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ORGANIZATIONAL INNOVATIONS, HUMAN RESOURCES AND FIRM PERFORMANCE. THE EMILIA-ROMAGNA FOOD SECTOR

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Abstract

This paper studies the relationship between organizational innovation, industrial relations and economic performance at the firm level. It adopts an applied perspective by means of a comprehensive survey on a specific industrial sector, the food industry, with the aim of investigating: (i) the degree of organizational innovation and the diffusion of HRM practices; (ii) the relevance of the interaction between unions and top management in the process of decision-making at an operative, organizational and strategic level; (iii) the relations between the intensity of organizational innovation and the quality of industrial relations; (iv) the effects of organizational changes on firm performance.

The focus is on firms with bargaining activity at establishment level where worker committees exist. The dataset is derived from a structured questionnaire submitted to union members concerning structural data on firms and local productive units, production flexibility, organizational models, compensation systems, industrial relations and firm performance.

The quantitative analysis highlights the following critical elements.

First, the firm governance seems characterized by a strong relevance of industrial relations, in terms of "good quality atmosphere" and "involvement of worker representatives and employees": their action proves to be a stimulus to organizational changes. The set of industrial relations variables does emerge as a significant factor explaining firm innovation intensity.

Second, although we cannot ascertain the causal link given the cross-sectional nature of data, firm performance and organizational innovations arise as two elements which are strictly and positively related to each other.

Third, the evidence points out that good industrial relations are important as far as the firm performance is concerned; nevertheless their role is mediated by their effects on organizational changes rather than having a direct impact on performance. The analysis also shows a "reciprocal causative effect" between firm performance and organizational innovation.

JEL Code : J51, L60, M54

Keywords: Organizational innovation, high-performance practices, firm performance, industrial relations, human resource management

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Introduction

In recent years, economic research and political debate has witnessed an increased awareness of the role of organizational change within firms as a crucial factor for competitiveness in national and international markets. Various authors[1] pointed out that these changes favor the transition from a rigid and hierarchical enterprise to a flatter organisation, where interactions between formalized divisions of the firm and between management and employees become stronger. This kind of organisation, identified as a learning organisation, is more reactive to external changes and able to anticipate and influence changes in the market where it operates. It adopts policies aimed at the enrichment and development of personnel competencies and skills. The increased awareness of the importance of organizational changes has contributed to the emphasizing of the human resource management (HRM hereafter) role. At the firm level, HRM practices, such as management of internal labour markets, selection procedures for personnel, hiring and lay-off policies, career advancement policies, training and development of worker competencies, incentives and worker evaluation, are outlined in theoretical and empirical studies by economists and business researchers. The adoption of these practices is also considered relevant for the fulfillment of better economic performance. Some authors even tend to identify a functional relationship between HRM practices and firm economic performance.

The literature concerning HRM practices constitutes a benchmark in this research agenda. Policies of worker involvement in the decision-making processes represent a crucial tool in order to accomplish the sharing of the firm's objectives with the workers. Such policies imply a more direct relationship between management and workers, a greater autonomy of employees in their work activity and in problem-solving, a greater flexibility in the accomplishment of tasks. The importance of bottom-up - rather than top-down - channels of information is stressed as well. Furthermore, the increased operative autonomy is accompanied by evaluation systems, incentives, and monetary and non-monetary rewards (bonuses and financial incentives, pay for performance, career advancement, training) to encourage superior performance. These rewards constitute monitoring tools on worker activities.

Worker involvement is present mainly in the decision-making processes for *operative tasks*. Worker initiatives are excluded in organizational and strategic management. Furthermore, a direct relationship between managers and workers, which is usually unidirectional, is often preferred to the *decentralization of decisions* and to the *interaction with worker representatives*. These last two fields of intervention are included instead in the approach which emphasizes the role of *industrial relations* within the firm, hence an open dialogue between social partners: employees, their representatives, and managers, considered as stakeholders. More precisely, employee representatives play a double role: on the one hand, they defend and guarantee the rights of the weaker side of the labour market - i.e. the workers -, on the other hand, they need to contribute to a non-antagonistic organizational climate, which is considered to favor organizational innovations and to improve performance. A participatory model where worker representatives and trade unions share organizational and even strategic objectives is substituted for the exclusive involvement of workers in objectives and procedures designed by the management. Industrial relations enjoy a quality gain, whereby shared objectives and co-determined procedures require a participatory culture.

The two models support different, though not contrasting, visions of the role of personnel within the organisation and of the interaction between the social partners. The first is *management oriented,* since it emphasizes the direct relationship between top managers and employees. Worker involvement is essentially achieved at the operative level. The second is more open towards discussion and bargaining with unions, hence it is *industrial relations*

[1] See Antonioli-Mazzanti-Pini-Tortia (2004), Foss-Laursen (2000), Ham-Kleimer (2002), Laursen-Mahnke (2000), Leoni-Cristini-Mazzoni-Labory (2000), Wilkinson (2000). For a critical viewpoint see Altman (2002), Tomer (2001) and the survey by Cappelli-Neumark (1999).

oriented. Employee participation needs to be addressed to a range of objectives shared by management, workers and unions and be accomplished on the basis of co-determined procedures. Consultation between social partners is extended to organizational and strategic aspects of the firm.

The main questions underlying our research can be summarized as follows: first of all, what is the degree of organizational innovation at the firm level and the diffusion of HRM practices? In addition, is the adoption of new organizational models worked out exclusively through managerial initiatives or does it involve employees and representatives as well? Finally, what are the relations between intensity of organizational innovation, quality of industrial relations and firm performance?

1. Theoretical background

The model of a firm characterized as a *learning organisation* has been extensively covered in specialised literature (Lundvall-Nielsen, 2002). The increase of uncertainty which characterizes the new business environment in an age of globalization together with the associated higher competitive pressure exert a powerful environmental influence in inducing firms to decentralize decisional processes and to flatten their hierarchical structure (Foss-Foss, 2002; Foss-Laursen, 2002). Decentralization is imposed on firms by the need to create and accumulate knowledge (Wood, 1999; Nielsen-Nielsen, 2002; Tomer, 2001). The flattening of hierarchical structures (Cristini-Gaj-Labory-Leoni, 2002, 2003) is found to be among the main preconditions for the introduction of new organizational protocols.

The resulting evolutionary process has transformed the old Fordist-Taylorist organisation into a knowledge-based economic system. In the new organizational paradigm, individual workers, groups of workers, and their representatives participate in decision-making processes, at least at an operative and, to a lesser extent, organizational level. This kind of participation can be mutually advantageous for firms and workers. While the former are able to exploit worker competencies, generated and developed in the workplace through *empowerment and job enrichment* (Foss-Foss, 2002; Foss-Laursen, 2002; Ichiniowski-Shaw, 2003; Cristini-Gay-Labory-Leoni, 2003), the latter benefit from a more involving and participatory working environment, and at the same time obtain credit with the management at the bargaining table and financial reward through negotiation.

In addition, recent studies (Black-Lynch, 2001) show that worker participation has a crucial role in making new technologies work within new organizational settings. New practices (frequently labeled as *high-performance practices*) are often initiated by managers. However, they appear to be more effective the more they actively involve employees in the production process, even if only at the operative level (Kato-Morishima, 2002), with or without worker representative intervention. Furthermore, the introduction of new work practices is related to the utilization of *knowledge intensive* technologies.

The mere introduction of a new technology, without organizational innovation and new human resources management practices, does not seem to support better performance (Arnal-Ok-Torrens, 2001). On the other hand, knowledge-intensive practices, which appear to be adopted in bundles (OECD, 1998), are likely to require new and more flexible technologies, able to transcend the old Fordist-Taylorist scheme and to underpin a more integrated and inclusive working environment. It should be noted that the direction of innovation *(technology driven* or *organization driven)* is not easy to detect. At any rate, it seems fair to state that the two components (organizational and technological innovations) are likely to co-evolve, and, when disjointed, do not lead to remarkable results (Cristini-Gay-Labory-Leoni, 2002).

From the policy point of view, the European Commission (EC, 1997) also underlines the impact of organizational innovation and new work practices on industrial relations. In turn, industrial relations can have an active role in favoring or hindering innovation.

New organizational models necessarily influence information, consultation and bargaining procedures between management and worker representatives, at times in a way similar to the model of partnership (Marks-Findlay-Hine-McKinlay-Thompson, 1998; Appelbaum-Hunter, 2003). In firms where the old scheme requiring the definition and measurement of simplified and predetermined tasks is progressively overcome, union intervention cannot be limited any more to the mere control of measurements carried out by supervisors. It needs to become wider and more complex. Bi-directional information sharing, consultation, and negotiation concerning organizational settings and economic results are added to traditional bargaining procedures at the local level. In a context where it becomes difficult to measure worker output, it is necessary to devise new patterns of interaction between managers and worker representatives. The sharing of procedures seems to be a particularly promising direction to follow, e.g. in the field of formal worker evaluation. The management of internal labour markets in itself would constitute an especially promising field of interaction for the social partners (managers, union delegates, and workers). Although opinions are largely diverging on the issue, an active role for unions, focused on guaranteeing the respect of procedures and supporting the development of worker competencies, would represent a highly important field of increased participation and involvement.

However, the contributions of the literature which address the description and assessment of the role of the unions in a milieu where new organizational schemes are adopted, highlight the fact that the impact of the unions' presence cannot be predicted in advance. It crucially depends on the effective attitudes of both worker representatives and firm managers. This result is confirmed by the empirical findings concerning union impact on innovation activities, worker productivity and firm performance (Deery-Erwin-Iverson, 1999; Addison-Siebert-Wagner-Wie, 2000; Addison-Belfield, 2001). Nevertheless, given the clear distinction between differing roles, the presence of unions devoted to negotiation in a non-antagonistic context seems to favor both organizational innovation and better economic performance (Antonioli-Mazzanti-Pini-Tortia, 2004; Black-Lynch, 2001; Leoni-Cristini-Mazzoni-Labory, 2000; Pini, ed., 2002).

Participation is the area in which firm modernization and development possibilities can intersect. Right choices are not guaranteed and the risk of taking a wrong direction is always present. While many firms choose a more conservative attitude and retain traditional organizational settings, the connection between participation, which can take the form of participative industrial relations, and organizational innovation, for example in the field of human resources management, constitutes a new frontier characterized by opportunities and risks. At the level of a scientific enquiry there is no doubt about the interest created by the exploration of the potentialities of participation (Delbridge-Whitfield, 2001; Poole-Lansbury-Wailes, 2001; Rubinstein, 2001; Mizrahi, 2002). However, it has to be remembered that participation cannot interfere with fundamental institutional barriers. For example, property rights and the connected governance structure of the firm continue to be underpinned by managerial initiative which, in turn, is accountable to the firm owners (Godard, 2001).

2. The case study

2.1 Food industry in Emilia-Romagna

A brief presentation of the main characteristics of the regional food sector helps understanding its strategic role for the economic development and success of the Italian industrial food production.

Its competitive strength, recognized at an international level, originates from the entrepreneurial capability embedded in local traditions and cultural heritage. The size of the sector and its evolution over the last few years can be highlighted by its main structural

features. In addition, some characteristics contribute to explain specific weaknesses of this industry.

Recent data (Infocamere, 2002) show that there are 8439 firms in the region representing 9,5% of the national total of all firms in the food sector. At the regional level the firms in the food sector constitute 14% of the manufacturing sector and 2% of all registered firms.

Aggregate data on the sectoral national performance (Federalimentari, 2001) during the period 1996-2000 confirm the increasing importance of the sector. Although it is considered a mature sector, it has been grown both in terms of production and exports. More specifically, in terms of production growth, Federalimentari reports national increase equal to 11,1%. This evidence becomes significant when the increase of Italian industry is considered as a whole (7,7%). Export dynamics show a similar pattern.

The average number of employees per firm is 9,2 workers. This average size is small, both in absolute terms and compared with other Italian regions (Nosvelli-Pini, 2001). A total of 95% of the firms within the Food sector in Emilia-Romagna have less than 20 employees.

Nevertheless, medium-sized and some large firms constitute an important part of the sector, and some of them are prestigious for the regional economy, notwithstanding some recent case of firm financial bankruptcy. Internationally known brands and innovative capabilities are key aspects in firms that lie over critical size thresholds[2].

Considering both small and medium-large firms, it is possible to state that the food sector in Emilia Romagna is also competitive in standardized and craft production. This feature strengthens its resiliency and adaptability during falls of demand. The roots of this success story are to be found not only in the complex entrepreneurial structure, where different factors play an important role, such as industrial districts, cooperative enterprises, large firms and industrial groups, but also in the long standing tradition of locally producing, high quality food.

2.2 Database and sampling procedures

Our sample is built on the list of firms with bargaining activity included in the IRES[3] Emilia-Romagna database. We identified the local productive units (establishments) referring to those enterprises where worker committees with union members[4] exist. A questionnaire was submitted to union members.

The criteria used to identify firms and local productive units to be included in the sample are as follows.

1) The sample is representative of the population with respect to firm size in terms of number of employees, branch of operation within the food industry, and geographical location of the firm within the regional area.

2) Firms with at least 50 employees are included, given the nature of the questionnaire focusing on organizational innovations and industrial relations[5]. In addition, we focused mainly on medium-sized firms that dominate the Emilia-Romagna food sector.

3) A significant number of firms which adopted the national contract for agricultural workers was included.

4) The potential availability of worker representatives with adequate information on firm organisation and performance is a factor considered in order to build the sample[6].

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[2] Firms employing more than 250 workers are 23, and represent 27% of the whole workforce in the food sector in the region.

[3] IRES is a regional research centre of the CGIL Trade Union.

[4] Worker committees ("RSU: *Rappresentanze Sindacali Unitarie")* are composed by union members directly elected by the employees.

[5] In firms with less than 50 workers both industrial relations and organizational models do not present a degree of complexity sufficient to justify the analysis. In the majority of firms with less than 50 workers, and in almost all firms with less than 20 workers, worker committees do not exist.

[6] Potential availability means the presence of union members in charge of their position for a number of years sufficient to guarantee adequate knowledge about the organisation of the firm and the contracts signed between unions and managers. Cases of strong worker representatives turnover could have hindered the correct filling of the questionnaire.

By adopting the above criteria, we selected 101 enterprises and 123 local productive units. In the case of some firms, we selected more than one productive unit taking into account the number and geographical distribution of establishments for production, transformation and storage of food products[7].

We ended up collecting 84 questionnaires filled by one or more union delegates for each production establishment located in Emilia-Romagna. 71 firms took part in the survey[8].

The questionnaires were administered during the period from September to November 2001 in specific meetings with union delegates of the 84 productive units, in the presence of researchers and without interactions with union officers. Some quantitative information concerning the firm and the specific establishment were gathered by union delegates directly at the firm or establishment administrative department.

The response rate is equal to 70% and 68% respectively of the total firms and local productive units included in the sample. The completed questionnaires cover 37% of all firms with decentralized bargaining, and 19% of the total enterprises registered by ISTAT[9] in 1996.

The distortion of the collected questionnaires with respect to the sample and the universe of firms is limited. We note an over-representation of firms with 50-499 employees. In addition, we register an under-representation for some geographical areas compensated by a limited over-representation for some other areas. As for the ownership structure, industrial and cooperative groups are over-represented, while private and cooperative firms are under-represented.

3. Adoption of work organisation practices and industrial relations

In this section we present the main descriptive results emerging from the analysis in the areas of (1) organizational models and their changes, (2) human resource management and (3) industrial relations.

At an organizational level, innovation in working practices (e.g.: team-work, job rotation, total quality management, quality circles, just-in-time) turn out to be significant, though they are characterized by strong heterogeneity across firms, in particular in terms of employees involved (Table 1). *In addition we found strong innovation activity in organisation, technology, human resource management, working time, payment systems, and product quality* (Table 2). *All these practices are often adopted in bundles, appearing in cluster and not in isolation.* An additional result concerns the organisation of the firm: the intensity of organizational innovation is positively associated with a lower hierarchical intensity. Innovation seems to be favored by a flatter organisation, with increased horizontal interaction between the different functions of the firm.

Table 1. Innovative practices in work organisation

Innovative high-performance practices present or adopted since 1998	% of firms	% of workers involved (1)	% workers involved in innovative firms (2)
Team-work	21,43	8,43	39,33
Quality circles	8,33	2,68	32,14
Just-in-time	7,14	3,43	48,00
Job rotation	59,52	23,06	39,40
Total quality management	26,19	9,85	37,59
No innovative practice adopted	29,76		

[7] We did not consider the number of storage sites which firms may have in Emilia-Romagna.

[8] The delegates of 4 productive units were interviewed for 2 firms, and the delegates of 2 productive units for 6 firms. In addition, in the case of one firm, due to ownership change in 2000, the same productive unit was involved twice.

[9] The Italian institute for national statistics.

We find an organizational model characterized by a strong operative flexibility of labour. The strategy pursued by firms seems aimed at an even stronger flexibility of labour services. With a partial application of what is suggested by the HRM literature, firm management tends to retain many prerogatives at the organizational level. At the same time, the practices involving employees, with bi-directional features, are limited. Innovation appears even greater as far as quality and product design are concerned[10]. In these fields, managers govern and control the adoption of new organizational models, retain their prerogatives at an organizational and strategic level, and involve employees exclusively at an operative level.

Table 2. Organizational changes introduced since 1998

Organizational and technological change	% of firms
New process technologies	67,86
New product/services	47,62
Working hours regimes	44,05
Compensation systems	15,48
Work organisation	53,57
Initiatives of employee involvement	15,48
Initiatives of worker representatives involvement	15,48
Quality control	
Protection of local quality brands	28,57
Improve the terms of delivery	33,33
Fulfill sanitary rules	34,52
Environmental preservation	34,52
Improve product labeling	34,52
Conform to new legislation for food product	25,00

Furthermore, firms adopted various individual and collective incentive systems suggested by the HRM literature (Table 3). First of all we find that individual incentive schemes are quite widespread in the productive units. They involve not only managerial employees and white-collar workers, but also specialised blue-collar workers. The practice of employee formal evaluation and the distribution of individual bonuses remain prerogatives of the management, hence they are not bargained with unions. The utilization of other non-monetary incentives such as training and career advancement is quite different: in this case, the unions often take part.

Collective incentives have a yet different imprinting. In this area industrial relations and contractual agreements between unions and management play a strong role. Flexible wages, which are present in almost all local production units, are generally bargained between the social partners[11]. Their function seems to be aimed at conflict reduction, rather than at playing the role of an incentive tool.

The two systems (*individual incentives* and *collective incentives*) tend to polarize. The former follows the approach highlighted by the HRM literature: it is directed towards organizational and production efficiency, and managers retain many prerogatives. The latter responds to an industrial relations approach. Low complementarity between the two systems thus emerges.

[10] The latter two aspects are acquiring strategic momentum in the food sector, where competition of product quality increasingly outplay competition on costs.

[11] Introduced by national agreement in 1993. It concerns income policies linking nominal wage increases to target inflation rate and a reform of the national system of bargaining. Wage flexibility was introduced with the aim of increasing the degree of flexibility in the compensation system as a whole. The attempt to connect the remuneration of labour to productivity and economic performance of firms should have been joined by an increase in the degree of worker involvement in firm, mainly at

Table 3. Monetary and non-monetary incentives introduced since 1998 (% of firms)

Typologies of incentives	*Introduction, % of firms*	*Of which, negotiated with worker representatives*
Financial participation (shares, stock options etc…)	2,38	1,19
Pension funds	13,10	11,90
Life-long training	3,57	2,38
Collective incentives (pay for performance)	88,10	90,48
Individual incentives	44,05	10,71
Career advancement	59,52	52,38
Fringe benefits	13,10	3,57

The interaction between unions and managers is more extensive than the interaction between employees and managers. Table 4 shows that managers and unions share information, consult and negotiate on various aspects of labour organization. Involvement is much weaker at the strategic level, for example as far as the innovation in quality and product design is concerned. Unions acquire a more prominent role in the field of labour organisation, for example in aspects such as job rotation. There also exists a positive association between the intensity of organizational changes and the quality of industrial relations: in firms where positive and cooperative industrial relations prevail, the intensity of organizational innovation is stronger. The active intervention of the unions does not seem to hinder innovation in organizational models. In fact, non-conflicting industrial relations seem to favor organizational change.

Table 4. Interaction between management and worker representatives on organizational innovation

Typology of interaction	*% of firms*
Information	90,48
Consultation	71,43
Negotiation	52,38
No interaction	8,33

Finally, we can underline that the quality of industrial relations is positively associated with the intensity of organizational innovation. Industrial relations seem to play a crucial role: on the one hand, they limit the unidirectional management of human resources; on the other hand, they do not seem to affect the development of organizational innovation. Industrial relations which favor the involvement of the unions in the decision making process through the formal bargaining on various forms of labour flexibility result in organizational innovation.

4. Econometric analysis

This paragraph illustrates the main econometric results of the applied investigation. More specifically, the dataset is built upon a set of variables derived from quantitative and qualitative data provided by the questionnaire administered to employee representatives. In the econometric study we only use data regarding local production units where contractual agreements on flexible remuneration were signed[12]. Four sub-sets of variables are used in the analysis: (i) variables related to *firm performance*[13]; (ii) variables representing *industrial*

the operative and organizational level. Positive results were expected both in employment stability and in labour productivity and firm competitiveness.

[12] Contractual agreements on flexible wages were signed in 71 of the 84 local productive units.

[13] The first column of table 5 lists the performance variables used. As far as the performance related variables are concerned, we first consider an average index of performance, ranging from –5 to 5, which includes the following factors: competitiveness, profitability, firm productivity, team productivity, individual productivity, and product quality. For the

relations prevailing within the firms; (iii) variables representing *organizational innovations* adopted by management and (iv) variables representing characteristics of *performance related pay* schemes. Variables in sets from (i) to (iv) are mostly index-type variables. Index variables are chosen with the aim of drawing out the most significant elements concerning economic performance, industrial relations, organizational innovations, and performance related pay schemes. A set of dummy variables relating to the territorial areas of Emilia-Romagna, the number of employees and the typology of firm governance are also considered as additional explanatory factors.

4.1 The dataset and the procedure

The aims of the applied investigation are as follows. First, we intend to assess the relationship between variables included in set (iii) and variables in sets (i), (ii), (iv), using a synthetic index of the main forms of organisation innovation examined in the survey as dependent variable. Secondly, we want to highlight which factors included in sets (ii)-(iv) are potential explanatory elements of performance indexes (i). It is worth noting that the dataset concerns cross-sectional data. Thus, the causality links between variables are to be intended as "weak linkages": the objective *is not* to test cause-effect relationships between performance, innovation and industrial relations, but to assess the significance and intensity of relationships between those variables.

Two main hypothesis are therefore tested by the statistical exploration.

Hypothesis 1: There exists a positive and significant relationship between performance and innovation intensity

Hypothesis 2: Industrial relations are relevant both for the adoption of innovative practices and for firm performance

Both hypotheses emerge from the economic and managerial literature presented in section one.

Hypothesis 1 refers to the relationship between performance and innovation. Both directions should be explored.

First, the implementation of innovations requires a relevant amount of resources that only better performing firms may be able to afford. Higher profits, for example, may boost innovation dynamics given an expanded capacity of financing new investments in intangible capital and organizational restructuring and in activities devoted to the experimentation of new practices. Nevertheless, firms with a lower productivity performance may have higher incentives in finding new innovative techno-organizational solutions to reverse this situation. Negative and positive effects can thus jointly determine the effect of performance on innovation (Legge, 1995). We here test the hypothesis of a positive and significant effect, which is plausible when using aggregate indexes of performance instead of single elements of firm performance (e.g. productivity).

On the other hand, the literature often points out that the introduction of organizational innovations is likely to support a higher level of performance indicators. The mere introduction of innovation, nevertheless, does not necessarily set up better performance (Cappelli - Neumark, 1999). Empirical analysis is thus necessary to shed light on the relationship case by case. Lagged variables or a full panel data set would be useful in order to fully explore the direction of causality. Since such data is not available here and is not easily obtainable, we here

indexes above, the performance is elicited having as benchmark the introduction of flexible compensation mechanism in the '90s (generally since 1994). Thus, a zero value means that there has been no change in performance since then.

define as dependant variables, in turn, both performance indicators and organizational innovation indexes, as shown below[14].

The second hypothesis refers to the impact of industrial relations on performance and innovation. The mere existence of trade unions and good industrial relations is not sufficient to support and stimulate good performance and good organizational practice. The quality of industrial relations should be studied in detail, by using specific indexes, in order to assess which elements concerning the relationships between management, workers and trade unions exert a positive effect on the strategic aims of firms. The applied analysis should determine whether the eventual effect on performance is significant, and whether it is direct or it is mediated by other factors (such as organizational innovation), as we may expect.

Table 5 provides a synthetic scheme of the full set of variables. The correlation matrix does not show specific problems regarding highly correlated factors: we thus start the analysis from this set of potential independent explanatory variables[15]. Since the study is a typical data-mining analysis, the most sensible technique for selecting significant explanatory factors out of the full data set is the procedure "from general to particular", beginning with the full set of index variables, selected as most relevant on the basis of the theoretical background and descriptive analysis presented in the previous paragraphs. At each consequential step, the variables with non-significant coefficients (those associated to *t* ratios less than 1.671[16]) are dropped. Tables 6, 7 and 8 present the results for the econometric analysis as far as the most robust and consistent regressions are concerned[17]. As said above, the applied analysis revolves around two levels: we first focus on a regression analysis in which the dependent variable is an average index of organizational innovations, then, we study different specifications using as dependent variables the firm performance indexes. Table 6 shows regressions using as dependent variables the synthetic index of innovation content, while tables 7 and 8 show regressions including as dependent variables two average firm performance indexes. We present and comment on results focusing both on statistical significances and the economic interpretation of the relationships between variables, giving priority to the second aspect.

4.2 Analysis of organizational innovations

Table 6 shows results for the analysis concerning the potential relationships between organizational innovation content and the set of variables representing the three realms of industrial relations, performance related pay schemes, and firm performance. The two regressions differ only with respect to the performance index used among the set of covariates. The indexes are referring to six and four performance factors: PERF6 includes competitiveness, profitability, productivity (firm, team, individual), and product quality, while PERF4 is set considering a subset of performance related factors: competitiveness, profitability, firm productivity, and product quality.

From a statistical perspective, the overall outcome is satisfactory. We note the high level of adjusted R^2, the high overall significance of regressions and the low t ratio of the constant coefficients. All those elements jointly show the robustness of the two regressions. As far as parameter coefficients are concerned, the performance variable adds significance to the regression and presents a positive sign.

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[14] The endogeneity problem which characterises cross-sectional data is specifically addressed by estimating predicted values in a two-stage model. This method is extensively used to deal with cross-sectional data where endogeneity problems are judged relevant. See, for instance, the contribution by Cassiman-Veugelers (2002), who deal with endogeneity concerning R&D cooperation and knowledge spillovers for innovative firms. They point out that the two-stage estimation and the use of predicted values may alleviate problems of measurement errors arising from the use of qualitative measures for some variables.

[15] The analysis of correlations is needed in order to reduce ex ante, by dropping highly correlated elements, the problem of multicollinearity.

[16] 10% level of statistical significance with n=60.

[17] In terms of: (i) coefficient's significance; (ii) F test value on regression significance; (iii) adjusted R^2 value; (iv) heteroskedasticity tests.

The key points concerning the economic interpretation of the relationships between variables are the following. Firm performance is strongly and positively associated with organizational innovation. Furthermore, the "quality" of industrial relations, in terms of "management involvement vs. unions representatives" (index INVOLV 1) and "management involvement vs. employees" (index INVOLV 3), as well as the variable capturing the involvement initiatives by management vs. employees in the area of work organization and production activities (index INVOLV 4), are factors which drive to higher innovation intensity. Overall, different aspects of industrial relations are important for the development of organizational innovations, with a primary role of involvement driven by management initiatives. Thus, this evidence supports the positive oriented relationship between industrial relations and innovation intensity stated in hypothesis 2 above.

As far as managerial hierarchical intensity is concerned, it is confirmed here that higher innovation content in organization practices is associated with flatter managerial firm structure. This result also emerged from the descriptive analysis: it confirms the hypothesis that a flatter organisation, stimulating an increased horizontal interaction between the functions of the firm, may favor the introduction of new organizational practices.

With respect to the factors related to innovations in payment schemes and incentives, the first important result concerns the variable related to adopted incentives (INC-ADP), which includes not only individual payment schemes, e.g. bonuses, but also collective payment systems negotiated between trade unions and management, and other non-monetary incentives, e.g. training and carrier advancement: the introduction of these incentives seems to be positively associated with innovation practices. This result confirms the theoretical link between the introduction of innovation practices and incentive payment schemes, two realms of innovations which may be characterized by strong complementarity. We also note here the important role played by collective payment systems negotiated by unions, which seems not to be in conflict with the innovative dynamics within firms. The adoption of *individual and discretionary* bonuses for all employees (variable BONUSES) seems instead to be negatively associated with the introduction of innovative practices within firms[18].

4.3 Analysis of firm performance

Table 7 shows the results of two econometric exercises, in which two average indexes of firm performance (PERF6 and PERF4) are the dependent variables. Robust and consistent regressions arise in both cases[19].

The analysis carried out on the synthetic index PERF6 shows that four factors are of joint importance: the organizational innovation with employee involvement (INNO-ORG2), the index capturing the positive effects of Performance-Related-Pay incentives on organizational climate within firms (POS-PRP), the degree of flexibility of labour utilization (LABOUR-FLEX), and formal employee evaluation schemes (IND-EVAL). All those variables are positively associated to better performance with the relevant exception of the latter. This fact is confirmed also when using PERF4, and it may appear as counterintuitive. Nevertheless, both the individual formal evaluation and the percentage of employees involved in this practice do not constitute a significant factor of structural change in firm organization, as it emerged from the set of estimates presented in table 6. In fact, formal evaluation is not among the core explanatory factors[20].

[18] It is also worth noting which elements seem not to influence the degree of innovation intensity as here defined: percentage of PRP on total wage (PRP ratio) and percentage of employees with individual formal evaluations.

[19] In terms of: (i) coefficient's significance; (ii) F test value on regression significance; (iii) adjusted R^2 value; (iv) heteroskedasticity tests.

[20] It is worth noting that the constant term is not significant, thus the explanatory power revolves mainly around the set of selected regressors.

The PERF4 regression shows the same driving factors for firm performance as in PERF6. We note in this case a relatively weaker regression for reasons which probably pertain to the different explanatory weight of specific performance indexes entering the average full indexes.

It is worth noting that the applied analysis considering firm performance as dependant variable does not show a direct role of industrial relations on performance trends. The second part of hypothesis two, the relationship between industrial relations and firm performance, is not supported by empirical evidence, *at least* as a direct relationship.

As noted, the *weak link* of causality between performance and innovation stems primarily from the cross-sectional nature of the dataset and secondly from the intrinsic dynamic nature of the innovation-performance relationship, highly characterized by endogeneity[21]. Thus, we prefer referring to "association" linkages rather than "causation" ones.

Nevertheless, in order to circumvent the problem concerning the endogeneity of innovation, a further analysis is attempted. The aim is to increase the strength of our results by framing a two-stage estimation procedure in order to account for the potential endogeneity.

The performance-innovation relationship is thus estimated using a 2SLS estimation procedure to account for endogeneity. In the first stage, a regression using industrial relations indexes and PRP related pay variables as covariates for the index of innovation intensity is estimated[22]. We obtain *prediction values* from both a regression including PERF4 among covariates and two regressions without performance variables. In the latter case, we get predictions from both a "general from particular" regression strategy and a regression which presents all covariates. Then, the predicted value of innovation intensity (PREDINN[23]) is used as explanatory factor in the second stage of the analysis, to help explain firm performance. In this case, we use the performance index PERF6 as dependent variable, using predicted values for innovation and the series of dummies concerning firm typology, union territory and firm dimension as additional control variables. The aim of the analysis is to study the association between performance and innovation using only predicted values and variables which we may safely assume as exogenous (dummies). Table 8 reports the final parameter coefficients for the two-stages analysis. For clarity of exposition, in the tables below only the coefficients for predicted values are shown[24].

Results confirm what we previously highlighted. Innovation intensity turns out to be a relevant factor in explaining performance, as table 8 shows. Nevertheless, the role of performance emerges as crucial, since PREDINN1 is the highest significant variable among predictions for innovation. Thus, the potential endogeneity characterizing the relationship between innovation and performance should be further addressed using a dataset with different features. Although a longitudinal analysis *may* represent a better framework[25], our econometric results have increased in strength by means of the two-stage procedure.

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[21] Economic theory cannot assess which of the two variables is the exogenous independent one. Therefore, the availability of panel data, though useful since it adds dynamic information, does not completely solve problems inherent to the analysis of innovation and performance. Endogeneity should be tested also in a panel data environment.

[22] The relevancy of industrial relations in this first stage, added to significance of innovation in explaining performance in the second stage, may be a key proof supporting hypothesis two we stated above, the indirect link between industrial relations and performance. First stage estimation are available on request.

[23] Defined as PREDINN1 when using PERF4 as explanatory variable, PREDINN2 and PREDINN3 in the other two cases without performance as independent variable. PREDINN2 stems from a regression using only significant covariates, PREDINN3 using all explanatory factors.

[24] Full information on the two stage analysis is available on request.

[25] Huselid and Becker (1996) analyse the issues of *heterogeneity bias* and *measurement error* in cross section and panel frameworks concerning the specific HRM management system-firm performance relationship. In a cross section environment, on the one hand heterogeneity bias may generally lead to upward estimated of HRM effects on performances (but downward estimates are also possible, though less likely to occur), given the existence of unmeasured and positively correlated (with HRM) firm effect, on the other hand HRM measurement error bias the OLS estimates towards zero. They argue that although panel data offer an opportunity to mitigate the heterogeneity bias in the OLS estimates, this approach may exacerbate the effects of measurement error; a trade off would then exist between the two estimation procedures. Since the value added of panel data can be questioned, they suggest devoting more attention on comprehensive identification and correct measurement of as many as possible HRM practices. Extensive and high-quality cross sectional dataset could add as much or more value to applied research than panel dataset, where, among the other things, four or five years could be necessary in order to fully specify the model relationship.

Table 5. Variables list for firm performance and organizational innovations

Variable	*Acronym*	Type
Firm performance indexes *	Perf6 Perf4	-5, 5 -5, 5
Firm performance for the year 2000	Perf2000	0, 1
Competitiveness	Comp	-5, 5
Profitability	Profit	-5, 5
Firm Productivity	Firm-Prod	-5, 5
Individual productivity	Ind-Prod	-5, 5
Team productivity	Team-Prod	-5, 5
Product quality	Quality	-5, 5
Innovation content index^	Innov-index	0, 1

Notes:

* the performance indexes are referred to: competitiveness, profitability, productivity (firm, team, individual), product quality. Perf6 is referred to all 6 indexes, while Perf4 is only referred to 4 indexes (competitiveness, profitability, firm productivity, product quality). The range of variation, as elicited by the questionnaire, is [-5, 5] for all indexes.

^ the Innov-index is referred to all the innovations in firm organization.

cont. Table 5: Variables list for organizational innovations, industrial relations, PRP, and structural variables

	Variable	*Acronym*	*Type*
	Industrial relations indexes		
1	Involvement: management vs. unions representatives	INVOLV 1	0, 1
2	Involvement: unions representatives vs. employees	INVOLV 2	0, 1
3	Involvement: management vs. employees	INVOLV 3	0, 1
4	Involvement: qualitative initiatives by management vs. employees	INVOLV 4	0, 5
	Organisational innovation indexes		
5	Working time flexibility innovation	WT-FLEX-INNO	0, 1
6	Team-work	TW	Dummy
7	Quality circle	QC	Dummy
8	Just-in-time	JT	Dummy
9	Job rotation	JR	Dummy
10	Total quality management	TQM	Dummy
11	Organizational innovations type 1 (standard innovations)	INNO-ORG 1	0, 1
12	Organizational innovations type 2 (with employees involvement)	INNO-ORG 2	0, 1
13	Organizational innovations type 3 (related to product quality)	INNO-ORG 3	0, 1
14	Product quality control	PQC	0, 1
	Performance related pay (PRP) indexes		
15	Adopted incentives	INC-ADP	0, 1
16	% employees with individual formal evaluations	IND-EVAL	0, 100
17	Individual bonuses for employees	BONUSES	Dummy
18	No relation between PRP and firm organizational atmosphere	NO-REL-PRP	0, 1
19	Employees not interested in PRP	NO-INT-PRP	0, 1
20	Positive effect of PRP on firm organization atmosphere	POS-PRP	0, 1
21	Negative effect of PRP on firm organization atmosphere	NEG-PRP	0, 1
22	Cosmetic PRP	COS-PRP	Dummy
23	% PRP on total wage (PRP ratio)	PRP RATIO	0, 100
	Structural variables		
24	Gross revenue	REV	continuos
25	Territorial areas	PROV	3 Dummies
26	Corporate structure	CORP	3 Dummies
27	No. of employee	EMPL	3 Dummies
28	Managerial hierarchical intensity	HIER-MANAG	0, 1
29	Management divisions in human resources	HRM-DIV	0, 1
30	Plant flexibility	PLANT-FLEX	0, 1
31	Labour flexibility	LABOUR-FLEX	0, 1

Table 6: Analysis of Organizational Innovation Content (*)

Dependent Variable	*Innov-index*		*Innov-index*	
Covariates (**)	*Coefficient*	*T ratio*	*Coefficient*	*T ratio*
CONS	0.411	0.77	0.0308	0.517
INVOLV1	0.357	3.236	0.351	3.267
INVOLV3	0.279	2.035	0.283	2.030
INVOLV4	0.0378	2.829	0.0376	2.784
HIER-MANAG	-0.124	-2.320	-0.113	-2.069
NO-INT-PRP	0.153	2.616	0.146	2.469
INC-ADP	0.271	2.705	0.257	2.567
BONUSES	-0.0618	-2.098	-0.0590	-2.040
Performance index	Perf6 0.175	2.099	Perf4 0.023	2.760
Adj R^2	0,406		0,429	
F test value and Probability	6,86 [0,000]		7,45 [0,000]	

Notes:

* the null hypothesis of homoskedasticity is tested using White's general test and Breusch Pagan test. It is not possible to reject the null hypothesis in both cases. White test on Heteroskedasticity: the residuals are regressed on covariates, the R^2 value is 0.0074, the chi-sq statistic is therefore 78*0,0074= 0,577, the 95% critical value is (4 dof) 9,48. The homoskedasticity hp is not rejected by the test. The Breusch Pagan test is performed by Limdep as a routine using all parameters. Results are available upon request.

** two dummies when included in the regression above are significant but do not overcome the 95% threshold significance value. The first is the dummy for the typology "single firm" within CORP (the other two dummies are "industrial groups" and "cooperative firms"). The second is a dummy for the lower class of firms in terms of number of employees (EMPL) (< 50 employees).

Table 7: Performance indexes analysis(*)

Dep variable	Perf6		Perf4 (d)	
Covariates	Coefficient	T ratio	Coefficient	T ratio
CONS	-.673	-1.578	0.0839	.267
LABOUR-FLEX	1.476	2.426	1.568	2.443
INNO-ORG2	2.112	2.202	2.664	3.231
IND-EVAL	-.0073	-2.029	-0.0685	-1.889
POS-PRP (a)	1.799	2.104		
EMPL (b)	.635	1.909	0.576	2.250
PROV (c)	.546	1.702	0.571	1.902
Adj R^2	0,263		0,213	
F test value and Probability	5.58 [0.00009]		5,18 [0,00041]	

Notes:

* the null hypothesis of homoskedasticity is tested using White's general test and Breusch Pagan test. It is not possible to reject the null hypothesis in both cases;

(a) positive effects on the "organisational atmosphere";

(b) the significant dummy relates to the class of firms from 500 to 999 employees (EMPL);

(c) the significant dummy is for the provinces of Bologna, Modena, Reggio-Emilia and Parma;

(d) the Perf4 index considers a subset of performance related factors: competitiveness, profitability, firm productivity, and product quality.

Table 8- 2SLS Estimates (second stage)

Dep variable	Perf6					
Covariates	Coefficient	T ratio	Coefficient	T ratio	Coefficient (b)	T ratio
CONS	-0.49	-1.317	0.3291	.0743	0.0712	0.141
PREDINN1	8.00	5.761				
PREDINN2			3.462	2.405		
PREDINN3					5.70	3.453
Adj R^2	0.2961		0.0434		0.1432	
F test value and Probability	9.10 (0.000)		1.87 (0.124)		4.22 (0.00396)	
Breusch-Pagan test	1.10 (3 d.o.f.)		3.229 (4 d.o.f.)		2.478 (4 d.o.f.)	

Notes: a) d.o.f. (degrees of freedom); b) it is worth noting that in this regression the dummy associated to the class of firms with more than 500 employees is negatively and highly significant at 0.01 critical value.

5. Conclusions

The food sector in Emilia-Romagna constitutes an important frame for testing many theoretical hypotheses concerning the relationship between human resource management, industrial relations, and firm performance. The features of the regional industrial system are well suited for this aim. The organizational architecture of the system appears to be quite advanced: it is characterized by a flat hierarchical firm structure and by an ongoing process of innovation that has led to a sustained introduction of new work practices and incentive systems, which deeply transformed the traditional organisation of production. The territory is strongly unionized, with one of the highest union densities at national level, and the food sector is no exception to this rule. Relations between management and worker representatives tend to be cooperative, though disputes are by no means absent. Finally, the economic performance of the region and of the sector, over the past decade, has been good. These are the reasons why it is interesting to explore organizational innovation and industrial relations within this specific environment, deriving some empirical results by means of descriptive and econometric analysis.

Descriptive results highlight the clustering of innovative practices in firms where flatter hierarchical structures do seem to favor innovation. The process of organizational and technological innovation is governed by managerial initiative. Worker involvement occurs at an operative level, while there is little worker involvement in the organizational and strategic fields. The interaction between managers and worker representatives is greater and embraces the organizational field, mainly in terms of labour organisation, which is characterized by widespread information flows, consultation and bargaining procedures. The key link in the framework is the strong relevance of industrial relations, in terms of "good quality atmosphere" and "involvement of worker representatives and employees". The quality of industrial relations emerges as a significant element that favors organizational innovation: cooperative industrial relations are likely to represent a factor of competitive advantage where they are able to prosper. Payment systems were also taken into account, and here our research outlines a polarization between individual incentives and bonuses (manager-driven), on the one hand, and collective pay for performance schemes (industrial relations-driven), on the other.

The econometric exercise highlights the following critical elements. It strengthens the analysis by confirming results and exploring more deeply the relationships between variables. Firstly, although the direction of the causal effect is not detected here, the analysis highlights that, on the one hand, firm performance is a significant driving factor of innovation and, on the other hand, firms experimenting higher organizational innovation practices are more likely to perform better. This confirms the positive linkage stated by hypothesis 1. Secondly, the set of industrial relations variables emerges as a significant explanatory factor of firm performance through its positive effects on organizational innovations, and not directly on performance indexes (hypothesis 2). We hope that our analysis provides evidence that helps improve the understanding of these issues and stimulate further applied research in this field.

It is clear that in the food industry good, industrial relations are important as far as firm performance is concerned. The positive effect on performance is mediated by good industrial relation effects on organizational innovations, rather than being a direct stimulus to performance. Furthermore, the dynamic interplay between innovation and performance is likely to evolve along a positive path.

When we analyse the explanatory factors of organizational innovations, we see that there are three groups of variables which appear positively associated with our synthetic index of innovation content in organization practices. First of all, the two performance indexes are associated with significant and positive statistical coefficients; this means that firms with better

performance, and probably higher financial resources to invest, are committing themselves more extensively to organizational changes. Secondly, good quality industrial relations within the firm, characterized by a management policy favoring the involvement of both employees as well as worker representatives in work organization practices, constitutes a relevant factor for stimulating organizational changes. Third, systems of bargained and non-bargained incentives represent important factors associated with innovation in firm organization. Critical results emerge instead for specific incentive forms, such as individual bonuses and individual formal employee evaluations.

Finally, we would like to stress the relevance, at an organizational and strategic level, of human resource management practices adopted by management initiatives, while we observe a notable degree of decisional decentralization at an operative level. Such practices need to balance with industrial relations, which are mainly oriented towards information and consultation rather than bargaining upon various operative and organizational issues. The relations between management and union representatives do not seem to occur exclusively in terms of conflicts where social partners retain their prerogatives: firm governance by the management and defense of workers' rights (mainly pay levels and working conditions) by unions. Worker representative involvement and quality of industrial relations develop along a path where information sharing and jointly determined procedures seem to prevail.

Furthermore, our evidence stresses that the way towards organizational innovation does not have a unique imprinting, but it is likely to be a mixture of wise managerial initiatives, direct and indirect worker participation, and cooperative industrial relations. The results of such an equilibrium appear to be positive: the best economic performance are strictly associated with the intensity of organizational change. In turn, innovation is supported by good quality industrial relations. The firms with best performances do have such features.

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