge the work of IRES-ER. A special thank goes to Loris Lugli and Stefano Tugnoli for providing us the database which we worked on. We further refer the interested reader to the report by Lugli and Tugnoli 'Innovazione e Qualità del Lavoro a Modena' www.er.cgil.it/ireser.nsf/Documenti.

[9] For details about the data see BLINDED and Lugli, Tugnoli (2008).

[10] The respondents to the questionnaire (union representatives) were asked to indicate the trend for ten items (effort, security and job stability, employees competences, information disposable to the employees, autonomy in accomplish

in the interval 1-3 we have rescaled the variable using integers on a range going from 1 to 5; then, we have used ordered probit regressions in the estimation phase, instead of OLS[11].

The separate utilization of the two dependent variables is aimed at verifying the impact of innovations and industrial relations variables on different items enclosed in the concept of working conditions: some related to the concept of job empowerment, and others related to 'critical' aspects that can be used to "measure" psychological and physical strain.

It is important to note that there may be a lack of simultaneity between the dependent variables and the innovation variables, which derives from how the question was framed for both the questionnaires: "*…subsequently to the introduction of changes by the management, how did the working conditions change?*". The generic term 'changes' without other specifications, in the context of the questionnaires, refers to changes in innovation areas (technology, organization, training and ICT).

Structural variables. The vector of structural variables captures as much as possible the firm specific heterogeneity in our cross sectional environment in order to reduce, to some extent, the likelihood of relevant variables being omitted.

Innovation variables. Innovation indexes encompass several spheres. In fact, the administered questionnaire allowed collecting information not only on product and process innovations (with a wealth of information on R&D activities), but also on organizational changes (including those practices that international literature defines as HPWP), training activities and ICT adoption.

Industrial Relations variables. The indexes of industrial relations takes into account both formal (e.g. presence of bilateral technical commissions or existence of firm level bargaining) and informal aspect of the firm level relations between management/union representative and management/workers.

Given the literature review provided above it is possible to expect the list of "signs" as reported in table 1 associated to the linkages between working conditions, on the one hand, innovations and good quality industrial relations on the other hand.

TABLE 1- Hypothesized signs of influencing variables on the working conditions: WC_EMP, WC_SAFE

Influencing factors	**Empowerment Thesis**	**Intensification Thesis**
Hypothesized causality directions:		

the job tasks, influence over the managerial decisions, monetary incentives, non-monetary incentives, stress, safety/security) concerning the working conditions on a scale from 1 (decreased) to 3 (increased). Only for the stress item the number 1 means increased and 3 decreased, so that the higher is WC_SAFE the better is for workers.

[11] We have also run OLS estimations and the results, which are available from the authors upon request, rarely differ.

Innovations à Working Conditions		
Organizational innovation	(+)	(-)
Technological innovation	(+)	(-)
Training	(+)	(+)
ICT	(+)	(-)
Hypothesized relations[12]: *Industrial relations ß à Working Conditions*		
(Cooperative) Industrial relations	(+)	(+)

4. Results of the econometric analysis

The results of the econometric exercises are reported in tables 2a.1, 2a.2, 2b.1 and 2b.2[13].

At first, it should be stressed that because of the importance of organizational changes in influencing working conditions, we estimate both a specification with only the synthetic index of organizational innovation (INNO_ORG) and a specification with the disaggregated variables used to construct INNO_ORG. The same has been done with the industrial relation index (IND_REL). Second, we have settled up different specifications for each synthetic innovation index because of their quite high bivariate correlations (Tab.A.3 in Appendix). Third, we have also run regressions with multiplicative interaction terms between innovation indexes and the industrial relations one, in order to verify if the interaction of industrial relations and innovations reinforce the impact of the latter on working conditions (tables 2a.2 and 2b.2). Finally, it must be stressed that for Reggio Emilia sample of firm we decided to drop those firms having less than 50 employees, in order to make the comparison between the two LPSs more direct[14].

Looking at table 2a.1 we note a positive and significant impact of the innovation activities on WC_EMP for both the LPSs, with some specificities. When we disaggregate the synthetic index INNO_ORG, using its components we observe that the sign of the synthetic index is mainly driven by the two components that capture changes in production and labour organization (ORG_PROD and ORG_LAB). This means that workers empowerment is spurred by such typologies of organizational changes, in accordance with the advocates of HPWP implementation.

[12] When we take into consideration the linkages between working conditions and industrial relations we do not have the potential causality direction implied by the question posed to the respondents. Thus, we can strictly refer to correlations rather than to weak causality relations.

[13] Because the aim of the empirical analysis is not to calculate elasticities we avoid presenting the coefficients, rather we adopt a more qualitative way of results displaying.

[14] As a matter of fact we also conducted the estimation with all the sample of Reggio Emilia firms and the results do not differ. The results are available from the authors upon request.

TABLE 2a.1 – Results of the econometric exercise with WC_EMP as dependent variable (OLS)

Dependent variable WC_EMP	RE							MO						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7
	Organizational Innovation							*Organizational Innovation*						
INNO_ORG	0.932*** (3.30)							0.623** (2.21)						
INNO _LAB_ ORG		0.311* (2.48)							0.367** (2.22)					
INNO_PROD_ ORG		0.506** (1.76)							0.506*** (4.55)					
REW		0.052 (0.54)							0.159* (1.67)					
	Industrial Relations							*Industrial Relations*						
COOP_INDREL			0.594*** (3.51)							0.482** (2.53)				
BTC				-0.028 (-0.59)							0.025 (0.31)			
BARG				0.014 (0.20)							0.096 (0.98)			
REL_ITEMS				0.172*** (2.86)							0.052 (0.93)			
INDREL_TREND				0.122** (2.39)							0.109*** (2.80)			
	Innovation Activities							*Innovation Activities*						
INNO_TRAIN					0.290*** (3.72)							0.353*** (5.12)		
INNO_TECH						0.362*** (3.28)							0.132 (1.11)	
INNO_ICT							0581*** (3.00)							0.354** (2.45)
R^2	0.26	0.34	0.25	0.28	0.29	0.24	0.28	0.16	0.28	0.16	0.18	0.23	0.12	0.15
F test prob.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N	134	134	134	134	134	134	134	176	176	176	176	176	176	176
VIF	1.55	1.35	1.25	1.19	1.50	1.58	1.82	1.9	1.46	2.08	1.99	1.93	1.97	1.94

Notes: levels of significance 10% *, 5%**, 1%***; t-statistics in parenthesis; robust standard errors have been used; empty cells mean the variable is not included in the specification; additional controls include sector and size dummies, index of perceived firm performance, strategy dummies, belonging to a group, delocalization dummy, international turnover, diffusion of short term contracts and their conversion in long lasting ones, in/out-sourcing activities, relations with client/suppliers; VIF is the Variance Inflation Factor and it represents a 'test' to recognize the existence of multicollinearity when the threshold of 10 is exceeded.

The same strong and positive relations emerge when the index capturing the intensity of good quality (cooperative) industrial relations at firm level is considered. Also in this case when we disaggregate the index in its components we find that the sign of the synthetic index is driven by specific components, which can be considered the less formal aspects of good quality industrial relations: the index capturing the management attitude to inform, consult or negotiate with union representatives on several items (REL_ITEMS) and the index providing the union representative perception of the industrial relations trend over time (INDREL_TREND). The result does not come unexpected (BLINDED; BLINDED), but despite the proximity of the two LPSs an interesting difference concerning the role of good quality industrial relations on working conditions emerges. For RE firms the variable REL_ITEMS is strongly significant, while it is not for MO firms. We may argue that due to historical and idiosyncratic conditions, local unions in RE have a stronger power than those in MO. Such power translates into the capacity to make the union voice listened within the firm. At the same time it is possible that RE firm's management is more inclined to discuss union instances. This finding support a sociological literature that recognizes in cultural specificities, which also lead to different balancing of powers between unions and firms, influencing factors of organizational changes implementation (Vidal, 2007) and, thus, influencing factors of workers empowerment.

TABLE 2a.2 – Results of the econometric exercise with WC_EMP as dependent variable with interaction terms (OLS)

Dependent variable WC_EMP	RE				MO			
	1	2	3	4	1	2	3	4
	Interaction Terms				*Interaction Terms*			
INNO_ORG* COOP_INDREL	1.898*** (4.30)				1.185*** (2.78)			
INNO_TRAIN* COOP_INDREL		0.658*** (4.11)				0.609*** (5.46)		
INNO_TECH* COOP_INDREL			0.750*** (3.54)				0.360** (2.28)	
INNO_ICT* COOP_INDREL				0.857*** (3.97)				0.624*** (3.10)
R^2	0.27	0.31	0.28	0.30	0.18	0.25	0.14	0.18
F test prob.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N	134	134	134	134	176	176	176	176
VIF	1.12	1.66	1.98	1.25	2.11	2.14	2.17	2.10

Notes: Notes: levels of significance 10% *, 5%**, 1%***; t-statistics in parenthesis; robust standard errors have been used; empty cells mean the variable is not included in the specification; additional controls include sector and size dummies, index of perceived firm performance, strategy dummies, belonging to a group, delocalization dummy, international turnover, diffusion of short term contracts and their conversion in long lasting ones, in/out-sourcing activities, relations with client/suppliers; VIF is the Variance Inflation Factor and it represents a 'test' to recognize the existence of multicollinearity when the threshold of 10 is exceeded.

In order to verify the importance of industrial relations we construct several multiplicative interaction terms between the synthetic industrial relations index and the innovation ones. As

expected (table 2a.2) the relations between the interaction terms and WC_EMP are reinforced versions of those obtained without interactions. As a relevant example the INNO_TECH variable, which is not significant for MO firms, when it is interacted with the industrial relations index turns out to be significant. This result seems to support the idea that good quality industrial relations are complementary elements to innovations. We might infer, although we do not test it here, that cooperative industrial relations at work is a mediating factor that allows to obtain stronger effect of innovations on workers' well being[15].

If the results are quite clear cut when we consider the index WC_EMP, the same cannot be said when the index capturing the trend in workers stress and safety/security is used as dependent variable of our regressions (tables 2b.1 and 2b.2).

At first, we notice that only the training index is significant and positive for the firms belonging to both local production systems. This result does not come unexpected since a better trained workforce is likely to better know and implement safety/security norms[16]. The other innovation indexes do not increase the probability of having high values of the dependent variable, that is a positive trend in the aspects enclosed in the dependent. However, when the INNO_ORG variable is disaggregated we find that for RE the changes in production organization likely spur better working conditions while the presence and intensity of diffusion of reward schemes is negatively related with the dependent variable. The latter result may be interpreted as a consequence of the intensification in working pace due to the linkages between the reward system and performance indicators. Things are slightly different for MO context: here we have a negative sign associated to ORG_LAB variable, while positive is the association of the dependent with ORG_PROD and REW. The absence of significance of the synthetic index of organizational changes is given by the fact that the negative sign associated to ORG_LAB seems to be strong enough to offset the positive impact of the other two main variables used to construct the synthetic index. The result of the ORG_LAB variable is in line with the recent, critical literature on the relations between organizational changes and working conditions (Green, 2004; Brenner, Fairris, Ruser, 2004; Askenazy, Caroli, 2006). Although those organizational changes clustered in ORG_LAB variable are usually interpreted as ameliorative elements of the job content, the results we obtained underlines the possibility that the workers are subject to higher level of stress when changes in labour organization are introduced, notwithstanding the fact that such changes positively affect the job contents. A potential explanation calls in question the synergic nature of organizational innovations and good quality industrial relations. As we can see in table 2b.1

[15] In our previous researches we have found that industrial relations exert an indirect role on labour productivity, spurring innovation activities: BLINDED

[16] We also cannot forget that part of training activities on safety/security norms is compulsory.

industrial relations indexes are less robustly linked with working conditions in MO local system than in RE one. Moreover, the simple bivariate correlations between innovation indexes and industrial relations ones (Tab.A.3 in Appendix) clearly show how innovations and good quality industrial relations are more related in RE than in MO. Thus, in the latter LPS there are less opportunities to exploit synergies between organizational changes and cooperative industrial relations. In synthesis, the results for the two LPSs partially support both the empowerment thesis and the intensification thesis.

Another interesting result emerges when the interaction terms are considered. Here the evidence does not seem to robustly support the existence of synergies, although for ICT innovations in Reggio Emilia we register a significant result when interacted with cooperative industrial relations. In firms having high intensity of ICT adoption and high level of cooperation between management and unions/employees, that is to say high values in the interaction term INNO_ICT*COOP_INDREL, then the level of stress is lower and the level of safety/security is higher than in firms having low levels of the interaction term, because of a low degree of ICT adoption or because of poor industrial relations or both. In addition to the result for ICT innovation we cans see that the role of training is also reinforced when we interact the training index with that of cooperative industrial relations in the case of Modena firms. In conclusion, we may say that if firms have both high intensity in training activities or in ICT adoption and in cooperation between management and union delegates or workers then, they are likely to have better working conditions than those firms whose ICT and training innovating activities and industrial relations are both poor.

TABLE 2b.1 – Results of the econometric exercise with WC_SAFE as dependent variable^ (Ordered Probit)

Dependent variable WC_SAFE	RE							MO						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7
	Organizational Innovation							*Organizational Innovation*						
INNO_ORG	-0.713 (-0.67)							0.468 (0.55)						
INNO _LAB_ ORG		0.381 (0.44)							-1.119** (-2.13)					
INNO_PROD_ ORG		1.299* (1.81)							1.242*** (2.92)					
REW		-0.749** (-2.20)							0.649** (2.11)					
			Industrial Relations							*Industrial Relations*				
COOP_INDREL			1.467** (1.97)							1.052* (1.81)				
BTC				-0.241 (-1.18)							-0.249 (-1.04)			
BARG				0.019 (-0.09)							0.038 (0.14)			
REL_ITEMS				0.437** (2.11)							0.018 (0.11)			
INDREL_TREND				0.492*** (2.76)							0.662*** (4.85)			
					Innovation Activities							*Innovation Activities*		
INNO_TRAIN					0.907*** (2.67)							0.413* (1.69)		
INNO_TECH						0.471 (0.93)							0.285 (0.69)	
INNO_ICT							0.289 (0.44)							0.099 (0.21)
Pseudo R^2	0.11	0.14	0.11	0.12	0.13	0.11	0.11	0.08	0.12	0.08	0.13	0.08	0.08	0.07
Prob. Wald Chi2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N	134	134	134	134	134	134	134	176	176	176	176	176	176	176

Notes: Notes: levels of significance 10% *, 5%**, 1%***; z-statistics in parenthesis; robust standard errors have been used; empty cells mean the variable is not included in the specification; additional controls include sector and size dummies, index of perceived firm performance, strategy dummies, belonging to a group, delocalization dummy, international turnover, diffusion of short term contracts and their conversion in long lasting, ones in/out-sourcing activities, relations with client/suppliers; VIF is the Variance Inflation Factor and it represents a 'test' to recognize the existence of multicollinearity when the threshold of 10 is exceeded.

TABLE 2b.2 – Results of the econometric exercise with WC_SAFE as dependent variable with interaction terms (Ordered Probit)

Dependent variable

WC_SAFE	RE				MO			
	1	2	3	4	1	2	3	4
	Interaction Terms				*Interaction Terms*			
INNO_ORG* COOP_INDREL	1.209 (0.76)				1.649 (1.34)			
INNO_TRAIN* COOP_INDREL		2.161*** (3.15)				0.858** (2.16)		
INNO_TECH* COOP_INDREL			1.478 (1.55)				0.844 (1.52)	
INNO_ICT* COOP_INDREL				1.493* (1.80)				0.802 (1.35)
Pseudo R^2	0.11	0.14	0.12	0.12	0.08	0.09	0.08	0.08
Prob. Wald Chi2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N	134	134	134	134	176	176	176	176

Notes: Notes: levels of significance 10% *, 5%**, 1%***; z-statistics in parenthesis; robust standard errors have been used; empty cells mean the variable is not included in the specification; additional controls include sector and size dummies, index of perceived firm performance, strategy dummies, belonging to a group, delocalization dummy, international turnover, diffusion of short term contracts and their conversion in long lasting ones, in/out-sourcing activities, relations with client/suppliers.; VIF is the Variance Inflation Factor and it represents a 'test' to recognize the existence of multicollinearity when the threshold of 10 is exceeded.

5. Conclusions

The intensification of work in Europe during the '90s and the simultaneous diffusion of ICT and organizational changes have raised concerns about the effects of innovations as widely conceived, on workers' well being. In fact, the outcome of innovation activities is not confined only to the firm, it also affects the workers. Similarly, the effect of cooperative relationships between union delegates and management cannot be thought to be neutral in terms of the quality of work. The main hypothesis underlying the present work is that techno-organizational changes and the industrial relations climate are both factors that influence workers' well being.

Our empirical results support the hypothesis that working conditions are an outcome of techno-organizational changes. Moreover, we have to observe the existence, notwithstanding the contiguity and the substantial homogeneous social environment of the two LPSs, of specificities in the results for the two samples of firms, although for the strong majority of the specifications we have similar signs for the coefficients related to the explanatory variables. Thus, context specific factors, likely related to the employment and industrial relations, influence the strength of the relations between working conditions and innovation activities.

As a whole we may say that both techno-organizational innovation and industrial relations are factors that positively influence working conditions. This homogeneity in the relations seems to support the positive position we recognized in the literature (*empowerment thesis*), while the

intensification thesis is only marginally supported by the evidence. The results seem to tell us that the sign of the relations between innovation activities and working conditions depends crucially on those aspects included in the working condition indexes. More specifically, we have put in evidence that some organizational changes are positively linked with aspects related to the job contents, but they are negatively related to job aspects such as stress and safety security at the same time. Organizational innovations do not have a univocal impact on workers well being.

Among the innovation activities only the training ones are able to preserve a positive impact on both the indexes of working conditions utilized in the analysis, along with cooperative industrial relations: the latter less robustly for Modena LPS than for Reggio Emilia one. As far as training is concerned we may argue that the robustness of the results is linked to the fact that training issues explicitly address safety/security aspects, making workers more aware of the risks inherent in their jobs. In terms of industrial relations, we may assert that the more intense the cooperation between management and union delegates, the higher the quality of the workers' well being over all the dimensions here taken into consideration. Good quality employment/industrial relations emerge as mediating factors that reinforce, in a positive way, the role of innovation activities on workers well being.

In terms of policy prescriptions we may argue that whenever there is the opportunity it is better for policy makers to create the conditions that guarantee a good social dialogue between the social actors, both at macro and micro level, as in the case of local policy makers.

Finally, the rather different results for the two indexes of working conditions highlight the importance, in the empirical analysis, of considering specific aspects of workers' conditions as outcomes of innovation and industrial relations. Indeed, the definition of workers' well being encompasses several components and dimensions, and calls for further empirical evidence and for a systematization of the dimensions included in the working conditions concept.

Appendix

TABLE A.1A – Firms percentage distribution in RE

RE Population with UR (376)						
	Size classes 31.12.2004					
Sectors	20-49	50-99	100-249	250-499	>499	Total
Food	1.6	1.3	1.9	0.3	0.5	5.59
Other Industries	1.6	0.3	0.0	0.0	0.3	2.13
Chemical	4.5	1.9	2.4	0.0	0.3	9.04
Wood	1.1	1.3	1.1	1.1	0.0	4.52
Machineries	23.1	16.5	12.2	3.5	2.4	57.71
Non-metallic mineral	3.7	4.3	4.5	2.6	1.9	17.02
Textile	1.1	1.6	0.5	0.8	0.0	3.99
Total	37.77	28.19	20.74	8.24	5.05	100
RE Interviewed Units (192)						
	Size classes 31.12.2004					
Sectors	20-49	50-99	100-249	250-499	>499	Total
Food	1.6	2.1	3.1	0.5	0.5	7.81
Other Industries	2.1	0.0	0.0	0.0	0.5	2.60
Chemical	4.7	1.6	3.1	0.0	0.5	9.90
Wood	1.0	1.0	1.6	1.6	0.0	5.21
Machineries	15.1	13.5	14.0	3.6	3.6	50.00
Non-metallic mineral	4.7	3.1	5.2	4.1	2.1	19.27
Textile	1.0	2.1	1.0	1.0	0.0	5.21
Total	32.29	25.52	24.48	10.94	6.77	100

Cochran Test *Margin of error* q *	*Interviewed firms vs. Population with RSU*
$q = \sqrt{\frac{N}{(N-1)n} - \frac{1}{N-1}}$	**0.05**

TABLE A.1B – Firms percentage distribution in MO

MO Population with RSU (246)					
	Size classes 31.12.2006				
Sectors	50-99	100-249	250-499	>499	Total
Food	3.7	6.5	0.0	0.8	11.0
Other Industries	0	0	0	0	0
Chemical	3.3	4.9	1.6	0.4	10.2
Wood	2.8	2.4	0.8	0.4	6.5
Machineries	24.8	14.6	5.7	2.0	47.2
Non-metallic mineral	4.9	10.2	2.8	2.8	20.7
Textile	2.4	1.6	0.4	0.0	4.5
Total	41.9	40.2	11.4	6.5	100
MO Interviewed Units (176)					
	Size classes 31.12.2006				
Sectors	50-99	100-249	250-499	>499	Total
Food	3.4	5.1	1.7	0.6	10.8
Other Industries	0	0	0	0	0
Chemical	6.3	2.3	0.6	0.6	9.7
Wood	2.3	4.0	0.6	0.0	6.8
Machineries	18.2	15.3	4.0	3.4	40.9
Non-metallic mineral	9.1	12.5	2.3	0.6	24.4
Textile	6.3	0.6	0.6	0.0	7.4
Total	45.5	39.8	9.7	5.1	100

Cochran Test *Margin of error* q *	*Interviewed firms vs. Population with RSU*
$q = \sqrt{\frac{N}{(N-1)n} - \frac{1}{N-1}}$	**0.04**

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

TABLE A.2 – Descriptive statistics

		RE (192 obs)			*MO (176 obs)*		
Variables	*Description*	*Min*	*Max*	*Mean*	*Min*	*Max*	*Mean*
	Dependent Variables						
	Working Conditions						
WC_EMP	Index capturing the trend in 8 job items (effort, security and job stability, employees competences, information disposable to the employees, autonomy in accomplish the job tasks, influence over the managerial decisions, monetary incentives, non-monetary incentives) on a scale from 1 to 3 (decreased, stable, increased)	1	3	2.04	1	3	1.97
WC_SAFE	Index capturing the trend of two job items, safety/security and stress, on a scale from 1 to 3 (decreased, stable, increased). Codified as an ordered variable from 1 to 5.	1	5	2.48	1	5	2.31
	Controls and Explanatory Variables						
	Structural Variables						
Sectors Dummies (Food , Other Industries, Chemical, Wood, Machineries, Non-metallic minerals)	Binary variables (0,1)	0	1	/	0	1	/
Size Dummies (20-49, 50-99, 100-249, 250-499, >499 for RE; and 50-99, 100-249, 250-499, >499 for MO)	Binary variables (0,1)	0	1	/	0	1	/
Firm Typology Dummies (private firm, industrial group, cooperative firm, cooperative group; private firm/group, cooperative firm/group)	Binary variables (0,1)	0	1	/	0	1	/
Percent of International Turnover (**INT_TURN**)	Percentage of turnover made on international markets. Rescaled on interval (0-1)	0	0.9	0.42	0	1	0.40
Delocalization (**DELOC**)	Binary variable (0,1)	0	1	0.17	0	1	0.41
Cost-Price Strategy (**CP_STR**)	Binary variable (0,1)	0	1	0.62	0	1	0.50
Technology-Quality Strategy (**TQ_STR**)	Binary variable (0,1)	0	1	0.87	0	1	0.78
Brand Strategy (**BR_STR**)	Binary variable (0,1)	0	1	0.3	0	1	0.40
Variety Strategy (**VA_STR**)	Binary variable (0,1)	0	1	0.45	0	1	0.32
Performance Indicators from questionnaire (**PERF**): Productivity, Revenue, Profit, Investment	Indexes: each type of performance is ranked on a -5 (worse than the preceding year)+5 (better then the preceding year) scale	-5	5	/	-5	5	/
Out-sourcing (**OUT**)	Index: intensity of out-sourcing in ancillary activities, production support activities and production activities. Interval (0-4).	0	3.53	1.16	0	3.78	1.33
In-sourcing (**INS**)	Index: intensity of in-sourcing in ancillary activities, production support activities and production activities. Interval (0-4).	0	2.53	0.29	0	3.88	0.38
Relations with Client and Suppliers (**REL_SUPPCLI**)	Index: relations with clients and/or suppliers on furniture, assistance, changing technological equipment, exchange of technical and commercial knowledge/information etc…. Interval (0-1).	0	0.78	0.25	0	0.66	0.21
	Training						
INNO_TRAIN…. (interval 0-1)	Composite index capturing the intensity in training activities Mean of the following variables:	0	0.97	0.31	0	0.95	0.43
….Training Coverage	Index: percentage of employees involved in training programmes (0 nobody; 1=1-24%; 2=25-49%; 3=50-74%; 4=75-100%)	1	4	2.08	1	4	2.37
Training Modalities	Index: modalities of training (side-by-side training with structured programmes, internal and external to the firm programmes). Interval (0-1).	0	0.76	0.33	0	1	0.40
Training Advantages	Index: advantages for employees involved in training activities Interval (0-1).	0	1	0.39	0	0.8	0.35

Index of Training Competencies	Index: based on the whole competencies the training programmes aim to develop. Interval (0-1).	0	1	0.41	0	1	0.36
Technological Innovation							
INNO_TECH…. **(interval 0-1)^**	Composite index capturing the intensity in technological innovations Mean of the following variables:	0	1	0.39	0	1	0.53
….Process Innovation	Binary variable (0,1)	0	1	0.49	0	1	0.70
Product Innovation	Binary variable (0,1)	0	1	0.55	0	1	0.74
Quality Control Innovation	Binary variable (0,1)	0	1	0.61	0	1	0.64
Radical Innovation	Binary variable (0,1)	0	1	0.27	0	1	0.38
Incremental Innovation	Binary variable (0,1)	0	1	0.61	0	1	0.76
R&D activities	Index: it synthesizes the information about innovation input (formal R&D division, R&D activities, resources and employees involved in R&D activities, collaborations with other firms on R&D for Reggio Emilia; formal R&D division and collaborations with other firms on R&D for Modena). Interval (0-1).	0	1	0.49	0	1	0.66
Organizational Innovation							
INNO_ORG….. **(interval 0-1)**	Composite index capturing the intensity in organizational innovations Mean of the following variables:	0.05	0.62	0.24	0	0.56	0.23
……Organizational practices in production (**INNO_PROD_ORG**)	Index: Changes in organizational practices in production (quality circles, team working, just in time, total quality management). Interval (0-1).	0	0.8	0.19	0	0.75	0.16
Organizational practices in labor services (**INNO_LAB_ORG**)	Index: Changes in organizational practices in labour services (job rotation, delegation, continuous training, etc…). Interval (0-1).	0	0.83	0.26	0	0.81	0.25
Reward System (**REW**)	Index: Individual and collective reward in 2004. Interval (0-1).	0	1	0.4	0	1	0.33
ICT							
INNO_ICT… **(interval 0-1)**	Composite index capturing the intensity in ICT adoption Mean of the following variables:	0.08	1	0.64	0	1	0.62
….ICT in Production	Index: introduction of ICT in production. Interval (0-1).	0	1	0.57	0	1	0.51
ICT in Communication	Index: introduction of ICT for communication purposes. Interval (0-1).	0	1	0.82	0	1	0.88
ICT in Management-Integration	Index: introduction of systems that use ICT such as EDI, Electronic Data Interchange, EDI (Electronic Data Interchange); MRP (Material Requirements Planning) etc… Interval (0-1).	0	1	0.52	0	1	0.48
Flexibility							
Labor Contract Flexibility (**LCF**)	Index: captures the characteristics of the contractual flexibility (number of contracts, typology of contracts, trend of the flexible contracts diffusion etc…). Interval (0-1).	0	1.2	0.66	0	1.5	0.85
Conversion of Flexible Labor Contracts in Long-lasting Ones (**CONV_LCF**)	Index: percentage of workers who are hired permanently after the flexible contract expires. Rescaled on interval (0-1).	0	1	0.39	0	1	0.39
Industrial Relations							
COOP_IND_REL (0-1)	Synthetic index of good quality industrial relations	0.16	0.76	0.39	0.14	0.93	0.54
Firm Level Bargaining (**BARG**)	Binary variable (0,1): 1 if a second level formal agreement has been signed in 2004	0	1	0.68	0	1	0.90
Bilateral Technical Commissions (**BTC**)	Binary variable (0,1): 1 if a BTC exists	0	1	0.32	0	1	0.11
Trend in Industrial Relations (**INDREL_TREND**)	Index: trend of the industrial relations compared to the preceding year (worsened, stable, improved). Interval (1-3)	1	3	2.03	1	3	1.97
Management/Union Relation on Issues (**REL_ITEMS)**	Index: relation between management and union representatives (no interaction (1), information (2), consultation (3), negotiation (4)) on a list of 23 items (e.g. production, quality, employment, working hours, etc…). Interval (1-4)	1	3.43	1.92	1	3.56	1.95

TABLE A.3 – Bivariate correlation coefficients for the main explanatory variables

	Reggio Emilia									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
INNO_TRAIN (1)	1									
INNO_TECH (2)	0.4830*	1								
INNO_ORG (3)	0.4001*	0.4464*	1							
INNO_ICT (4)	0.4041*	0.4653*	0.3960*	1						
INNO_PROD_ORG (5)	0.2641*	0.2933*	0.6073*	0.2971*	1					
INNO_LAB_ORG (6)	0.3470*	0.3660*	0.5888*	0.3691*	0.3739*	1				
REW (7)	0.2278*	0.2709*	0.7144*	0.2934*	0.2835*	0.18	1			
REL_ITEMS (8)	0.1698	0.1175	0.2347*	0.0821	0.1435	0.2842*	0.1071	1		
INDREL_TREND (9)	0.1266	0.1468	0.0629	0.0544	0.0369	0.098	-0.0358	0.2494*	1	
COOP_IND_REL (10)	0.1889*	0.1951*	0.2424*	0.2031*	0.2110*	0.2500*	0.1876*	0.6298*	0.3671*	1
	Modena									
INNO_TRAIN(1)	1									
INNO_TECH(2)	0.4084*	1								
INNO_ORG(3)	0.3455*	0.3903*	1							
INNO_ICT(4)	0.3234*	0.4300*	0.3768*	1						
INNO_PROD_ORG(5)	0.2730*	0.3414*	0.5045*	0.2507*	1					
INNO_LAB_ORG(6)	0.3550*	0.3594*	0.5799*	0.2902*	0.2031*	1				
REW(7)	0.1437	0.1806	0.5823*	0.2091*	0.0855	0.2629*	1			
REL_ITEMS(8)	0.3332*	0.3682*	0.2508*	0.1975*	0.2067*	0.159	0.2006*	1		
INDREL_TREND(9)	-0.0379	0.0928	-0.014	-0.0316	0.2228*	-0.0361	-0.0356	0.1128	1	
COOP_IND_REL(10)	0.2869*	0.3634*	0.2558*	0.2052*	0.2452*	0.1612	0.2638*	0.5708*	0.3211*	1

Note: * means significant at 1%

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