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Innovation types and labour organisational practices: A comparison of foreign and domestic firms in the Reggio Emilia industrial districts

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Innovation types and labour organisational practices: A comparison of foreign and domestic firms in the Reggio Emilia industrial districts[§]

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Abstract – In his *Theory of Economic Development* (1934), Schumpeter introduced the distinction between different innovation types (namely product and process innovations). Since then, a variety of studies have addressed this topic by mainly focusing on the relationship between different types of innovations and selected economic determinants (i.e. firms' size, market structure, appropriability and imitation methods and firms' performance). However, despite of the recognised significance of more de-verticalised organisational forms in shaping and directing firms' innovative performance, no attempt has been made, as far as our knowledge is concerned, to investigate whether this practices are linked to the introduction of specific innovation types.

The aim of the study is to fill this gap by investigating the impact of de-verticalised forms of labour organisational practices, different modes of organising R&D activity and the nature of employees' competences (whether new to the firm or reshaped) on the likelihood of introducing different types of innovations (i.e. product, process and quality innovations), controlling for firm's size and sectoral specificities.

The results obtained on a sample of 199 firms located in Reggio Emilia province confirms that innovation development is a heterogeneous activity as shown by the different impact that the variables considered have on product, process and quality innovations. The empirical evidence gathered also shows that foreign and domestic firms do not differs, to some extents, in the introduction of different kinds of innovations. However, being foreign or domestic is a discriminating factor in the introduction of innovations stimulating labour organisational developments most probably as a result of the fact that foreign large firms operating in industries where local competencies are stronger are more flexible than domestic ones.

Keywords: product, process and quality innovations, horizontal information structure, R&D organisational modes, employees' competences

JEL classification: L23, O30, O33, R1

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1. Introduction

In his *Theory of Economic Development* (1934), Schumpeter introduced the distinction between different innovation types (namely product and process innovations). Since then, a variety of studies have addressed this topic by mainly focusing on the relationship between different types of innovations and selected economic determinants mainly in terms of firms' size, market structure, appropriability and imitation methods and firms' performance. However, no attempts, as far as our knowledge is concerned, have been made in order to assess the relationship between the introduction of different innovation types and firms' organisational practices and competences.

If this research topic appears particularly significant in the light of the evolutionary understanding of technology, which also encompasses firms organisational capabilities as a reflection of routinised practices developed over time, it is also topical when considering the most recent developments in the capitalism system. Such developments, greatly affected by the information and communications technology (ICT) mode of competencies accumulation, have promoted new heterarchical forms of corporate organisation replacing the Chandlerian M-form (of multiple division) (Hedlund, 1992; Ridderstråle, 1992). The heterarchical logic promotes an efficient intra-firm organisational form rooted on flexible managerial roles and developing an interdependent intra-firm network. This tendency towards a more heterarchical relationship between headquarters and subsidiaries seems to have been combined with a flatter organisation where interactions between firm divisions and top management become stronger (Mazzanti *et al*., 2002, Antonioli, Mazzanti, Pini, and Tortia, 2003, Cristini *et al*. 2003). In the sphere of production, this has been reflected in the shift from old models of production organisation to new models centred on the conception of the firm as a learning organisation (Penrose, 1958). Post-fordist models of production organisation (such as the Swedish (Berggren, 1992) and Japanese (Aoki, 1988) model) are based upon functional flexibility made operational through the active involvement of workers in production activity. Similarly, in the development of new technology, increasing complexity calls for an in-depth understanding of the innovation process, which can effectively take place through an active participation of workers in the learning path (Coriat, 2002). In line with a competence-based view of the firm (Prahalad and Hamel, 1990) and dynamic capabilities approach (Teece *et al*., 1997), workers participation in the firm learning path allows for greater competitiveness as a result of the conscious understanding of innovative potential. Similarly, outsourcing (rather than externalisation) of innovative activities misses to create a thorough comprehension of the new technology, despite of the likelihood of costs reduction in the short-run.

The aim of the study is to investigate the impact of de-verticalised forms of labour organisational practices, different modes of organising research and development (R&D) activity and the nature of employees' competences (whether new to the firm or reshaped) on the likelihood of introducing different types of innovations (i.e. product, process and quality innovations), controlling for firm's size and sectoral specificities. Moreover, the empirical exercise carried out in the paper also attempts to address the question whether the introduction of new technologies, regardless of their types (whether product, process or quality innovations), is stimulated by labour organisational innovations to different extents for foreign and domestic firms across sectors and firm's size.

The issue is analysed in the context of the Reggio Emilia province (Eurostat NUTS 3) hosting an industrial district in mechanicals, ceramics and made-in–Italy industries, by using a dataset stemming from a questionnaire administered to 199 industrial companies with at least 50 employees out of 257 firms with local establishments in the province in question. We hold that foreign and domestic firms do not differ, to some extents, in the introduction of different kinds of innovations. However, being foreign or domestic is a discriminating factor in the introduction of innovations stimulating labour organisational developments most probably as a result of the fact that foreign large firms operating in industries where local competencies are stronger are more flexible.

The argument is articulated in 6 sections. The following section reviews the state of the literature as far as innovation types and firms' organisational structure are concerned, by providing a theoretical explanation for the econometric exercise carried out in the paper. Section 3 draws some light on the data and methodology adopted. In section 4, the econometric model and the statistical methodology used are exposed. The results obtained are discussed in section 5, while in section 6 a few conclusions are drawn.

2. Innovation and labour organisational practices

Great emphasis has been given to the impact of organisational forms on the innovation and market performance of firms. Such a topic has been mainly addressed in relation to the performance of Japanese firms *vis-à-vis* American ones in the 1980s. In this context, American weakness has been attributed to old style mass production methods, which were obsolete in an era of flexible manufacturing. Conversely, for Japanese firms more heterarchical modes of organisation, and proximity of the research and product design and development to manufacturing and production engineering proved to be more effective modes of operation.[i] The flourishing of this explanation to the American weakness was parallel to the emergence of a broader concept of technology by comparison to the one proposed by orthodox economic literature, which understands technology as a easily transferable and readily imitable good. This wider concept understands technology as made by two components: a public (or *explicit*) one encompassed in blue prints, patents, books, etc., and a private (or *tacit*) one rooted in the unique learning path of firms which enables them to develop dynamic capabilities that make their knowledge operational (Nelson and Winter, 1982). This perspective of technology is wider in the sense that it refers to what firms know as well as to their capabilities in developing successful routines to make such knowledge operational. Following the dynamic capabilities approach (Teece *et al*., 1997), the competitive advantage of firms lies in the managerial and organisational process which can be identified with the routines and patterns of practices and learning defining the way things are done; in the technological, financial, complementary and locational assets of the firms; and in their history (path-dependency) and way they perceive technological opportunities. Since different firms develop different hierarchies of practiced organisational routines as a result of their unique history and learning process, this explains why firms differ across and within industries (Nelson, 1991). In turn, this implies that the internal organisation of firms does matter in shaping and orienting innovation and market performance.

By encompassing the way firms organise their knowledge, this evolutionary concept of technology also emphasises the significance of learning as a collective process in the sense that individual contributions to advances in learning is developed through interaction with others. As argued by Nonaka and Takeuchi (1995), it is the interaction between public explicit knowledge and private tacit knowledge which generates organisational knowledge. Going back to the Japanese experience, Aoki (1986) shows analytically the differences in the information structure between American and Japanese firms, the former relying more on a vertical structure by comparison with the more horizontal information structure of the latter. This information structure is practically accomplished by the rotation of workers among various jobs and the encouragement to workers in the shop floor to solve emergent problems by themselves and improvise improvements on designed work process. This allows training multiskilling workers who understand the entire production process and are able to respond to unexpected events without calling the supervisors (Carmichael and MacLeod, 1993, Black and Lynch, 2001; Lundvall and Nielsen, 2002). Conversely, strategic decisions (such as R&D investments) are placed under hierarchical control. Thus, according to Aoki's model (1986), the significance of collective learning by doing and informal knowledge sharing within Japanese firms would explain the emphasis given to efforts in developing potentially useful knowledge, collectively accumulated through production experience. This flexibility enables firms to respond timely to a wide variety of changes in the competitive environment (Volberda, 1996). Due to the fast pace of technological change in the current techno-socio-economic paradigm, greater adaptability to new conditions is a major requirement for surviving to market selection.

However, despite of the recognised significance of more de-verticalised organisational forms in shaping and directing firms' innovative performance, no attempt has been made, as far as our knowledge is concerned, to investigate whether these practices are linked to the introduction of specific innovation types.[ii] Conversely, as far as different innovation types are concerned, the existing literature has mainly focused on the effect of firm size on the allocation of R&D effort between process and product innovations. Cohen and Klepper (1996), for instance, show empirically that larger firms carry out more process R&D as a result of the fact that, since process innovations are less saleable in disembodied forms, larger firms can average the fix costs of their innovations over a greater level of output. Analogous conclusions are also reached by Pavitt *et al*. (1987), and Fritsch and Meschede (2001). Similarly, the importance of factors such as market structure has been emphasised in the distinction of product and process innovations as confirmed by the greater concentration associated to the introduction of the latter (Lunn, 1986). The dichotomy between product and process innovation has also been studied in the context of the product life cycle. In the earlier phases of an industry development, product innovations seem to be mainly introduced, while process innovations appear when the industry is became more mature (Utterback and Abernathy, 1975). Product and process innovations also seem to differ in terms of appropriability and imitation methods when considering that imitation of product innovation is easier than process, and that product innovations are usually protected by patents, while process innovations by industrial secrecy (Levin *et al.*, 1987). The introduction of process innovation has been also emphasised as far as firms' performance is concerned (Antonelli, 1986).[iii]

Due the uncertain character of technological change, it also seems relevant to investigate whether the introduction of specific innovation types show specific patterns in terms of R&D organisation and employees' competences. The former can be shaped according to whether R&D is internally or externally carried out. In the first case, firms develop specific capabilities on selected problems through their learning process and rely on knowledge produced outside them to the extent that it is complementary to the knowledge internally generated. That is, they generate directly knowledge which is immediately necessary to their production activity, while outsourcing knowledge complementary to it, which can be used on the grounds of the firm's competences and aims. Conversely, R&D organisational modes mainly relying on market transactions limit the extent to which firms can fully exploit the potential of the acquired knowledge since they miss the preceding learning process. However, such a distinction between R&D outsourcing and market R&D has not been made, as far as our knowledge is concerned, with reference to different types of innovations. Similarly, we have no record of analyses investigating the relationship between the nature of employees' competences and innovation types. This issue is particularly relevant due to our evolutionary understanding of the innovation process as a problem solving activity. As emphasised in existing studies briefly reviewed above, product and process innovations show specific characteristics in different respects. The question we want to answer is whether they are related, to different extents, to employees' competences new to the firm or to existing but reshaped workforce's competences. The former would imply that the innovation process requires a great effort to the firm in terms of diversification of its portfolio of competences. The latter would, instead, require an adjustment of the firm's competences profile in order to cope with specific innovative activities.

Within this framework, this study attempts to fill the gap by investigating the determinants of different types of innovations distinguishing between not only product and process but also quality innovations. Thus, the following hypothesis is tested:

Hypothesis 1: De-verticalised forms of labour organisational practices, different modes of organising R&D activity and the nature of employees' competences (whether new to the firm or restructured) affect the likelihood of introducing product, process and quality innovations to different extents.

Moreover, since empirical evidence exists about the intertwinedness of product and process innovations (Matinez-Ros, 2000) as well as on the different behaviour of foreign and domestic companies (Kotabe and Murray, 1990), the analysis goes ahead by investigating whether the introduction of new innovations regardless of the type has some impact on the organisational structure. The literature concerned with the evolution in corporate organisation has mainly focused on large multinationals (for a review see e.g. Martines and Jarillo, 1989), neglecting the comparison with national companies. Therefore, our analysis goes ahead by testing the following hypothesis:

Hypothesis 2: The introduction of new innovations regardless of their types (whether product, process or quality innovations) stimulates labour organisational developments to different extents by foreign and domestic firms across sectors and employees' classes.

3. Data and methodology

The sample of analysis refers to 199 firms drawn from a universe of 257 companies located in the province of Reggio Emilia in the year 2001, listed in national[iv] and local[v] databases. They operate in 19 manufacturing sectors as classified by the ISTAT-ATECO 91 code and are all firms with at least 50 employees. Firms were also classified according to an OECD (1994) revision of Pavitt's sectors (specialised suppliers, scale intensive, resources intensive, labour intensive and science based).[vi] The information about these firms has been gathered through a survey made up of a questionnaire addressed to the management, on four main topics: (a) firm's characteristics and employment structure; (b) organisational innovations and human resources management practices; (c) industrial relations; (d) payment systems. In this study, only information concerning the first two topics is used. After a first phone contact, the introductory part of the questionnaires was sent by fax directly to each firm in February 2002, asking to answer the questions concerning the structural features of the firm and ascertaining the willingness to answer the whole questionnaire during a direct interview. Interviewers were sent to accepting firms between May and July 2002. Interviewees are generally top managers and human resources directors. Firms were contacted again, if necessary, to solve problems pertaining their answers or to complete the questionnaire.

The firms in the sample are all responding firms (the questionnaire had a reply ratio of 77,4% of the entire population[vii]). Firms' distribution by sector and size is characterised by limited bias when comparing the responding firms with all surveyed firms. Both the textile sector and small-size firms (50 to 99 employees) are under-represented.[viii] However, no significant distortion emerges in all other sectors and dimensional employees classes, with the number of interviewed firms approaching or reaching 100% of the total in many of them (see Tables A.1a and A.1b*).*

Going into the details of the information gathered from the questionnaire concerning product, process and quality innovations, as argued by Simonetti *et al.* (1995), the terms of production and process innovations are not self-explanatory as shown by the numerous approaches in the literature.[ix] Each of these approaches has some advantages as well as drawbacks. The approach adopted in constructing the database used is a *firm level approach* in the sense that innovations are classified by the interviewed managers of the innovating firm.[x] Although classifications made by interviewing produces a share of process innovations much lower than a classification focusing on the economic definition, this is not the case in our sample where the difference between the number of firms introducing process and product innovations is almost negligible (see Table A.1c).

4. The econometric model and the statistical methodology

In order to test whether more de-verticalised forms of labour organisation practices, different modes of organising R&D activity and the nature of employees' competences (whether new to the firm or reshaped) affect the likelihood of introducing product, process and quality innovations (*Hypothesis 1*), three probit models were fitted to the data. In each of the models, the dependent variables were specified respectively as follows:

$PRODINNO_i$ is equal to 1 if firm (*i*) has introduced a product innovation, 0 otherwise;

$PROCINNO_i$ is equal to 1 if firm (*i*) has introduced a process innovation, 0 otherwise;

$QUALINNO_i$ is equal to 1 if firm (*i*) has introduced a quality innovation of product and/or process, 0 otherwise.

As far as the independent variables were concerned, the first set of variables considered are those *related to labour organisational practices*. In order to capture more horizontal information structures, it has been included in the model:

$teamwork_i$, which is equal to 1 if firm (*i*) organises team work and equal to 0 otherwise;

$jobrotation_i$, which is equal to 1 if firm (*i*) practices job rotation and equal to 0 otherwise;

$innoglo_i$, which ranges from 0 to 1 according to the number of organisational innovations (such as total quality management, job rotation, team work) adopted by firm (*i*);

$innoeilo_i$, which ranges from 0 to 1 according to the number of organisational innovations having a more pronounced participatory characteristic (such as greater autonomy of employees in problem solving decisions, introduction of employees' suggestions channels on products quality and organisational issues, permanent training related to the organisational needs of firm (*i*)).

Similarly, the model accounts for whether in the firm (*i*) quality control procedures exist ($qualitycontrol_i$ is equal to 1 if it does so, 0 otherwise) and managers formally evaluate employees (in which case $empeval_i$ is equal to 1, 0 otherwise).

The second set of variables refers to *variables related to different modes of organising R&D activity*. The independent variables considered are the following:

$R\&D_i$ equals 1 if firm (*i*) has a R&D function, 0 otherwise;

marketR&D$_i$ equals 1 if the firm (*i*) does not carried out R&D and externalises it, 0 otherwise;

R&Doutsourcing$_i$ equals 1 if firm (*i*) carries out R&D and externalises it, 0 otherwise.

A third set of variables relates to the *impact of new techno-organisational innovations on firms' competences*. First of all, it has been considered whether techno-organisational innovations adopted by the firms in the sample have promoted the reshaping of employees competences through training. Thus, a variable which is equal to 1 if in firm (*i*) techno-organisational innovations have impacted on training, 0 otherwise (*compres*$_i$) was built. Secondly, it has been taken into account whether the introduction of new techno-organisational innovations has stimulated the acquisition of new employees competences through recruitment by including in each of the three probit models a variable which is equal to 1 if firm (*i*) has introduced new techno-organisational innovations that have impacted on recruitment, 0 otherwise (*newcomp*$_i$).

In each of the three models, a variable accounting for the share of skilled labour (i.e. top managers, executive and clerks) employed in each firm (*i*) relative to the firm's total employees (*skill*$_i$) has also been included.

Table A2 lists and describes the variables adopted, while the summary statistics and correlation matrix are reported in Table 1 and 2 respectively.

As far as *Hypothesis 2* is concerned, the differences between foreign and domestic firms across sectors and sizes relatively to the introduction of innovations stimulating labour organisational developments are investigated by conducting a univariate GLM analysis. For this purpose, the firms in the sample were grouped according to whether they are foreign or domestic (*FOREIGN*), to the size of the parent company they belong to in terms of employees' classes (*EMCLASS*), to Pavitt's sectors (*PAVITTSECTOR*) and to whether they have introduced innovations stimulating labour organisational developments (*LABOURORG*). In order to further test the robustness of the results, the univariate GLM analysis was also conducted by classifying firms according to the ISTAT-ATECO 91 code (*SECTOR*) rather than Pavitt's sectoral classification. This also enables us to explore in greater details the sectoral distribution of firms as far as the introduction of innovations stimulating labour organisational developments is concerned.

5. Empirical evidence

In this section, the results of the econometric and statistical analysis are reported and discussed. For the sake of clarity, the exposition is organised into two sub-sections, each of which deals with a specific aspect of the empirical analysis.

5.1 Factors affecting the introduction of different innovation types: **e*conometric results and discussion***

The results of each of the three probit estimates are reported in Table 3, 4 and 5 respectively.[xi] In each of the three models run, variables controlling for firms' size, sectoral specificities (in terms of Pavitt classification) and for different behaviour of foreign firms were included.[xii]

As far as the introduction of product innovation ($PRODINNO_i$) is concerned, the econometric results reported in Table 3 provide evidence of the fact that the likelihood of introducing product innovations is positively associated to the organisation of team work ($teamwork_i$ is statistically significant at $p \leq 0.10$), but negatively associated to job rotation practices ($jobrotation_i$ is statistically significant at $p \leq 0.10$). This may be due to the fact that team work favour the fruitful exchange of ideas and the common development of a set of competences among the group members. Conversely, rotation practices where labour partners change periodically limit the possibility of cooperation between team members and the common development of their capabilities. Outsourcing of R&D activity also seems to promote product innovations most probably because the fact that firms carry out R&D allows them to fully exploit the potential of the knowledge sourced outside. Similarly, high shares of skilled labour within the firm positively impact on the introduction of product innovations. In line with Pavitt's (1984) argument firms operating in specialised supplier sectors are mainly introducing product innovations.

The results concerning the likelihood of introducing process innovations ($PROCINNO_i$) are somehow different (see Table 4). First of all, the estimates for $teamwork_i$ e $jobrotation_i$ are opposite to those obtained when estimating the previous relation. Rotation practices seem positively associated to the likelihood of introducing process innovations ($jobrotation_i$ is statistically significant at $p \leq 0.05$), while the organisation of team work is negatively associated (with a statistically significant level at $p \leq 0.05$). This may be found an explanation in the different nature of this type of innovation in which the competences and knowledge developed in different production phases may be extremely useful in adding new value to the innovation activity exploring new processes or improvements of the existing ones. This can be easily achieved by rotating employees through the various production phases. Job rotation facilitates knowledge flows among people with different experience by creating informal worker networks and awareness of others' skills and knowledge (Pettigrew, *et al.*, 2000). Thus, in the case of product innovation what matters seems to be the common learning path leading to innovation, while in the case of process innovations the variety of different learning paths seem to be the key point. As empirically shown by Gopalakrishnan *et al.* (1999), process innovations are more systemic than product innovations. Similarly, the adoption of innovations concerning general labour organisational innovations has a positive impact on the likelihood of introducing process innovations ($innoglo_i$ is statistically significant at $p \leq 0.01$). Techno-organisational innovations promoting the recruitment of employees with new competences are also positively associated to the introduction of process innovation ($newcomp_i$ is statistically significant at $p \leq 0.10$), most probably due to the fact that employees with new competences enlarge the firm's knowledge set and, therefore, its potential for innovation. Instead, employees' evaluation practices are found to negatively affect the introduction of process innovations, maybe because they limit the employees' opportunities to freely join in innovation development.

The results concerning the likelihood of introducing quality innovations of product and/or process ($QUALINNO_i$) show a negative association to team work ($teamwork_i$ is statistically significant at $p \leq 0.01$ and $p \leq 0.05$) and a positive association to the procedures of quality control ($qualitycontrol_i$ is statistically significant at $p \leq 0.01$), as reported in Table 5. The latter is clearly a key capability in introducing quality innovations due to the great knowledge of all weakness and straightness of the firm this activity yields. Conversely, the results concerning the former seem to suggest that team work undermines quality innovations most probably as a result of the fact that workers lack very specialised competences on specific issues. Unlike in the case of the introduction of process innovations, practices evaluating employees have a positive impact on the introduction of quality innovations ($empeval_i$ is statistically significant at

$p \leq 0.01$), where the employees' tasks are more codified and linked to firm's protocols. Like in the case of the introduction of process innovation, the adoption of innovations concerning general labour organisational practices positively impact on the introduction of quality innovations ($innoglo_i$ is statistically significant at $p \leq 0.10$ and 0.01). Due to the nature of this type of innovations, the externalisation of R&D activity is an organisational mode preferred by firms successfully introducing quality innovations of product and/or process ($marketR\&D_i$ is statistically significant at $p \leq 0.05$). This may be explained by the fact that, although successful firms do not carry out R&D activity, quality control procedures supply the necessary competences to apply the R&D results exchanged in the market. Unlike the introduction of product innovations, the successful introduction of quality innovations of product and/or process is associated with the reshaping of competences already present in the firms, as shown by the positive statistically significance of the variable capturing the impact of techno-organisational innovations on employees training ($compres_i$ is statistically significant at $p \leq 0.05$). Similarly, unlike the results obtained from the previous probit estimations, being a domestic or a foreign firm does matter in the likelihood of introducing quality innovations of product and/or process in the sense that domestic companies seem more akin to introduce this type of innovations than foreign ($foreign_i$ is statistically significant at $p \leq 0.05$ but with a negative sign). Most probably this result may be due to the fact that foreign firms introduce quality innovations in locations different than Reggio Emilia province. Moreover, firms with more than 250 and less than 999 employees introduce more quality innovations ($dimensionCD_i$ is statistically significant at $p \leq 0.10$), thus suggesting an inverted U-shape relation between quality innovation and firm's size. Accordingly, firms operating in resource intensive sectors do not seem to introduce quality innovations.

5.2 Innovation activities in domestic/foreign firms: statistical results and discussion

Foreign firms seem to act differently in the introduction of innovations by comparison to domestic firms only relatively to the introduction of quality innovations of product and/or process. Thus, in order to investigate whether being foreign or domestic is a discriminating factor in the innovative behaviour of companies regardless of the innovation types considered, we go further in our analysis by investigating whether foreign firms (as opposite to domestic ones) behave differently as far as the introduction of new innovations stimulating labour organisational developments is concerned across sectors and employment classes (*Hypothesis 2*).

As far as the results concerning the univariate GLM analysis grouping firms by Pavitt's sectors are concerned, all three factors provide a statistical significant classification of the firms in the sample (see Table 6), thus confirming that there is a statistical difference between the number of foreign and domestic firms (*FOREIGN* is significant $p < 0.05$), the number of firms classified across different employees' classes (*EMCLASS* is significant at $p < 0.05$), the number of firms across Pavitt's sectors (*PAVITTSECTOR* is statistically significant at $p \leq 0.05$) and the number of firms that introduce innovations stimulating labour organisational developments and those that have not (*LABOURORG* is significant at $p < 0.05$). The more interesting findings concerned the 2- and 3-way interaction effects. As far as the former are concerned, the findings reveal that there is a statistical significant difference between being a foreign firm and having introduced innovations stimulating labour organisational developments, and being a domestic one and having introduced innovations stimulating labour organisational developments (*LABOURORG*FOREIGN* is significant at $p < 0.05$). Similarly, firms assigned to different employees' classes and operating in different sectors introduce innovations stimulating labour organisational developments to different extents (*LABOURORG*EMCLASS* and *LABOURORG*PAVITTSECTOR* are both significant at $p < 0.05$). As far as the 3-way interaction effects are concerned, the number of foreign firms introducing innovations stimulating labour organisational innovations differs from the number of domestic ones across employees' classes as well as across sectors (*EMCLASS*LABOURORG*FOREIGN* and *FOREIGN*LABOURORG*PAVITTSECTOR* are both significant at $p < 0.05$), as illustrated in Table 6. In order to identify the relevant sectors and employees' classes a Tukey HSD test was performed, as illustrated in Table 7 and 8 respectively. Table 7 shows that statistically significant differences exist between firms operating in specialised suppliers sectors, and those operating in scale intensive and labour intensive sectors. Accordingly, Table 8 reveals that there are statistically significant differences between small (50-99 employees) and medium (100-249 employees) firms, and all other firms' sizes ranging from 250 to 499 employees and very large firms.

In order to test the robustness of these results, the univariate GLM analysis was also conducted by classifying firms according to the ISTAT-ATECO 91 code. The results exposed above are confirmed with the only exception of the 2-way interaction effect *EMCLASS*LABOURORG* (see Table 9). In this case too, a Tukey HSD test was performed in order to identify the relevant sectors and employees' classes. Table 10 and 11 reports the results only for the industrial sectors yielding statistically significant values, which are "non metal mineral" and "mechanical machinery" respectively. These sectors are, indeed, fields of local strengths as shown by the role of the mechanical and ceramics district in Reggio Emilia province. Similarly, a Tukey HSD test was performed in order to identify the relevant employees' classes as reported in Table 12. Major differences emerge between small firms and firms with more than 249 employees, and between medium firms and firms with more than 500 employees. Conversely, no differences are detected among the cohorts of firms with different employees size but with more than 250 employees.

The graphical analysis of such findings is reported in Figure 1 and 2, where the estimated marginal means of firms are plotted against ISTAT-ATECO 91 sectors and employees classes respectively by distinguishing between the introduction of innovations stimulating labour organisational developments and innovations that have not yield this outcome (*LABOURORG*). The analysis of Figure 1 reveals that being a firm operating in "non metal mineral" and "mechanical machinery" is a discriminating factor since the firms classified in these industries are the firms heavily introducing innovations stimulating labour organisational developments. Conversely, the plot reported in Figure 2 shows that on average firms tend to introduce more innovations stimulating labour organisational developments across all employees' classes than innovations that have not this outcome.

On the grounds of the empirical evidence emerging from the econometric analysis, these results seem to suggest that foreign firms both across sectors and employees' classes are more akin to introduce innovations stimulating labour organisational developments most likely as a result of their adoption of more heterarchical organisational forms. Nonetheless, no differences are detected between foreign and domestic firms when looking at the introduction of two specific types of innovations (e.g. product and process).

6. Conclusions

This paper has attempted to throw some light on the explicative factors of different innovation types (such as product, process and quality innovations) in terms of labour organisational practices, R&D organisational modes and the nature of employees' competences as well as of the differences between foreign and domestic firms. This topic can be traced back to the 1934 Schumpeter's distinction of different innovation types as one of the key factors in understanding the process of technological development. Similarly, it can be also framed within the evolutionary concept of technology, which understands firms' organisation as encompassing the development of firms' successful routines making their knowledge operational.

The empirical evidence gathered from a sample of firms located in Reggio Emilia confirms that innovation development is a heterogeneous activity as shown by the different determinants of product, process and quality innovations. Team work, high shares of skilled labour and R&D outsourcing are mainly associated with the introduction of product innovations, which is, instead, negatively affected by job rotation. Conversely, job rotation, general labour organisational practices and new employees' competences seem to positively impact on the introduction of process innovations, on which employees' evaluations has a negative impact. The introduction of quality innovation is, instead, driven by quality control procedures, employees' evaluation, general labour organisational practices, externalisation of R&D through market transactions and employees' restructured competences, while negatively affected by teamwork. Differences have also emerged in terms of sectoral specificities as far as product and quality innovations are concerned, the former being mainly introduced by specialised supplier firms, the latter mainly lacking in resource intensive sectors. The results also allow to establish an inverted U-shaped relationship between firms size and quality innovation with firms ranging fro 250 to 999 employees mainly contributing to innovations production.

Similarly, the analysis carried out enables us to draw some conclusions on the different behaviour of foreign and domestic firms as far as the introduction of new innovations (regardless of their type) is concerned. The statistical analysis reveals that foreign and domestic firms do not differs in the introduction of different kinds of innovations with the exception of quality innovations. However, being foreign or domestic is a discriminating factor in the introduction of innovations stimulating labour organisational developments most probably as a result of the fact that foreign large firms operating in industries where local competencies are stronger are more flexible than domestic ones. The results obtained allow to identify two industrial sectors ("mechanical machinery and ceramics" and "non metallic minerals") in which firms heavily introduced innovation stimulating labour organisation developments. These sectors are those around which the two industrial districts located in Reggio Emilia province have flourished.

By reading together the results of the econometric and statistical exercises carried out, it seems that, if foreign firms are more akin to introduce innovations stimulating labour organisational developments due to the more heterarchical organisational forms adopted, no differences seem to emerge between foreign and domestic firms when considering the introduction of two specific types of innovation such as product and process.

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Notes

[i] It should be, however, borne in mind that the Japanese model experiments a deep crisis in the 1990s, as documented by e.g. Dore (2000).
[ii] An exception can be considered the work of Capon *et al.* (1992) trying to sketch the profile of product innovators among large US manufacturers, although in that study organisational structure was one among other elements explaining product innovation and financial performance. Moreover, although Cristini *et al*. (2003) deal with the issue of the introduction of new technologies and work organisational changes, no distinction is made between different types of technologies. In this context, the work of Nielsen and Nielsen (2003) showing that advanced learning organisations tend to introduce product innovations more frequently than the rest on a dataset of Danish firms should be also mentioned.
[iii] For a more comprehensive overview on the streams of literature tackling the dichotomy of product and process innovation see Simonetti *et al*. (1995).
[iv] Intermediate census 1996 of the National Institute of Statistics (ISTAT 1999).
[v] *Camera di Commercio* in Reggio Emilia (Infocamere 2001).
[vi] The OECD revision of Pavitt's sectoral classification intends to link sectoral performance with labour markets. Hereafter, we will refer to this sectoral classification as Pavitt's classification for the sake of simplicity.
[vii] For details on the structures of the database see Antonioli, Pini, and Tortia (2003).
[viii] Although there are a few other industrial sectors showing representation biases in the database, their weight in Reggio Emilia economy is rather negligible.
[ix] For a review see Simonetti *et al*. (1995).
[x] Like for other approaches adopted in the literature, some drawbacks have been identified for this method too. Indeed, it is claimed that a *firm level approach* contains a high degree of subjectivity and is meaningless from a macroeconomic point of view (i.e. an innovation which is a product innovation for a firm could be a process innovation for another). Nonetheless, due to the micro-economic nature of our analysis, the later drawback is by-passed. As far as the former is concerned, if the perspective of classifying the innovation surely confers subjectivity to the classification, it is also revealing of an in-depth knowledge of the innovation introduced by the interviewee.
[xi] In order to solve the problem of coefficient interpretation, marginal effects have been computed (*dF/dx*) in order to be directly interpretable as elasticities.
[xii] As far as firms' size is concerned, a dummy variable equal to 1 if the size of firm (i) is between 250 and 999 employees, 0 otherwise ($dimensionCD_i$) was considered. Sectoral specificities were accounted for scale-intensive, specialised suppliers, resource-intensive and labour intensive sectors (no science-based firms are present in the sample).

Table 1 - Summary statistics

Dependent variable	***Obs***	***Mean***	***Std. Dev.***	***Min***	***Max***
PRODINNO $_i$	199	0,678	0,468	0	1
PROCINNO $_i$	199	0,668	0,472	0	1
QUALINNO $_i$	199	0,528	0,500	0	1
Independent variable	***Obs***	***Mean***	***Std. Dev.***	***Min***	***Max***
R&D $_i$	199	0,563	0,497	0	1
teamwork $_i$	199	0,296	0,458	0	1
jobrotation $_i$	199	0,322	0,468	0	1
qualitycontrol $_i$	199	0,457	0,499	0	1
empeval $_i$	199	0,548	0,499	0	1
innoglo $_i$	199	0,468	0,255	0	1
innoeilo $_i$	199	0,362	0,264	0	1
foreign $_i$	199	0,141	0,349	0	1
skill $_i$	199	39,068	21,926	0	92,763
marketR&D $_i$	199	0,040	0,197	0	1
R&Doutsourcing $_i$	199	0,106	0,308	0	1
newcomp $_i$	199	0,613	0,488	0	1
compres $_i$	199	0,854	0,354	0	1
dimensionCD $_i$	199	0,205	0,405	0	1

Table 2 - Correlation matrix

	PRODINNO $_i$	*PROCINNO* $_i$	*QUALINNO*	*R&D* $_i$	*teamwork* $_i$	*jobrotation* $_i$	*qualitycontrol* $_i$	*empeval* $_i$	*innoglo* $_i$	*innoeilo* $_i$	*foreign* $_i$	*skill* $_i$	*marketR&D* $_i$	*R&Doutsourcing* $_i$	*newcomp* $_i$	*compres* $_i$	*dimensionCD* $_i$
PRODINNO $_i$	1																
PROCINNO $_i$	0,132	1															
QUALINNO $_i$	-0,027	0,060	1														
R&D $_i$	0,131	0,089	0,059	1													
teamwork $_i$	0,164	-0,010	-0,025	0,129	1												
jobrotation $_i$	-0,033	0,211	0,113	0,130	0,236	1											
qualitycontrol $_i$	0,049	0,154	0,323	0,097	0,133	0,318	1										
empeval $_i$	-0,064	-0,104	0,232	0,074	0,170	0,107	0,105	1									
innoglo $_i$	0,151	0,215	0,271	0,213	0,493	0,408	0,420	0,221	1								
innoeilo $_i$	0,006	0,140	0,230	0,178	0,397	0,361	0,211	0,290	0,598	1							
foreign $_i$	0,031	0,070	-0,051	0,007	0,180	0,155	0,035	0,164	0,119	0,204	1						
skill $_i$	0,084	0,013	0,028	-0,001	0,024	0,081	0,040	0,028	0,189	0,097	-0,046	1					
marketR&D $_i$	0,086	-0,073	0,142	-0,181	-0,021	-0,086	-0,085	-0,071	-0,075	-0,087	-0,009	-0,053	1				
R&Doutsourcing $_i$	0,131	0,034	-0,068	0,303	0,099	0,079	-0,020	0,049	0,114	0,043	-0,092	-0,053	0,013	1			
newcomp $_i$	0,138	0,164	0,158	0,153	0,132	0,172	0,067	0,045	0,189	0,062	0,203	-0,028	0,163	0,038	1		
compres $_i$	0,082	0,133	0,265	0,095	0,081	0,071	0,208	0,083	0,212	0,189	0,085	-0,012	0,012	0,003	0,286	1	
dimensionCD $_i$	0,0049	0,0949	0,1833	0,0983	-0,0314	0,1015	0,0312	0,1633	0,1858	0,2502	0,0797	0,1375	0,0222	-0,0536	0,1241	0,1752	1

Table 3 – Probit estimation results (dependent variable *PRODINNO* $_i$)

Variables	Model 1					Model 2				
	dF/dx	***Std. Err.***	***Z***		***x-bar***	***dF/dx***	***Std. Err.***	***Z***		***x-bar***
R&D $_i$	0,081	0,074	1,100		0,563					
teamwork $_i$	0,140	0,083	1,590		0,296	0,132	0,070	1,770	*	0,296
jobrotation $_i$	-0,148	0,091	-1,670	*	0,322					
qualitycontrol $_i$	0,160	0,080	0,200		0,457					
empeval $_i$	-0,078	0,720	-1,080		0,548					
innoglo $_i$	0,271	0,204	1,330		0,468					
innoeilo $_i$	-0,219	0,176	-1,240		0,362					
foreign $_i$	0,201	0,106	0,190		0,141					
skill $_i$	0,003	0,002	1,660	*	39,068					
marketR&D $_i$	0,229	0,109	1,280		0,040					
R&Doutsourcing $_i$	0,205	0,087	1,760	*	0,106	0,215	0,800	2,04	**	0,106
newcomp $_i$	0,074	0,080	0,960		0,613					
compres $_i$	0,025	0,106	0,240		0,854					
dimensionCD $_i$	0,021	0,091	0,230		0,201					
specialised suppliers $_i$	0,176	0,091	1,840	*	0,392	0,155	0,066	2,24	**	0,025
scale intensive $_i$	0,155	9,097	1,390		0,151					
resource intensive $_i$	0,046	0,100	0,450		0,291					
obs. P	0,678					obs. P	0,678			
pred. P	0,706	(at x-bar)				pred. P	0,690	(at x-bar)		
No of obs.	199					No of obs.	199			
Log likelihood	-110,360					Log likelihood	-118,027			
	LR chi2(17)	29,25	**				LR chi2(3)	13,92	***	
	Pseudo R2	0,117					Pseudo R2	0,056		

**** Significant at $p \leq 0.01$

** Significant at $p \leq 0.05$

* Significant at $p \leq 0.10$

Table 4 – Probit estimation results (dependent variable *PROCINNO $_i$*)

Variables			***Model 1***					***Model 2***		
	dF/dx	***Std. Err.***	***Z***		***x-bar***	***dF/dx***	***Std. Err.***	***Z***		***x-bar***
R&D $_i$	0,025	0,076	0,320		0,563					
teamwork $_i$	-0,195	0,097	-2,030	**	0,296	-0,196	0,092	-2,150	**	0,296
jobrotation $_i$	0,144	0,078	1,720	*	0,322	0,170	0,073	2,140	**	0,322
qualitycontrol $_i$	0,054	0,770	0,690		0,457					
empeval $_i$	-0,202	0,071	-2,720	***	0,548	-0,163	0,068	-2,310	**	0,548
innoglo $_i$	0,401	0,201	1,990	**	0,468	0,505	0,169	2,970	***	0,468
innoeilo $_i$	0,096	0,176	0,550		0,362					
foreign $_i$	-0,001	0,099	0,424		0,141					
skill $_i$	0,085	0,002	0,635		39,068					
marketR&D $_i$	-0,197	0,194	0,424		0,040					
R&Doutsourcing $_i$	0,022	0,123	0,293		0,106					
newcomp $_i$	0,123	0,079	0,118		0,613	0,125	0,072	1,760	*	0,613
compres $_i$	0,077	0,111	0,476		0,854					
dimensionCD $_i$	0,047	0,094	0,621		0,613					
specialised suppliers $_i$	-0,066	0,104	0,523		0,206					
scale intensive $_i$	-0,054	0,136	0,683		0,391					
resource intensive $_i$	-0,004	0,108	0,973		0,151					
obs. P	0,668					obs. P	0,668			
pred. P	0,696	(at x-bar)				pred. P	0,693	(at x-bar)		
No of obs.	199					No of obs.	199			
Log likelihood	-110,682					Log likelihood	-113,15602			
	LR chi2(17)	31,5	**				LR chi2(5)	26,56	***	
	Pseudo R2	0,1246					Pseudo R2	0,105		

**** Significant at $p \leq 0.01$
** Significant at $p \leq 0.05$
* Significant at $p \leq 0.10$

Table 5 – Probit estimation results (dependent variable *QUALINNO $_i$*)

Variables	***Model 1***					***Model 2***				
	dF/dx	***Std. Err.***	***Z***		***x-bar***	***dF/dx***	***Std. Err.***	***Z***		***x-bar***
R&D $_i$	0,026	0,089	0,290		0,563					
teamwork $_i$	-0,280	0,102	-2,600	***	0,296	-0,256	0,100	-2,440	**	0,296
jobrotation $_i$	-0,020	0,105	-0,190		0,322					
qualitycontrol $_i$	0,237	0,086	2,670	***	0,457	0,227	0,083	2,660	***	0,457
empeval $_i$	0,256	0,082	3,010	***	0,548	0,261	0,078	3,150	***	0,547
innoglo $_i$	0,428	0,244	1,750	*	0,468	0,552	0,211	2,620	***	0,468
innoeilo $_i$	-0,001	0,207	1,340		0,362					
foreign $_i$	-0,285	0,108	-0,280	**	0,141	-0,250	0,118	-2,150	**	0,141
skill $_i$	0,003	0,002	-2,380		39,0678					
marketR&D $_i$	0,390	0,110	2,180	**	0,040	0,390	0,106	2,280	**	0,400
R&Doutsourcing $_i$	-0,147	0,139	-1,030		0,106					
newcomp $_i$	0,089	0,092	1,970		0,613					
compres $_i$	0,267	0,124	0,960	**	0,854	0,284	0,113	2,260	**	0,854
dimensionCD $_i$	0,144	0,107	1,300			0,174	0,101	1,66	*	0,206
specialised suppliers $_i$	-0,017	0,122	-0,140							
scale intensive $_i$	-0,117	0,150	-0,770							
resource intensive $_i$	-0,245	0,126	-1,870	*		-0,234	0,092	-2,450	**	0,291
obs. P	0,528					obs. P	0,528			
pred. P	0,526	(at x-bar)				pred. P	0,524	(at x-bar)		
No of obs.	199					No of obs.	199			
Log likelihood	-102,098					Log likelihood	-104,557			
	LR chi2(13)	71,07	***				LR chi2(9)	66,15	***	
	Pseudo R2	0,258					Pseudo R2	0,240		

**** Significant at $p \leq 0.01$
** Significant at $p \leq 0.05$
* Significant at $p \leq 0.10$

Table 6 - Results of the GLM test of between-subjects effects considering Pavitt's sectors (dependent variable *FIRM*)

	Sum of Squares	df	Mean Square	F	
Corrected Model	1477.8375§	55	26,870	7,663	**
Intercept	495,012	1	495,012	141,180	**
EMCLASS	240,675	4	60,169	17,160	**
FOREIGN	255,612	1	255,612	72,902	**
LABOURORG	148,512	1	148,512	42,357	**
PAVITTSECTOR	76,838	3	25,613	7,305	**
*EMCLASS*LABOURORG*	80,675	4	20,169	5,752	**
*FOREIGN*LABOURORG*	90,312	1	90,312	25,758	**
*PAVITTSECTOR*LABOURORG*	55,737	3	18,579	5,299	**
*EMCLASS*FOREIGN*LABOURORG*	305,450	8	38,181	10,889	**
*EMCLASS*LABOURORG*PAVITTSECTOR*	123,050	24	5,127	1,462	
*FOREIGN*PAVITTSECTOR*LABOURORG*	100,975	6	16,829	4,800	**
Error	84,150	24	3,506		
Total	2057,000	80			
Corrected Total	1561,988	79			

** significant at $p < 0.05$

§ R Squared = 0.946 (Adjusted R Squared = 0.823)

Table 7 - Tukey HSD results for Pavitt sectors (dependent variable *FIRM*)[a]

(I) Pavitt sectors	(J) Pavitt sectors	Mean Difference (I-J)	
scale intensive	specialised suppliers	-2,400	***
	resource intensive	-1,400	
	labour intensive	-0,150	
specialised suppliers	scale-intensive	2,400	***
	resource intensive	1,000	
	labour intensive	2,250	***
resource intensive	scale-intensive	1,400	
	specialised suppliers	-1,000	
	labour intensive	1,250	
labour intensive	scale intensive	0,150	
	specialised suppliers	-2,250	***
	resource intensive	-1,250	

[a]Std. Error 0.592
** significant at $p < 0.05$

Table 8 - Tukey HSD results (dependent variable *FIRM*)[a]

(I) *EMCLASS*	(J) *EMCLASS*	Mean Difference (I-J)	
50-99	100-249	1,813	**
	250-499	3,750	**
	500-999	4,438	**
	>999	4,438	**
100-249	50-99	-1,813	**
	250-499	1,938	**
	500-999	2,625	**
	>999	2,625	**
250-499	50-99	-3,750	**
	100-249	-1,938	**
	500-999	0,688	
	>999	0,688	**
500-999	50-99	-4,438	**
	100-249	-2,625	**
	250-499	-0,688	
	>999	0,000	
>999	50-99	-4,438	**
	100-249	-2,625	**
	250-499	-0,688	
	500-999	0,000	

[a]Std. Error 0.662
** significant at $p < 0.01$

Table 9 - Results of the GLM test of between-subjects effects considering ISTAT-ATECO 91 sectors (dependent variable *FIRM*)

	Sum of Squares	df	Mean Square	F	
Corrected Model	1115.724§	235	4,748	3,179	**
Intercept	104,213	1	104,213	69,778	**
EMCLASS	50,668	4	12,667	8,482	**
FOREIGN	53,813	1	53,813	36,032	**
LABOURORG	31,266	1	31,266	20,935	**
SECTOR	285,537	18	15,863	10,622	**
*EMCLASS*LABOURORG*	7,826	4	1,957	1,310	
*FOREIGN*LABOURORG*	20,845	1	20,845	13,957	**
*SECTOR*LABOURORG*	110,284	18	6,127	4,102	**
*EMCLASS*FOREIGN*LABOURORG*	53,737	8	6,717	4,498	**
*EMCLASS*LABOURORG*SECTOR*	242,705	144	1,685	1,129	
*FOREIGN*SECTOR*LABOURORG*	259,042	36	7,196	4,818	**
Error	215,063	144	1,493		
Total	1435,000	380			
Corrected Total	1330,787	379			

** significant at $p < 0.05$

§ R^2 = .838 (adjusted R^2 = .575)

Table 10 - Tukey HSD results for "non metal minerals" (dependent variable FIRM)[a]

(I) *SECTOR*	(J) *SECTOR*	Mean Difference (I-J)	
Non metal minerals	Food and drink	1,800	**
	Textiles	2,150	**
	Clothing and leather products	2,000	**
	Wood products	2,250	**
	Paper making apparatus	2,150	**
	Editing, printing and publishing	2,150	**
	Chemical products and synthetic fibres	2,100	**
	Rubbers and plastic materials	1,600	**
	Metal products	2,100	**
	Metal working equipment	1,400	**
	Mechanical machinery	-1,200	
	Office equipment and data processing systems	2,250	**
	Electrical devices and systems	2,000	**
	Radio-television and communications equipments	2,200	**
	Medical equipments	2,250	**
	Motor vehicles	2,100	**
	Other transport equipments	2,250	**
	Other manufacturing	2,200	**

[a]Std. Error 0.386
** significant at $p < 0.05$

Table 11 - Tukey HSD results for "mechanical machinery" (dependent variable FIRM)[a]

(I) *SECTOR*	(J) *SECTOR*	Mean Difference (I-J)	
Mechanical machinery	Food and drink	3,000	**
	Textiles	3,350	**
	Clothing and leather products	3,200	**
	Wood products	3,450	**
	Paper making apparatus	3,350	**
	Editing, printing and publishing	3,350	**
	Chemical products and synthetic fibres	3,300	**
	Rubbers and plastic materials	2,800	**
	Non metal minerals	1,200	
	Metal products	3,300	**
	Metal working equipment	2,600	**
	Office equipment and data processing systems	3,450	**
	Electrical devices and systems	3,200	**
	Radio-television and communications equipments	3,400	**
	Medical equipments	3,450	**
	Motor vehicles	3,300	**
	Other transport equipments	3,450	**
	Other manufacturing	3,400	**

[a]Std. Error 0.386
** significant at $p < 0.05$

Table 12 - Tukey HSD results (dependent variable FIRM)[a]

(I) *EMCLASS*	(J) *EMCLASS*	Mean Difference (I-J)	
50-99	100-249	0,382	
	250-499	0,789	**
	500-999	0,934	**
	>999	0,934	**
100-249	50-99	-0,382	
	250-499	0,408	
	500-999	0,553	**
	>999	0,553	**
250-499	50-99	-0,789	**
	100-249	-0,408	
	500-999	0,145	
	>999	0,145	
500-999	50-99	-0,934	**
	100-249	-0,553	**
	250-499	-0,145	
	>999	0,000	
>999	50-99	-0,934	**
	100-249	-0,553	**
	250-499	-0,145	
	500-999	0,000	

[a]Std. Error 0.1982

** significant at $p < 0.05$

Tab.A1a - Total firms (% and absolute values)

ISTAT-ATECO91 SECTOR	FIRM SIZE: no. of employees 50-99	100-249	250-499	500-999	> 999	**Total (%)**	***Total (absolute values)***
Food and drink	0,78	1,95	1,17	0,78	0,78	**5,45**	***14***
Textiles	0,78	0,78	0,00	0,00	0,00	**1,56**	***4***
Clothing and leather products	0,78	0,78	2,72	0,00	0,39	**4,67**	***12***
Wood products	0,00	0,78	0,00	0,00	0,00	**0,78**	***2***
Paper making apparatus	0,78	0,00	0,78	0,00	0,00	**1,56**	***4***
Editing, printing and publishing	0,78	0,00	0,39	0,00	0,00	**1,17**	***3***
Chemical products and synthetic fibres	0,00	0,78	0,39	0,00	0,39	**1,56**	***4***
Rubbers and plastic materials	3,11	2,33	0,78	0,00	0,00	**6,23**	***16***
Non metal minerals	9,73	6,61	1,95	2,72	0,78	**21,79**	***56***
Metal products	0,39	1,56	0,00	0,00	0,00	**1,95**	***5***
Metal working equipment	6,61	1,95	0,39	0,39	0,39	**9,73**	***25***
Mechanical machinery	17,90	8,95	3,11	1,95	2,72	**34,63**	***89***
Office equipment and data processing systems	0,00	0,39	0,00	0,00	0,00	**0,39**	***1***
Electrical devices and systems	1,95	1,17	0,39	0,39	0,00	**3,89**	***10***
Radio-television and communications equipments	0,00	0,39	0,39	0,00	0,00	**0,78**	***2***
Medical equipments	0,00	0,00	0,00	0,00	0,39	**0,39**	***1***
Motor vehicles	0,78	0,39	0,39	0,00	0,00	**1,56**	***4***
Other transport equipments	0,39	0,78	0,00	0,00	0,00	**1,17**	***3***
Other manufacturing	0,78	0,00	0,00	0,00	0,00	**0,78**	***2***
Total (%)	**45,53**	**29,57**	**12,84**	**6,23**	**5,84**	**100,00**	*14*
Total (absolute values)	***117***	***76***	***33***	***16***	***15***		***257***

Tab.A1b - Interviewed firms

ISTAT-ATECO91 SECTOR	FIRM SIZE: no. of employees 50-99	100-249	250-499	500-999	> 999	**Total (%)**	***Total (absolute values)***
Food and drink	0,00	60,00	100,00	100,00	100,00	**71,43**	***10***
Textiles	100,00	50,00				**75,00**	***3***
Clothing and leather products	50,00	100,00	28,57		100,00	**50,00**	***6***
Wood products		50,00				**50,00**	***1***
Paper making apparatus	50,00		100,00			**75,00**	***3***
Editing, printing and publishing	100,00		100,00			**100,00**	***3***
Chemical products and synthetic fibres		100,00	100,00		100,00	**100,00**	***4***
Rubbers and plastic materials	100,00	66,67	100,00			**87,50**	***14***
Non metal minerals	68,00	88,24	100,00	100,00	100,00	**82,14**	***46***
Metal products	100,00	75,00				**80,00**	***4***
Metal working equipment	58,82	100,00	100,00	100,00	100,00	**72,00**	***18***
Mechanical machinery	73,91	73,91	87,50	100,00	100,00	**78,65**	***70***
Office equipment and data processing systems		100,00				**100,00**	***1***
Electrical devices and systems	100,00	33,33	0,00	0,00		**60,00**	***6***
Radio-television and communications equipments		100,00	100,00			**100,00**	***2***
Medical equipments					100,00	**100,00**	***1***
Motor vehicles	100,00	100,00	100,00			**100,00**	***4***
Other transport equipments	100,00	0,00				**33,33**	***1***
Other manufacturing	100,00					**100,00**	***2***
Total (%)	**73,50**	**75,00**	**78,79**	**93,75**	**100,00**	77,43	*10*
Total (absolute values)	***86***	***57***	***26***	***15***	***15***		***199***

Table A.1c - Distribution of firms by different type of innovations introduced and size

Firm size	*Innovation types* Product	Process	Quality	None	**Total**
50-99 employees	59	57	37	3	**156**
100-249 employees	39	37	31	4	**111**
250-499 employees	19	19	18	0	**56**
500-999 employees	9	12	11	0	**32**
> 999 employees	9	8	8	2	**27**
Total	**135**	**133**	**105**	**9**	**382**

Table A2 - Description of variables

Variable	*definition*
Dependent variables	
$PRODINNO_i$	equals 1 if the firms has introduced a product innovation, 0 otherwise.
$PROCINNO_i$	equals 1 if the firms has introduced a process innovation, 0 otherwise.
$QUALINNO_i$	equals 1 if the firms has introduced a quality innovation, 0 otherwise.
Independent variables	
Variables related to labour organisational practises	
$teamwork_i$	equals 1 if the firm organises team work, 0 otherwise.
$jobrotation_i$	equals 1 if the firm practises job rotation, 0 otherwise.
$qualitycontrol_i$	equals 1 if quality control procedures exist in the firm, 0 otherwise.
$innoglo_i$	ranging from 0 to 1 according to the number of organisational innovations (i.e. total quality management, job rotation, team work) adopted by the firm, 0 otherwise.
$innoeilo_i$	ranging from 0 to 1 according to the number of organisational innovations having a more pronounced participatory characteristic (i.e. greater autonomy of employees in problem solving decisions, introduction of employees' suggestions channels on products quality and organisational issues, permanent training related to the organisational needs of the firm), 0 otherwise.
$empeval_i$	equals 1 if the firms evaluates employees, 0 otherwise.
Variables related to different modes of organising R&D activity	
$R\&D_i$	equals 1 if R&D functions exist in the firm, 0 otherwise.
$marketR\&D_i$	equals 1 if the firm does not carried out R&D and externalises it, 0 otherwise.
$R\&Doutsourcing_i$	equals 1 if the firm carries out R&D and externalises it, 0 otherwise.
Variables related to the impact of new techno-organisational innovations on firms' competences	
$compres_i$	equals 1 if techno-organisational innovations have impacted on training, 0 otherwise.
$newcomp_i$	equals 1 if techno-organisational innovations have impacted on recruitment of employees with new competences, 0 otherwise.
Variables related to the quality of the labour force	
$skill_i$	share of skilled labour (i.e. top managers, executive and clerks) employed in the firm relative to the firm's total employees.