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## Empirical Evidence for two Italian Provinces

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**Abstract**

The paper studies the driving factors of different firm training activities using two unique cross-sectional datasets at provincial level. Since the empirical literature on training at firm level is scarce, due to the costs and the intrinsic difficulty of collecting high-quality and extensive data, the paper value added is that it adds knowledge on the issue in providing new empirical evidence on the relationships between firm training decisions and firm characteristics at local Italian level. Data derive from two structured questionnaires administered to the management of 243 firms in the Province of Ferrara in 2003 and to the management of 166 firms in the Province of Reggio-Emilia in 2002. The applied analysis uses different econometric models to explore the linkages between firm decisions over training activities and the possible explanatory factors of training, at firm level.

The potential driving factors of training here analysed compounds structural characteristics, labour demand dynamics, human resource management practices, workforce features, and firm performances. The availability of an extended dataset on firm characteristics allows controlling for many relevant factors, which may explain training decisions, reducing the possible distortions arising in a cross-sectional environment.

The core of the empirical analysis thus revolves around the investigation of what the most significant driving forces of training coverage, variety of training activities adopted and training generality content are. Given a large percentage of firms declaring they do not adopt any training are present in our dataset, both OLS, Tobit and two-stage Heckman models are implemented and compared. The need of focussing the attention on different training proxies and different econometric models strongly emerges.

Summarising results, we observe that training activities emerges positively associated with productivity, high-performance practices, innovative labour demand features, workforce skill level, firm size, and affected by labour and plant flexibility in various directions. The high relevance of both structural variables (i.e. size, sector), labour demand factors and HRM/innovation practices (also positively correlated with structural variables and labour demand dynamics) shows that regional industrial policies must support labour policies within an integrated policy effort aimed at increasing potential firm productivity The analysis also suggests that a widening gap, between innovatively evolving and more stagnant firms, could characterise the future dynamics of those local areas. This is a key concern for the current debate on local systems in the European and Italian environment.

**Jel:** J24, C21, C24

**Keywords:** firm training, labour demand, human resource management, firm performance

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## 1. The theoretical framework

*1. 1 Training in firms: the Human Capital approach*

The seminal contribution in modern economic theory about training in firms is the classical treatment by Becker (1964). Becker draws the crucial distinction between specific and general training and analyses its consequences. Assuming perfect competition in both the labour and the product market, perfect information and perfect mobility of productive factors, Becker shows that no employer is available to fund training of employees for the acquisition of skills/ knowledge that affect positively employees' productivity in the firm financing training, as well as in other comparable firms; namely no employer funds general training. On the contrary, employer's financing is available for specific training, namely the acquisition of knowledge/skill that affect positively employees' productivity solely in the firm providing the financial means supporting this training programme. In the case of specific training the burden of financing is sustained not only by the employer, but also by the employees benefiting from training support, who share with the employer direct training expenses and opportunity costs.

Departing from Becker's treatment of human capital, the economic literature has focused on three different approaches. The first one is strictly theoretical and is aimed at investigating the consequences of relaxing some of the assumptions on which Becker's model is set up. The other approaches are mainly empirical and are devoted to investigate three different issues related to provision of training and cumulation of human capital in firms, namely: a) the propensity of employers to fund general training of employees; b) the structural determinants of firms associable to provision of any form of training; c) the effect of training on the level of both absolute and relative wages[1].

*1.1.1 Recent developments in human capital theory after Becker.*

In this approach both employers and employees are regarded as rational agents, maximising an objective function, given a set of constraints. Training activities push up employees' productivity and the target for both employees and employers is to maximise the remuneration arising from their activities of rent seeking. For the employer, the rent she can appropriate is given by: $R= MgPL – W_{MAX}$, where MgPL is the individual productivity after training and $w_{MAX}$ is the maximum wage level the employer can afford to pay, taking into account the percentage of training costs borne. As far as the single employee is concerned, her goal is the maximisation of a quasi-rent given by: $QR= W- W_{MIN}$, where W is the actual wage rate after training and $w_{MIN}$ is the minimum wage acceptable, given the level of the employee's investment in training and the condition of the labour market for comparable job positions[2]. In the case analysed by Becker, with perfect competition and general training provided, the rent (R) the employer can appropriate is negative, since the

[1] Since this important topic does not deal directly with provision of training in firms, this strand of the literature will not be discussed further on.

[2] A rent is the portion of earnings in excess of the minimum amount needed to attract a firm to finance a training programme. A quasi-rent is the portion of earnings in excess of the minimum amount needed to prevent a worker from quitting her job (Milgrom, Roberts, 1992).

employer is forced to pay a wage rate equal to individual productivity, if she does not want the trainee to quit the firm, since other firms would be available to pay a wage rate equal to w= MgPL. Unfortunately, the employer providing training cannot afford to pay the same level of wage as other employers, if she wants her investment in employees' training is paid off, because she has borne a percentage of training costs. Therefore, as Becker stated in his seminal paper, employees are not available to support employees for general training expenses. Things change, if one considers specific training. In this case, the employer's rent can be positive, as individual productivity has increased in the specific firm where training was provided, only. Of course, specific training is feasible if the employee finds it convenient, too, namely, if the level of quasi-rent the employee manages to extract is positive. Conclusively, a necessary and sufficient condition for the provision of training in firms is that both the employer's rent and the employee's quasi-rent are positive.

Basically, this straightforward analytical framework highlights two underlying mechanism regulating the provision of training in firms, namely promotion of asset specificity and the operation of the so-called "hold up problem". Asset specificity is favoured by employers and its pursue is carried out through the provision of firm specific training. In this way, since skills are poorly transferable, employers can manage to fix a positive level of rent. Hence, asset specificity push up the level of individual productivity and causes wage to increase at a slower pace than individual productivity. As to the hold up problem, this form of ex-post opportunism can be associated to the behaviour of trainees, once they have benefited from general training programme. Ceteris paribus, the level of wage in alternative firms ($w_{MIN}$) increases, due to the increase in individual productivity and if an increase in the level of remuneration paid by the firm providing training does not offset this increase, then the employee can be tempted to resign and to apply for a job in other firms[3]. The necessary condition for resignation is QR<0, which, obviously hold if the wage increase acknowledged is below the augment observed in individual productivity.

Using this simple framework of analysis, one can interpret and highlight recent developments in the economic literature. The standard strategy followed by economists working in this strand of the literature is to draw the consequences deriving from the violation of one or more of the standard hypotheses of perfect competition in both the labour and the product market on which, as stated previously, Becker's model is founded.

In their survey of the literature on human capital, Acemoglu and Pischke (1999) show this strategy effectively. The two Authors show what happens in non-competitive labour markets, when marginal productivity is above real wage and, more importantly, wage in time increases slower than productivity. In this case, one can observe a compressed wage structure that makes profitable for employers the financing of general training for employees.

Taking into account this general model of training provision in non-competitive labour markets, Acemoglu and Pischke stress three different sources of deviations from the model of perfect competition in the labour market. First of all, they show how the presence of turnover costs for both employees and employers limits employees' mobility and, hence, makes room for the two types of rents to raise. Secondly,

[3] Of course, this reasoning also holds in presence of problems of uncertainty and adverse selection. However, the analysis becomes more and more complicated.

they focus on two different sources of imperfect information, which are related to classical problems of adverse selection and moral hazard. In the case of adverse selection the problem arise, because potential employers, who did not pay for training, cannot appraise perfectly the individual productivity of potential employees. Since the effect of training on individual employees depends on their individual characteristics, and is not the same for all trainees, then potential employers can monitor imperfectly individual productivity ex-ante. Accordingly, employers financing general training programme are not forced to equal marginal productivity to wage rate and can enjoy benefits from their rent seeking activity. As to moral hazard, the problems of asymmetric information arising ex post can persuade the employer to set a minimum threshold on the level of wage. When the value of individual productivity is below this threshold, then the employer can push up its level through provision of general training, without increasing wages. In this way, a positive level of employer's rent can arise. Of course, in this case some mechanisms restraining employees' mobility needs to be at work.

In the same spirit as Acemoglu et al., Stevens (1994, 1999) develops a model based on a imperfectly competitive market for skills. In Stevens' model, employees' mobility is limited by the demand side, which is made up of a small amount of firms. Competition for transferable skills among firms is cut down and the level of wage is not driven up to the value of marginal product; competition does not compress completely the employer's rent and the incentive to sponsor general training, either.

On the theoretical ground, other scholars have pursued a different strategy (Lazear, 2003, Acemoglu, and Pischke, 1999). In these contributions general training is a specific case of specific training and, therefore, its effects on individual productivity are maximised in the firm sponsoring training. Acemoglu and Pischke claim that general and specific training are complements; an increase in the level of general skills increase the returns from specific training/skills. Consequently, even though general skills can also be used in different firms, its effect on individual productivity is firm specific and the employer can benefit from positive rent. Lazear maintains that employees' skills derive from a bundle of both firm-specific and general knowledge. The composition of this bundle and the mix among specific and general knowledge distinguishes each employees' endowment of knowledge. Training can be conceived as a bundle of learning practices. Even though training is general, two or more general training programmes can compose the bundle of learning activities. The composition of the bundle determines the firm specificity. From the employer's perspective, Lazear shows that the higher the expected tenure, the higher the propensity to provide general training. This raises an interesting point, because it confirms the claim that tenure has a positive effect on training.

Economists have carried out a lot of empirical analysis in the human capital approach. A detailed survey of this literature goes beyond the scope of this paper. However, it should be mentioned that several of these papers deal with the propensity of employees to provide training, neglecting its degree of specificity and focusing on the distinction between formal and informal training. This bias is caused by poor availability of appropriate data and by difficulties in measuring empirically the degree of firm specificity of training programmes. In addition to that, almost all empirical literature on human capital includes some structural

features of the firm among the determinants of the propensity to adopt training programmes such as firm's size and sector, composition of the workforce… The relevance of these variables stems from casual empiricism and is not explicitly rooted in any theoretical framework. As a matter of fact, the theoretical human capital literature addresses especially the effects of deviations from standard assumptions of perfect competition on the behaviour of maximising agents, ignoring the influence of structural variables.

## 2. Complementarities in production

Milgrom and Roberts (1990, 1995) have developed a formal model that refines Edgeworth's approach to complementarity among productive factors. In their contributions Milgrom, Roberts never define specific units of analysis. They refer to either characteristic features of production (Milgrom and Roberts, 1995) or to "elements of the firm's strategy" (Milgrom and Roberts, 1990, p. 513) or in a broader sense to "groups of activities (Milgrom and Roberts, 1990, p. 514). From a labour economics' perspective, complementarities among productive factors can be discussed with reference to four units of analysis:

a) employees' individual skills. In that case complementarity refers to both employees' knowledge and tasks carried out in productive activities.
b) division, shop floor, teams or, generically, autonomous sub-units of the productive unit;
c) organisational practices referring both to organisation of work in a broad sense (i.e.: teamwork, task rotation, training practices…) and to other defining features of production (i.e.: management of inventories, degree of vertical integration…)
d) capital equipment such as hardware (i.e.: lathe, computers…), software (i.e.; computer-aided design, word processing program…).

Complementarity among productive factors can be observed when the level of a given productive factor affects positively marginal productivity of other productive factors. In technical terms that means that the second mixed derivative of the production function with respect to two productive inputs is always positive.

Complementarity among inputs gives rise to two important interconnected consequences:

1. Relevance of the coordination function. The return of the single inputs depends tightly on the match among them. Hence, coordination of inputs becomes a crucial function in the determination of the firm's performance. As implied in the theoretical framework developed by Foss K. (2001), if one assumes boundedly rational agents and technological uncertainty, coordination is an inherent dynamic activity, based on learning-by-doing and different stages of experimenting. These activities originate production costs in the broad sense of the terms. These costs present a dual nature. From the one hand, they are production costs in the strict sense of the expression; on the other hand these costs include transaction costs arising from coordination activities. In the former case production costs linked to coordination can include wage costs and direct costs originating from the activity of supervisors and, in general, of employees in charge of coordinating complementary activities and inputs. In the latter case these include costs such as outlay for setting up the organisational structure for coordination of inputs, monitoring costs other than supervisors' wage, training costs…

2. Factors' productivity and production costs are highly idiosyncratic. The importance of the coordination function in the implementation of the complementarity relationships among inputs and the consequent path dependence of factors' productivity results into highly firm-specific level of factors' productivity and production costs. Internal mechanisms governing the coordination function become a central factor of competitiveness. This second consequence of complementarity is specially connected to tacit knowledge whose role will be analysed in the following section.

**3. Tacit knowledge and complementarity in production**

Polanyi (1967) introduced the notion of tacit knowledge, explicitly. Any human activity is based on a given amount of tacit knowledge and production is no exception. Two properties of tacit knowledge deserve special attention: a) uniqueness; and b) difficulty of transmission and reproduction.

The first property derives from the role played by the productive context in developing this form of knowledge. The single firm is conceived as a learning organisation (Nelson, 1995). In this perspective, learning in a firm is not a mere individual experience. The firm's knowledge endowment goes beyond the sum of the individual knowledge of its members. Individual tacit knowledge is transformed into explicit knowledge through a process of socialization and then is internalised in individuals (Nonaka and Takeuchi, 1995). In this way, acquisition of knowledge also depends on the social context and, therefore, has always a firm-specific component. Conclusively, each firm develops its unique stock of specific and distinctive knowledge. Uniqueness of knowledge and the conception of firm as learning organisation give rise to the second property of tacit knowledge. If the firm's knowledge does not coincide with the sum of individual knowledge of agents working in the firm, then it cannot be easily transferred and transmitted outwards from the firm's boundaries. Of course, this does not mean that transmission of knowledge and information out of the firm has to be ruled out, but that both of them can flow out mainly through informal and not codified channels.

Tacit knowledge and complementarities are tightly entwined. As a matter of fact, tacit knowledge implies a high degree of complementarity among inputs. Complementarity is a necessary but not sufficient condition for the existence of tacit knowledge. Tacit knowledge requires interactions among productive factors, even though the latter do not always cause tacit knowledge to grow up to significant level. When employees' skills have a high degree of complementarity, the potential room for tacit knowledge becomes wider and wider. When two or more skills are complements then it becomes more and more likely that this relationship turns out to be highly firm and/or context- specific. Conclusively, tacit knowledge accentuate idiosyncrasy of both factors' productivity and production costs. This effect can be strengthened by complementarity among inputs.

## 4. Asset specificity

The third pillar needed for the analysis of production is asset specificity. The relevance of asset specificity in transaction costs' economics has been widely investigated by neo-institutionalist economists. A brief survey can be found in Williamson (1981). In this paper one refers to skill specificity as a special case of human asset specificity.

It is important to point out that the degree of asset specificity affects the efficiency of institutions governing contractual relations among agents. If, during contractual execution investments in specific assets is nil or negligible, then the classical market governs efficiently these transactions. As this type of investment rises, classical market's mechanisms erode since the agent who invested in specific assets fits in with the characteristics demanded in the contractual obligations better than other potential competitors. The classical perfectly competitive contracting collapses into bilateral monopsonistic contracting, when investments in assets is "semi-specific". Investments in specific assets impair the traditional mechanisms of competition. If assets specificity becomes high, then contracting through any market mechanism fades and is superseded by internal organization.

### *4.1 The effect of complementarities among inputs and tacit knowledge on asset specificity.*

It should be clear that both complementarity and tacit knowledge affect the degree of asset specificity.

Complementarity implies some investment in specific asset for the execution of contractual obligations. Any agent, whose asset is coordinated in the course of production, has to invest a minimum amount of resources if she wants to match the requirements of production. The execution of one's contractual obligations has to fit into a cobweb of complementary contractual nexus and hence need adjusting through experience and learning-by-doing. Of course, the amount of resources to meet these costs varies considerably, according to the characteristics of production and of the inputs involved in the contractual obligations.

Additionally, complementarity results in the idiosyncratic nature of both factors' productivity and production costs. Use and return of resources and complementary relations among them, as well as the correlated production and transaction costs, depend on the productive context in which they develop. Asset specificity derives from the coordination among inputs and the nature of the complementary relations established. Since asset specificity evolves as the matching of inputs and activities progresses, then its determination is inherently dynamic.

As far as tacit knowledge is concerned, it should be clear enough that both uniqueness and difficult of transmission of this form of knowledge affect asset specificity. The development of tacit knowledge by agents affects positively the degree of asset specificity. In addition to that, the view of the firm as a learning organisation, which implies the idea itself of tacit knowledge, assumes investments by agents in assets, whose specificity evolves in time, along with the organisational knowledge. The continuous process of transformation of tacit knowledge into explicit one and, especially, the individual internalisation of knowledge can be conceived as a tool to smooth investments in specific asset.

Conclusively, when confronted with complementarity among inputs and tacit knowledge, asset specificity emerges as a process of adjustment and matching of different factors. Accordingly, asset specificity derives from a dynamic process, pushed by trial and error and, therefore, characterized by non-strictly linear dynamics. The development of this process is costly and depends on both the amount of resources available for this purpose and, more generally, on the distinctive characteristics of production in firm.

*4.2 Complementarity and skills*

Since employees' skills can be considered as productive inputs, it is interesting to analyse the effects of the establishment of complementary relationships among skills and other inputs.

Complementarity among inputs entails that the return of a single skills does not depend only on the skill itself, but also on other skills and inputs. The use of skills in firms depends on how skills are combined with other inputs. For this reason it is useful to introduce the distinction between skills acquired and skills used. The former refer to the content of education, training and, in general, to the knowledge content transmitted to the employee. Skills acquired account for the stock of knowledge and previous working experience of an employee, regardless of the specific productive context in which she operates. Acquisition of skills occurs through both formal (formal education, training) and informal procedure of transmission. The latter apply to the skills actually used by employees in their working activities and define the set of tasks to perform. Skills used cannot be specified out of a well-defined productive context and their development can occur through some kind of formal (off-the-job) and informal (on-the-job) training. Skills used are assets whose specificity depends on the complementarity relationships established with other inputs[4].

Employees' learning can be understood as a dynamic process of specification of complementary relationships between the skills acquired and the other inputs, which gives rise to the set of skills used. The endowment of skills acquired feeds skills used and vice versa. From an endowment of skills acquired, one can develop a set of skills used through learning processes such as those implied by on-the-job training, learning by doing, specific off-the-job training and other interactions with the domain of production. However, these learning mechanisms also work in the opposite direction. In other words, after a series of skills acquired has developed into skills used, the process of conversion can continue in reverse and proceed towards the acquisition of new skills and the consequent growth and sedimentation of the endowment of skills acquired. This relationship between skills used and skills acquired implies that the effect of training on both of them can be different. As far as skills acquired are concerned, training affects directly the endowment of individual knowledge. As to skills used the story can be different. On the one hand on-the-job training

[4] This distinction between skills acquired and used is consistent with the classification of skills introduced by Stasz (2001). The Author points out four broad skills area: a) cognitive skills, i.e.: school background; b) generic skills such as problem solving, communications and teamwork, whose meaning varies with the context; c) technical skills, i.e.: academic skills and knowledge of specific machinery or productive processes; d) work-related attitudes or soft-skills such as motivation, volition and disposition. Skills under a) and c) can be viewed as acquired skills, whereas b) and d) refer to firm-specific skills actually used.

affects directly skills used, on the other hand off-the-job training can affect indirectly skills used by favouring the setting up of new complementary relationship with other productive inputs[5].

This view of learning and the dichotomy between skills acquired and used cause the collapse of the identity between training and skill. In standard human capital literature, the distinction between training and skills is not sharply clear-cut. Ever since seminal Becker's analysis (1964) the distinction between general and specific training overlaps that between general and specific skill. Specific training gives rise to firm specific skills and general training develops general skills. As a matter of fact, general training can imply the acquisition of general skills. Nevertheless, skills used determine the actual range of employees' tasks and duties and her productivity. The widening, through some form of training, of an employee's endowment of skills acquired does not imply an increase in the level of her productivity. As a matter of fact, employees' productivity is fixed by the complementary relationships set up in the firm where the worker is employed at the moment of training. Therefore, labour productivity is always firm specific, because the return of the skills acquired always depends on highly idiosyncratic skills used. Hence, even when skills acquired are general, their return is always firm specific.

*4.3 Skills and asset specificity*

The fundamental distinction between skills acquired and skills used has to be analysed in comparison with the idea of asset specificity. Skills acquired and skills used point to different ideas of asset specificity. In the case of skills used, asset specificity depends on the complementary relationships established in production, which actually define it. The more firm specific these relationships are, the higher the degree of asset specificity (asset specificity type 1[6]). As far as skills acquired are concerned, asset specificity depends on the degree of generality/specificity of skills acquired, which determine the transferability of skills acquired to other firms (asset specificity type 2[7]). AS2 depends on the expected skills used that employers can extract from a given endowment of skills acquired. AS2 is defined with respect to the external universe of firms.

These two interpretations of asset specificity need not coincide; one can observe a high degree of AS1 and a low degree of AS2, and vice versa. The determinants of AS1 and AS2 and, accordingly, their dynamics differ. On the one hand, microeconomic variables such as change in the stock of capital, skills, HRM practices, techno-organisational variables and training influence the degree of AS1. On the other hand, sectorial composition of labour demand, labour laws (minimum wage, laws affecting hiring and lay-offs) and training determine the level and the dynamics of AS2.

Becker does not draw the distinction between skills acquired and used. Hence, in his analysis these two types of asset specificity overlap perfectly. Accordingly, the effect of general training is just an enlargement of the endowment of skills acquired. Trainees' productivity increases for any workplace, discouraging the propensity of employers to finance general training programmes. In the framework of analysis developed in

[5] This analysis of skill formation is consistent with that developed by Argyris and Schön (1978) about single loop and double loop learning processes.
[6] AS1 from now onward.
[7] AS2 from now onward.

this paper this is not always the case. Indeed, even though general training improves employees' productivity in any firm, training can also favour the establishment of new complementary relationships and widen the range of skills used. The degree of asset specificity of the skills used increases, making the trainees' productivity firm specific. Certainly, also the range of skills acquired grows, but its growth need not match the increase in productivity due to the widening of the range of skills used.

This analysis of training, learning and skill development raises two crucial consequences[8]. Firstly, general training affects productivity in the firm where the employee is currently employed (internal productivity) and productivity as perceived by employers in the external labour market (external productivity) in a different way. Divergence between internal and external productivity favours the setting up of internal labour markets, as they insulate the employers financing training from the underbidding of other employers. Secondly, the focus of the analysis shifts from the distinction between general and specific training to the analysis of complementary relationships among inputs. Of course, that does not mean that employers are always available to finance general training. However, the distinction between skills acquired and used provides the rationale to understand the potential arising of a positive level of employer's rent, even when general training is provided and wages are not compressed as in Becker's analysis.

*4.4 Skills, training and the labour market.*

The relevance of the distinction between skill used and skill acquired stands out neatly, when one discusses problems of marketability of skills, by using the simple framework developed previously for the analysis of rent seeking activities of both employers and employees. As far as the employer's rent is concerned, marginal product depends on skills used. The value of the trained employee for the firm in which the worker was employed at the period of training is determined mainly by skills used and asset specificity type 1, because, obviously, those define the range of tasks that the employee can carry out and, in this way, her actual and potential productivity.

If one takes into consideration the level of quasi-rent for employees, things change. In the definition of quasi-rent, $W_{MIN}$ depends on the wage attainable in comparable job position. Accordingly, the marketability of individual skills results from skills acquired, as product of previous working experience, training and school background, and the match between those and the features of potential labour demand. Labour demand constrains the marketability of skills acquired, given its role in the conversion of skills acquired into skills used. This match between skills acquired and labour demand is an indicator of potential skills used, extractable in different workplace from that to which the employee is currently linked. $W_{MIN}$ depends, ceteris paribus, on this potential match between the demand side of the labour market and skills acquired. Therefore, an increase in the endowment of skills acquired does not entail by itself an increase in the level of $W_{MIN}$, as stated in standard Becker's story. $W_{MIN}$ increases only if the increase in the endowment of skills fits into the features of potential labour demand.

[8] Figure 1 sketch out the fundamental relations of the conceptual framework developed in this paper.

Conclusively, the distinction between skills acquired and skills used points out a differentiated dynamics between the employer's rent and the employee's quasi-rent, in presence of training. The cumulation of skills acquired affects positively the width of the potential range of skills used, if and only if potential labour demand manages to extract newly skills used from the process of cumulation of skills acquired. To the extent that the process of acquisition of skills diverges from that of skills used, the impact of any form of training on the employer's rent and on the employee's quasi-rent is different. In Becker's classical treatment of human capital in firms, general and perfectly transferable training has the same effect on the rent and the quasi-rent and, as a consequence of that, the employer cannot finance it and its costs are entirely borne by employees. For opposite reasons, the employer's financing of specific training programme is feasible.

The discrimination between skills acquired and skills used enables to catch the possible differentiated effects on both the rent and the quasi-rent, not only of specific but also of general training. Conclusions are less sharp-cut than in Becker's seminal analysis of training in firms. Both specific and general training can yield differentiated levels of rent and quasi-rent, which is the condition required for the financing of training by employers. If this condition is met employers can finance general training. Paradoxically, this condition may not hold for specific training. As already stated, the development of skills used can have a positive effect on the endowment of skills acquired. If this effect outweighs the positive effect of specific training on the range of skills used, then the employer can be reluctant to finance this programme.

*4.5 Some hints about the interaction of structural variables with skill development*

The pivotal notion of complementarity among inputs points to the relevance of firm's structural variables. Hence, it is interesting to provide few hints about the interaction of some firm's structural variables and the process of skills development, discussed in the previous sections. Attention will be focused on three different elements, featuring the firm's structure such as: a) firm's size; b) firm's technology; c) internal labour market and the employment relation.

a) It is reasonable to believe that in small firms fewer complementary relationships among inputs can be coordinated than in big firms. This seems to have a negative impact on small firms' productivity. If fewer complementary relationships can be established, then the same set of skills acquired can produce a lower level of returns of the skills used in small firms than in larger ones. This impairs the value for the employer to provide training for employees in small firms. Furthermore, this characteristic of organisation of production in small firms can explain why downsizing strategies are consistent with promotion of functional flexibility. Basically, downsizing implies both a decrease in the level of employees and outsourcing of peripheral productive activities. When downsizing occurs, increase in employees' productivity is reached through the establishment of newly complementary relationships. This strategy is pursued by means of an extensive use of the workforce. Basically, a decrease in the range of productive activities brings about the pursuit of job enlargement strategies aimed at engineering new complementary relationships. As the scale of production augments, this strategy can be more and more carried out by implementing complementary relationships among sub-units of the firm (divisions, departments…) and less and less through the promotion

of employees' functional flexibility. Following Ramsay et Al.'s classification (2000)[9], one can say that the larger the productive unit, the higher the likelihood to adopt the involvement approach to achieve gains in labour productivity and, conversely, the smaller the scale of production the higher the likelihood to pursue productivity gains through work intensification[10].

b) Technology constrains the process of conversion of skills acquired into skills used. Capital equipment, machineries and, in general productive processes characterize technology. These factors constitute productive inputs with which skills acquired have to establish complementary relationship. The process of conversion depends on how one coordinates and manages the match between the elements characterizing technology and the development of skills used. Of course, the relationship between technology and skills used also runs in the opposite, i.e.: from skills used to technological development.

c) Internal labour market provides the suitable environment for the process of development of skills, as it implies employees' long-run attachment to firm. However, the role of tenure can be ambiguous. Training can be provided as long as expected tenure is long enough to pay off training costs. Tenure is a necessary condition for the provision of training, but it is not sufficient. Employees' trainability (Thurow, 1975) and quality of labour demand play a pivotal role. If poor employees' trainability rises training costs or, if the firm's potential to establish profitable complementary relationships between newly developed skills and other inputs is scarce, then tenure by itself does not cause training to be provided. In this respect the analysis of the association between training and tenure can test the quality of either labour supply or demand.

Additionally, a crucial variable is the promotion of functional flexibility in internal labour market. Job description in internal labour market can be so rigid to restrain the process of development of skills used, which requires a considerable degree of internal labour market flexibility. When, for any reason, internal labour market flexibility is poor, then the process of development of skills used can be strengthened by procedures easing the hiring of new employees and the firing of incumbents, i.e.: widening the range of ports of entry and exit to accommodate the establishment of complementary relationships and their development. On the other hand, if internal labour market flexibility is high, skill development can be compatible with fairly rigid procedure of hiring and, especially, firing. Conclusively, in order to meet the conditions for skill development, internal labour market flexibility/rigidity is always matched by external labour market rigidity/flexibility.

This framework of analysis can be a useful basis to understand possible effects of short-term labour contracts. This typology of contracts raises two considerations. First of all, in the short-run, these can be a tool to meet product demand fluctuation; when demand is highly uncertain and variable; short-run labour

[9] In this paper Ramsay et Al. point to two different purposes for the introduction of High Performance Work Systems. The first one also implies the empowerment of workers and is aimed at decreasing costs through a reduction for control and monitoring of employees (involvement approach). The second one claims that the adoption of these practices is directed at the intensification of workers' effort (intensification approach).

[10] Of course, things change if complementary relationships can be established out of the boundary of the firma s in districts or in clusters.

contract can act as a buffer to control wage costs. Secondly, short-term labour contracts can be adopted in order to increase external labour market flexibility, as they ease the procedures and the costs of hiring and firing.

In the former case, of short-term labour contracts restrict the expected temporal horizon for the process of conversion of skills acquired into skills used. This implies that the process has to be quite simple and little costly and, hence, that poor asset (skill) specificity is needed for the performance of the tasks attached to the job positions associated to short-term labour contracts. However, some simple form of training is required. The latter case is more complicated. If the process of skill development extends in the long run, a short expected duration of the employment relation can be a problem, as it loosens the employee's attachment to the firm. The time profile of skills development and the associated costs, as well as the processes of both rent and quasi-rent extraction, play a pivotal role in the specification of the most suitable labour contract's length and can also persuade the employer to set up open-ended labour contract. Therefore, when rigid internal labour market prevails, external labour market flexibility, reached through the hiring of short-term employees, can be a necessary but not sufficient condition for the development of skills used. A negative relationship between the stock of short-term employees and the employer's propensity to train is implied.

Conclusively short-term labour contracts can be useful to meet the requirement of firms to adjust in the short run, nevertheless their intensive adoption can be harmful in a long run perspective of development.

This simple conceptual framework has reached two intertwined results. The first one is that the notion of complementarity among inputs leads to the distinction between skills acquired and skills used. This simple idea undermines the importance of the distinction between specific and general training. Asset specificity of skills used depends on the complementarity relationship established in the management of production and not on the nature of training imparted. Accordingly, it not so important to understand the nature of training so much as the match among different training practices and the relationship among them and other inputs. The second point raised in this theoretical introduction is that firm's structural variables deserve more emphasis as determinants of the use of skills and the establishment of pivotal complementary relationships among inputs.

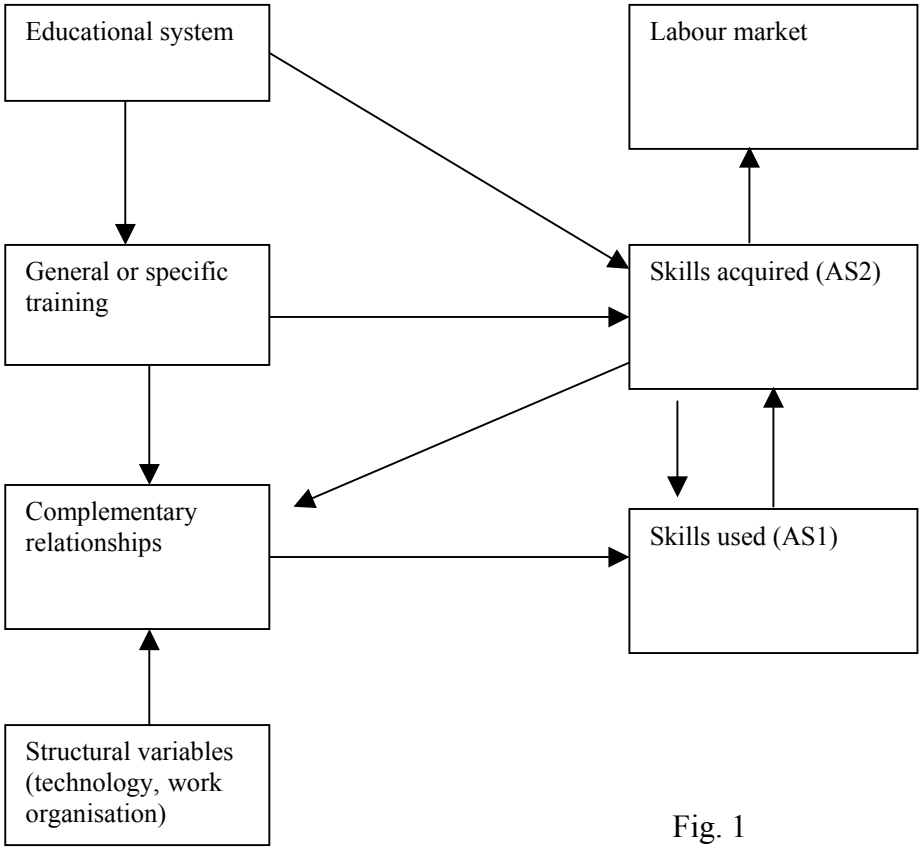


Fig. 1

**5. The empirical literature on firm-level training**

The empirical evidence on training driving forces is overwhelmed by contributions stemming from a micro-based approach, which takes the worker as statistical unit of reference. While a rich array of data on training is provided by cross sectional and longitudinal individual based surveys, data on the nature and extent of training investments and training typologies provided by private establishments and firms are scarcer (Frazis et al., 1995). Data are usually gathered from National firm or household surveys that elicit information on worker characteristics, contract features and position within the firm.

Our approach is specifically focussing on micro-based data at firm/establishment level. Within this field of applied analysis, empirical evidence is scarcer, presumably given the higher cost and difficulty of collecting high quality data at firm level by direct surveys, using structured questionnaires. The approach is nevertheless more interesting since by directly interviewing firms one has the possibility of collecting extensive data on firm performance, organisational structure and dynamics, structure of labour force and other key issues at firm level. One drawback is that the analysis is usually constrained within a specific

regional territory. Good sample representativeness is therefore important for rooting a robust statistical analysis on firm training and its driving forces.

We now summarise the more recent and relevant contributions that empirically analyse the relationship between training and various driving forces. This survey of the literature is aimed at highlighting (i) the different training indexes used in the literature, (ii) the econometric modelling, in terms of statistical specifications used, (iii) the empirical evidence arising from the studies. The critical analysis of those factors is crucial to introduce our empirical analysis on the two above described datasets next.

Whitfield (2000) is one of the recent studies that are of major interest to our analysis. He uses a dataset based on a nationally representative sample of British establishments[11], and analyses the core relationship between training decisions and high-performance work practices, finding that firms implementing a set or bundle of such practices exhibit stronger intensity in training. The main hypothesis tested is the (joint) effect of high-performance practices on training intensity. Another hypothesis tested is that the link between training and new work practices is stronger for those at the upper end of the occupational scale, following a bimodal distribution of training across occupations. A single equation model is estimated, having as dependant variable a proxy for training coverage/intensity. Training is measured by the number of days a worker in a work place receives training in a given year (Incidence), by a coverage index and by an intensity index (time spent in training). New practices included as covariates are quality circle, flexible working, teamwork, and briefing group. The joint variable obtained multiplying the four elements (dummies) is included as well to capture the joint effect. Then a set of control variables, like union presence, age of establishment, level of technology, market openness, sectors, is also added. The analysis of the cross sectional dataset based on 1991 data is limited to the trading sector (647 firms considered in the final analysis). Econometric analysis is based on a standard Tobit model. Main results are that there is strong evidence of a correlation between the adoption of new practices and training. The relationship is especially strong for intensity of training, rather than for coverage[12]. Thus, size effects are present, new practices are

[11] Obtained matching the third British Industrial relations survey and the employer manpower skills practices survey.

[12] The author correctly underlines some main methodological issues, like the necessity to develop a shared set of training measures, the need to be clearer and more accurate in measuring HRM practices and, finally, the need to use either longitudinal dataset or hybrid cross sectional dataset with lagged variables, in order to disentangle the causal relationship between training and its driving forces.

As far as the latter point is concerned, Caroli et al. (2001) analyse both theoretically and empirically, on French establishment-level data, the relationship between workforce skill and new work practices. Since both training, as kill accumulation, and new work practices may be considered as innovative factors related to organizational change, it is difficult to assess the eventual causal relationship. As an example of the possible different research perspective on the link between new work practices and skill accumulation (training), they estimate a probit model with dependant variable equal to one if net employment has increased in establishment I for skill group s, a test on the link between skill accumulation and organizational change is performed. It appears that organizational change leads to downsizing for all categories of workers, but it is more detrimental for the least skilled workers. Other empirical studies have tested such a reduction: OECD (1999) investigates the link skill of the workforce-organizational change, with a result that establishment with flatter hierarchical structures and those that use teamwork are less likely to have low skill requirements for the workforce. Caroli et al present evidence from some French empirical studies that confirm that the introduction of innovative work practices has important implications on the reshaping of the workforce at the expense of the least skilled workers.

A choice made by other author (Huselid, 1995) is to include training among the new work practices, as an eventual explanatory factor of performance (although the objective of the paper is more general and focused on HRM and firm

positively associated to training but on a joint basis, not in isolation, and the effect of new practices is significant for the intensity of training, not for coverage (HRM do not seem to extend the number of workers involved).

Black et al. (1999) use the 1992 UK Small Business Administration Survey for testing two main hypotheses linked to firm size. The first is related to formal training: do economies of scale provide an incentive towards more intensity in training, given the decreasing cost of investing in formal training for large organizations? The second refers to informal training: large organization may experiment more informal training due to the higher opportunity costs of co-workers (managers in that case) in small businesses, with respect to large firms, where multiple workers perform the same job or co-workers are used instead of managers for this type of training. Econometrically speaking, three measures of training are considered as dependant variable: hours per week that training is offered (intensity), duration of each type of training per week, and a mix of training (fraction of training provided by each type of training[13]). For covariates, they use the size of the establishment, the size of the firm, a union presence proxy, and other control variables. The analysis is carried out by using a Tobit model for intensity, an ordered logit for duration and a double limit Tobit[14] for the mix of training. Main results are the following. Regardless the typo of model of training measure implemented, intensity, duration or mix of the two, it emerges that larger establishment and firms provide training that is more formal. Then, larger firms are more likely to train elsewhere in the firm or purchase outside training course. In addition, larger firms tend to provide more informal training by both increasing intensity and duration.

The link between firm size and training performance was also the focus of Black and Lynch (1995), who use unique nationally representative survey of establishments and find that the smallest employers are less likely to provide formal training programs than larger employers are. In addition, regardless of size, the adoption of high performance work systems is correlated to the presence of more intense formal training. Finally, they also find that more investments in physical capital and higher educated workforce are elements that show to be positively correlated with formal training activities, especially in the manufacturing sector. The survey considered private establishments with more than 20 employees, interviewed in 1994. The cross section dataset consists of 1621 establishments in the manufacturing sector and 1324 in the non-manufacturing sector. Overall, 71% of establishments offered some formal training programs, although the coverage is 40% on average. The above results stem from a binary logit analysis based on a sub-sample of

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performance). All the different lines of analysis are useful to add new pieces of information on the complex links between new work practices, training, innovation and performance.
For the sake of transparency, this paper aims at investigating the force which lie behind the adoption and investment in training. As a second step, it will be possible to assess the impact of training and other driving forces on future performance. We are thus aware that each paper studies a specific part of the puzzle.

[13] In other words, the proportion of each type of training as a fraction of total training. In this manner, they see a firm's method of training response to different firm features.

[14] It is worth noting that the use of a two limit Tobit when fractional variable are analysed, limited but continuous over the range 0-1, is justified if censoring occurs at both tails. Following Long (1997, p.212), a common application of this model is when the outcome is a probability or a percentage, but upper censoring is present only if the latent phenomenon is higher or more positive than indicated by the limit 1 or 100%. This is not always true and it is often an ambiguous matter to assess. The point will be addressed also in the part devoted to econometric analysis.

firms, respectively 890 and 624, due to missing values of many explanatory variables. The most relevant explanatory variables taken as driving forces of the probability of investing in formal training are the book value of capital stock, human resource management practices, firm size, and worker characteristics such as education level, tenure, unionisation, skills, etc… although the analysis is a simple binary logit type, the focus of the author is on the analysis of diverse dimensions of formal training, as computer training, teamwork training, basic education, sales and customer service. Results previously described refer to the logit analysis. As far as the analysis of coverage is concerned, they use a Tobit model. The authors note that the driving forces of the proportion of workers trained look somewhat similar to the driving forces of the probability of offering formal training, especially in the manufacturing sector, besides the size effect, which seems less significant. Smaller establishments so not seem less likely to train a higher proportion their workers, condition on training at all. It remains confirmed the main result of the contribution, that is that investments in training are complementary to investments in physical and human capital[15]. This result, which is difficult to assess and generalise given the nature and quality of accounting data about capital, is not always supported by new evidence. Hempell (2003) explores whether investments in ICT and firms sponsored training are complementary, using a German panel data over 1994-1998. He finds that training is a complement to ICT investment but not to other capital good.

A study which also refers to the US environment is by Frazis et al., (1995), who examines the results of a survey conducted by the Bureau of Labour Statistics on formal training and on the job training. The dataset is of 8467 establishments, of which 71% is involved in any type of formal training (although about 97-98% of establishments over 50 employees provide training), with significant difference by sectors. In addition to gathering information on six major categories of training, from basic skill training to workplace training and apprenticeship training, the survey collected detailed information on diverse types of formal job skills training (management skills, computer skills, technical skills, etc..). The primary aim is to obtain detailed information on various typologies of formal training and formal job training[16]. Empirical analysis is carried out by a binary probit model, using as dependant variable the adoption of some specific forms of formal training (any formal training, formal job skills training, training in basic skills) and as explanatory variables factors tenure, new workplace practices, union coverage, worker skills, and establishment size. Findings are that the provision of formal training generally increases with the size of establishments, with the provision of some employer benefits (assistance plans), with the adoption of new work practices and with tenure.

Boheim and Booth (2004) present an empirical study which grounds on a hybrid dataset, partly deriving from a survey on employees and partly from the 1998 UK Workplace employee relations survey targeted on

[15] The same authors (Black and Lynch, 1996) then provide evidence on the effect of training and other driving forces of innovation on firm productivity, finding a relevant role played by human capital and certain types of employer provided training. As we said this is another piece of the puzzle, we will study in the future whenever data on future firm performances are available. The availability on data concerning past and future performance allows to move towards hybrid cross section environment, incorporating also lagged explanatory variables as well as two stage instrumental values approaches, with the aim of mitigating the well known simultaneity bias (Huselid and Becker, 1996; Huselid, 1995).

[16] It is worth noting that nearly 2/3 of establishments that did not provide formal job skill training in 1993 reported that on the job training satisfied needs.

the private sector. The paper analyses the link between workplace union recognition and private sector employer provided training. By using a probit model taking as dependant variable a variable which takes the value of one if a worker received formal training over the last year, the driving forces of the probability that worker participated in employer-provided formal training over the last year are investigated. Results show that union recognition (measure of union presence) is overall positively correlated with the individual training probability for non-manual men and women, but not for manual women. The interpretation is that the presence of a recognised union at the workplace is likely to be associated with features that are leading to training, such as labour turnover, and reduced wage dispersion.

Among the more recent contributions, Beckmann (2002) is one of the main interesting works and it is next to our line of applied analysis, although he focuses on apprentices training only. The author investigates firm-sponsored Apprenticeship training in Germany, using establishment data. Data comes from the largest firm-level data set (Establishment German panel) in Germany, covering both west and east Germany and containing information on business policies and developments, innovations, personnel structures, recruitment, wages, working times, training schemes, industrial relations. The panel for the wave 2000 includes 13931 firms of all sizes and industries. For the applied analysis, the author uses only data for 2000, thus opting for a cross sectional like model. The firm training decision is described as a two-stage process: first, the firm decides whether or not to invest in training then it decides the amount of training. In the paper training intensity is specified as the ratio between apprentices to total employees, which is defined as the dependant variable[17]. The explanatory factors are: some variables proxing capital investments, like indexes of modern and obsolete technologies, firm investment per employee, the number of quits after apprenticeship, the relevancy of short-term contracts among the workforce, the rate of qualified workers, firm profitability (proxied by dummies excellent/deficient, not by real accounting figures[18]). On the econometric ground, he applies probit and Tobit models in order to analyse both the binary choice and the censored phenomenon about training decisions. In addition, he estimates a truncated model accounting only for firms associated to positive training levels. Using a single regression model, the driving forces of training probability and intensity are investigated for both west and East Germany. Main overall results are that, on the one hand, modern technologies, union presence, firm size are significant with positive sign on the coefficient, while short term duration contracts and quits after apprenticeship is significant but with negative sign. It is to remark that performance dummies are not significant, as well as investment per employee. The study also highlights that structural regional differences concerning the economy, in this case west and East Germany, are associated to often striking different results concerning training explanatory factors[19].

[17] The author correctly stresses, " The choice of econometric model depends on whether the analysis should be based on all firms in the sample or whether it should concentrate on the training firms. In the first case, the training intensity is censored at zero, as non-training firms are excluded from the analysis. A suitable method to deal with this problem is to use a truncated regression model (Beckmann, 2002, p.298)".

[18] The availability of high quality data is a crucial problem in all analysis concerning the relationship between innovation and firm performance (Huselid, 1995; Antonioli et al., 2004).

[19] Another study dealing with apprentices training is Wolter (2003). The study is methodologically interesting since it exploits the two-stage selection heckman model for analysing the firm training decision. The data used derived from two surveys conducted in Swiss firms in 2001, embracing 2352 training firms and 2230 non-training firms. The final

Summing up, we may now underline the critical points of the literature which help us figuring out what the more value added research lines are. Critical points refer both to methodological/econometric issues and to data/measurement issues.

On a methodological ground, it is worth noting that the variety of training proxies/indexes used should be compatible with the model specified for the applied investigation. Many of these critical points have already been discussed.

The literature presents two main deficient points concerning econometric methodology which will be addressed below using the information contained in the two datasets: first, most authors cope with the intrinsic censored (at zero) training variable by using a Tobit model. Nevertheless, it relies on specific assumptions and it brings together in one choice two diverse decisions: whether or not to train and how much to invest in training. The exploration of two stage selection models and the comparison with the Tobit model are necessary and worthwhile. The second point is that the literature has left unexplored the eventual correlation between different forms of training. Thus, it is worth exploring such issue by specifying bivariate probit models.

On a quantitative and measurement level, the studies surveyed often possess low quality or not exhaustive information for the vector of explanatory variables. Some studies are deficient with respect to some key independent variables (i.e. performance indexes), other present detailed good quality information, but only for a limited set of explanatory variables. Measurement errors and heterogeneity bias thus may undermine estimates. We believe that our two datasets present partially different, but high quality and comprehensive information about most, if not all, the key explanatory variables highlighted by the theoretical and empirical literature.

As far as this contribution is concerned, the empirical value therefore revolves around the use of different econometric specifications, the investigation of a full set of training indexes and the introduction of a comprehensive set of covariates. This allows a detailed and robust analysis on the most significant determinant variables for firm training.

Comparatively speaking, those two point maybe represent the two main weaknesses we have found in the literature: if one the one hand the use of different training indexes, in order to capture different dimensions of the problem, is more or less widespread, on the other hand the econometric specifications used are often not very consistent with the available data, and, more important, the quality and quantity of such available data is seldom very satisfactorily, increasing the probability of exacerbating both heterogeneity biases (given the limited set of independent and control variables, thus omitting relevant ones) and measurement errors given the imperfect measure concerning key driving forces variables. A particularly rich set of key explanatory variables and simple controls, that should mitigate the selectivity bias, is an important asset for the estimation stage (Boheim and Booth, 2004). We possess good measures of a number of establishment control

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sample consisting of only private firms is composed of 3632 firms: the percentage of training firms after deletion and selection is 29%. Rooting on an empirical cost benefit model for apprentices training, the first stage estimate a probit model with the binomial variable of training, while the second stage estimates an OLS model where the dependant variable is net costs or gross costs of training.

variables and, for Reggio Emilia; we can use good quality past performance data stemming from official accounting data.

It is also true that poor measures of training plague this literature (Fairris and Pedace, 2004). As far as this work is concerned, we start (i) from the analysis of binary choices for (ia) formal and (ib) informal training, then (ii) specific indexes of (iia) formal training coverage and (iib) formal training intensity (here defined not in terms of training hours only, but derived from various collected information referring to the intensity of the investment in training) are investigated. Finally, we study the driving forces of general/specific training, using an index derived from various sources of training information purposefully elicited by detailed questions.

## 6. Empirical analysis: survey-based datasets and Econometric investigation

### *6.1 Case studies*

The applied analysis is based on two studies, one concerning the Province of Ferrara and the other the Province of Reggio Emilia, both located in the Emilia Romagna Region. Emilia Romagna is an area of Italy characterised by a high density of industrial districts (more than 20 following official statistics), a value added per capita (22.738€ per capita in 2000) higher than the Italian average level (17.952€)[20], and with four millions residents it represents the 7% of the Italian population. The two case studies aim at providing new empirical evidence on training driving forces in (partially) different economic environments, nevertheless located within the same Region. Since data on the vector of possible training driving forces partially differ in the two case studies, a larger set of hypothesis can be tested with respect to past studies, offering good insights for current policy given the recentness of data.

Two independent surveys were administered respectively in 2003 and 2002, with the aim of collecting detailed and extensive data. The two surveys differed with respect to the typology of issues addressed. While both questionnaires dealt extensively with training decisions issues (type of training, coverage, etc.), the survey administered to firms in the Ferrara province was biased toward investigating workforce features like skills, tenure, competencies and labour demand characteristics. HRM and industrial relations issues were not addressed. On the other hand, the survey administered in the Province of Reggio Emilia focused on HRM and industrial relations. As far as performance indicators are concerned, original balance sheets are available for Reggio Emilia, while only qualitative trend indicators are elicited in the other case study.

The firms included in the Reggio Emilia universe are classified on the basis of the codex ISTAT-ATECO 91. They are all the manufacturing firms (257) with at least 50 employees and establishments located in the province of Reggio Emilia in the year 2001. The survey is made up of a questionnaire addressed to the management, on five main topics: (a) firm's characteristics; b) employment structure and internal labour markets; c) organisational innovations and human resources management practices, including training

[20] The Region ranks third concerning value added per capita in Italy. As far as the two Provinces are concerned, Reggio Emilia ranks at the seventh place in Italy while Ferrara is at the 48$^{th}$ place. The former is above the regional average while the latter is below, but slightly higher than the national average.

decisions[21]; (b) industrial relations; (c) payment systems. The firms responding to the survey are 199, with a reply ratio of 77,4% of the entire population. Firm distribution by sector and dimension is characterised by limited bias. Interviewees are generally top managers and human resources directors. Balance sheet data are available for 166 firms out of the 199 interviewed, for the period 1995-2001. For a detailed analysis of the data see Pini (2004)[22].

The industrial local system of Reggio Emilia is a complex one, primarily characterised by a high degree of dynamics of the system, with important variations and exceptions to this general feature. Innovation intensity is high and the role of industrial districts (3) is relevant for its current development.

The survey concerning Ferrara has been carried out on industrial and market-service firms with at least 20 employees and establishments in the Province, thus excluding agriculture and public administration. The main source of information for setting up the universe of firm was the dataset acquired from the local Chamber of Commerce. We identified 436 firms, which were disaggregated by sectors (metalwork, market services and other industries: textile-wearing articles, food products, chemical products, engineering and energy and other manufacturing products) and size (20-49, 50-99 and more than 99 employees, corresponding to small, medium and large size firms as far as this paper is concerned[23]). Building on those 436 firms (the universe), a random sample of 250 firms was selected (57% of the universe). As far as size is concerned, we decided to determine it by firm and not by local units, for two reasons. First, it is plausible to assume that human resource management practices reflect the organisational complexity of the firm and are top down driven: from the firm to local units; secondly, the adoption of local units as statistical units would have implied a bias towards firms with more than one local unit in the territory, although occupational strategies are often, if not always, centralized at firm level. Data were collected during February and March 2003 by direct interviews at either the central offices or local establishment offices of the firm. We ended up with 243 filled questionnaires, which constitute the final information database used for the applied analysis. It was divided into 5 sections: firm structural characteristics; the stock of occupation, disaggregated by education level, contract typology, tenure, positions within the firm; occupational flows; training strategies. Stock data refer to 31.12.02, flow data to the 3 years period 2000-2002. For a full detailed analysis of the Ferrara dataset refer to Crudeli, Guidetti and Mazzanti (2004). It is worth noting that the Ferrara territory is quite different in terms of economic activity. The territory does not witness the presence of industrial districts, the agricultural sector is more important than elsewhere in the Region; all in all, the industrial activity is weaker as well as the economic performance of the Province, which is also associated to higher unemployment rates.

[21] The shortcoming of the definition of a set of best practices in an aprioristic way is the insufficient degree of analysis of the process steering organizational evolution. Our database on industrial firms in Reggio Emilia does not suffer from such limitations since it cover a high number of items connected with new work practices, training processes, firm hierarchical structure, internal labour markets, and industrial relations. Investigation concerning the determinant of organisational innovation and the diffusion of best work practices gains relevance when the process of organisation evolution receives closer inspection.

[22] Chapters 2 and 3.

[23] We excluded seasonal employees from the analysis.

A test of the good degree of representativeness for the two surveys comes from the following test taken from Cochran (1977), which allows determining, given the universe and the final sample, in addition to a given level of probability, the maximum error we are experimenting.

The formula is:

$n = N/[(N-1)teta^2+1];$

where n is the sample, N the universe, and theta the error we face (i.e.. 0,05, 0,04).

As far as Ferrara is concerned, n=243 and N=436, thus the associated "sample error" is 0,043. Values below 0,05 are generally considered as good. As far as Reggio Emilia is concerned, n=166 and the universe is 256; the sampling error is equal to 0,046 (though in this case 166 is not a real statistical sample but the number of firms with final interviews and balance sheets).

*6.2 Hypotheses tested*

On the basis of the theoretical framework two different sets of hypotheses are tested. Since the two datasets include different data, the hypotheses will not be tested on both.

*6.2.1 Set of hypotheses 1. Complementarity among training practices*

The analysis is articulated into two diverse ways to conceive complementarity among training practices:

H1.a) Complementarity among training practices in general. Data used in this paper allow singling out two diverse types of training. The first one ranks training according to the distinction between formal and informal. The second one ranks training according to its degree of generality/specificity.

H1.b) Complementarity among training practices involving different occupational groups. In this the hypothesis of complementary relationship between training practices involving newly hired and employees will be investigated.

*6.2.2 Set of hypotheses 2. The relevance of firm's structural variables as determinants of training policies.*

Particularly the analysis takes into consideration three types of variables:

H2.a) firm's structural variables. As stated in the theoretical section, a positive association is expected to hold between training provision and firm size. In addition to that, sector, intended as a proxy of capital equipment, is expected to affect the firm's choice as far as training is concerned.

H2.b) Practices of human resource management (HRM). The empirical section of the paper deals with the effect of innovative HRM practices such as task rotation, quality circle, total quality management and team work. In addition to that, data concerning the adoption of just-in-time are available. There is no reason to believe that each of them is associated to a specific form of training. The combination of size, features of internal labour market and HRM can give rise to a framework of complementary relationships, which make the analysis of the effects on training of each single practice extremely problematic. Furthermore, as maintained in the management literature (Ricart and Portales, 2001), different practices can hinder each

other. Consequently, these practices can also substitute and not only reinforce each other. For this reason, no a priori association between training and HRM can be expected to hold.

Innovative-oriented labour demand should also be associated to higher training efforts. Thus, firm whose hiring motivations are the recruiting of workers with new competencies and of workers complementary to the introduction of new products and processes are expected to train more.

H2.c) Variables connected to internal labour market. In this respect, the empirical section analyses three hypothesis. Firstly, a positive association between training provision and flows of short-term labour contract is expected to hold. Secondly, training provision and the stock of short-term employees should be negatively associated. Lastly, the analysis of the link between tenure and training is investigated. Since high tenure is a necessary but not sufficient condition for the employer to finance training (see paragraph 4), a positive link between tenure and training does not need to hold.

H2.d) Variables measuring the performance of the firm. As to the relation between training and any indicator of economic performance, things can be rather complicated. Provision of training gives rise to increase in both the level of labour productivity and firm's profitability. In its turn, the increase in profitability favours the accumulation of resources aimed at financing training for employees. For this reason, it is difficult to point out a causal link between any measure of provision of training and any indicator of performance of the firm. Anyway, a positive association between these two variables is firmly rooted in any approach to the analysis of training in firms. Problems arise when, from empirical evidence, this association turns out to be weak or, even worse, nil. In that case, the only sensible conclusion is that firms do not benefit from training, i.e.: training is irrelevant to their economic performance. This would mean that, if training is actually provided, then it is basically used as a tool to favour the match between the characteristics of the workforce and the organisation of work and not to strengthen and to widen the range of the skills used in production. Failure to find a meaningful association between training and performance might indicate a poor quality of labour demand. Of course, this is a quite strong conclusion, which should be also supported by further empirical evidence, concerning the quality of labour demand. In this circumstance, the datasets used for this paper provide a measure of the propensity of the firm to produce for the market, and not as subcontractor, and to compete on international product markets. Therefore, for testing the importance of training for a firm, it can be useful to study the degree of association between training and the propensity of the firm to produce for both the domestic and the international market.

*6.3 Methodological issues*

The primary aim of the applied investigation is to assess the relationship between training in firm and its driving forces using different synthetic index of the main forms of training activities as dependent variables. The estimated regression is a reduced form as it follows:

$$\textit{Training index}_i = \beta_{0i} + \beta_{1i}[\textit{firm characteristics}] + \beta_{2i}\,[\textit{internal labour market factors}] + \beta_{3i}[\textit{workforce features}] + \beta_{4i}[\textit{Performances}] + \beta_{5i}[\text{HRM/Innovation practices}] + \varepsilon_i$$

Tables 1 and 2 sketch the training-related dependant variables used for thee econometric analysis. It is worth noting that the dataset mainly concerns cross-sectional data. Thus, the causality links between variables are to be intended generally as "weak links": the objective is not to test cause-effect relationships, but to assess the significance and intensity of relationships between those variables. Only for Reggio Emilia, we may exploit lagged information concerning firm performances (data for the period 1995-2001) and other organizational innovation (trend data for 1998-2001), as potential driving forces of training indexes calculated on 2001 related data. As far as the analysis on Ferrara Province is concerned, data are cross-sectional [24, 25].

The potential driving forces of training here analysed compounds firm structural characteristics, labour demand dynamics, human resource management practices, workforce features, and firm performances[26]. The full set of explanatory variables used is presented for the two datasets in tables 3 and 4.

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[24] We here remark that although a panel setting is often a fruitful framework for investigating dynamic relationships (even a 2 years panel which allows a study on differences), also an "adjusted" cross section dataset, that is cross section frameworks integrated with lagged variables, may lead to clean and robust estimates (Huselid, 1995). The pros and cons of using panel in such settings are then well described by Huselid and Becker (1996), who point out: "the problem is 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" (p.403), and "panel data offer an opportunity for a cleaner estimate of the true effects of HR strategies", but "the risk is that panel estimates may be subject to even greater attenuation from measurement error than cross sectional estimates, and one is actually worse off using the panel estimates" (p.404), finally "Rather than relying on such assumptions, future research should devote more attention to the identification and measurement of these other management practices so that they can be explicitly controlled in the estimation method" [..] We believe that much progress can be made by well-executed industry studies that utilize both conventional measures of firm performance and new work on the economic contribution of business units to overall firm performance" (p.420). According to this, we agree that it exists a trade off between the collection of detailed panel data and the collection of good qualitative data on most HRM practices, most of which do not present strong observed variability over time. Thus, our effort was mainly devoted to collecting high-quality and detailed cross sectional data, integrating HRM data with balance accounts data as far as possible.

[25] Quoting Brynjolfsson et al. (2002, p.20): "If instead the omitted variables are time-invariant factors that are specific to individual firms, they can be removed by estimating difference equations that remove the contribution of firm-specific effects. […] However, these types of techniques also remove at least some of the true organizational practices differ across firms and are relatively slow changing". As an example, they have created a full 11 years panel of more than 400 US large firms, but with only two cross section observations for organizational practices (1996, 1994). Given the problem of quasi-fixed factors in a panel environment when a FEM is used since, preferred following a Hausman type test, they tackle it by interacting organisational practices with employment. Econometrically speaking, this is a way to address the problem in a panel environment; nevertheless, interactive variables may capture slightly different effects than the sole organisational innovation impact. At least a regression where the only "instrumental variable" is used as covariate without organisational innovation should be used as a term of comparison.

[26] Among firm performance, the literature underlines the pivotal role of productivity. We are aware that the main target of the analysis on training, HRM and performance is to assess the impact of all relevant inputs (man made and human capital, HRM, training activities) on different performance indexes. As far as our work is concerned, the focus is on the impact of past performances on current training decisions. A further step is certainly to study the effect of training decisions on performances like profitability and productivity. As pointed out by Storey (2004), empirical evidence is still scarce and ambiguous for both nodes of the training-performance link. It would have been possible to investigate the training → productivity (performance) link. Nevertheless, we decided to avoid such estimation in a pure cross section environment with only spatial heterogeneity and without temporal lags, postponing the analysis when new data on performances are available.

As a reference, Zwick (2002) presents evidence on the productivity effect of training investments (training intensity and different forms of training), exploiting the information of an establishment panel for the year 1997-2000 and adopting a production function approach. He finds that higher training coverage is a significant explanatory factor of productivity even with a limited 2 years lag (the paper concentrates with the influence of training in 1997 on productivity in the years 1998 and 1999. findings are that formal internal and external courses have the highest positive impact on productivity, quality circles have a smaller impact, while training on the job and job rotation do not affect productivity. Technically, the author first estimates the 1997 cross section regressions for training by means of a binary probit and in

The availability of an extended dataset on firm characteristics allows controlling for many relevant factors that may explain training decisions, reducing the possible distortions arising in a cross-sectional environment. As we said, the two surveys were aimed at collecting a partially different set of information: for Reggio Emilia, the focus is biased towards Human resource management practices, industrial relations and innovation dynamics; in addition yearly accounting data for most firms are available since 1995. The Ferrara case study is instead more focused on labour demand features and dynamics and on workforce characteristics[27].

We use as dependant variables in both cases different proxies for training: (i) total coverage, (ii) general/specific training content[28] and (iii) indexes of training activities adoption[29]. We focus both on formal and informal training, also analysing the eventual correlation between the two forms of training investment. In the case of proved correlation, the use of a single equation model is in fact not justified.

For the Reggio Emilia analysis, we use different training indexes at year 2001 as dependant variables, explanatory factors referring to the period 1998-2001and average performance indexes for the period 1995-2001. Thus, while the analysis is of a cross section type, we set into the model some temporal distances between variables with the aim of mitigating the simultaneity bias typical of dataset strongly affected by endogeneity of crucial explanatory factors.

For the Province of Ferrara, the analysis is instead a typical cross section exercise, based on average data for the period 2000-2002 in case of flow measures and at the date 31.12.2002 for stock measures. More information is available nevertheless for factors like tenure, skills, and other labour demand characteristics and labour demand motivations[30]. Given the structural difference in terms of data, the two analyses are not *directly* comparable: different driving forces and implications are then derived for the two provincial cases. Nevertheless, carefully considering the structural difference concerning the two economic and industrial

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another case by a Tobit model when training coverage is analysed. Firm size, workforce skill, union presence, ICT and technical investments are detected as explanatory factors. Then, two analyses are carried out to investigate the training → productivity link: an OLS model with lagged impact of 1997 training on productivity in 1998 and 1999, and a fixed effect panel model (1997-1999), adopted in order to correct for time invariant heterogeneity, leading to the result described above. The panel estimation is two-stage type since the focus is on estimating the residuals of the production function as in Black and Lynch (2001).
Another interesting work is by O'Connell (1999) who studies the impact on productivity growth of both general and specific training. This is of interest to us given our focus on training indexes related to "specificity". The author finds out that while general training has a positive significant effect on productivity, no effect is observable for specific training. The positive impact remains significant when additional control variables concerning work organisational are introduced, although that impact varies with the level of capital investment. The analysis grounds on 654 firm level survey questionnaires dated back to 1993, eliciting information on training coverage, training spending and training typology. In order to study the effect of training on productivity growth, a follow up survey was carried out in 1997. The finals sample of firms is 215: taking variables in differences, OLS estimation is then applied within a production function approach (where training indexes are included as explanatory factors directly into the production function together with usual inputs and controls).

[27] The diversity between the two datasets concerns more the realm of explanatory variables than the set of training indexes. Coverage, adoption and general/specificity training indexes for training are obtained in both cases.

[28] Assigning a specific training weight to each training activity adopted.

[29] Thus synthesising all the relevant information concerning the different typologies of formal and informal training adopted. In a certain sense, our index captures how widespread training is (by type); the index takes the value of one if a firm adopts all formal and informal activities.

[30] The questionnaire was not set for collecting information on organisational and technological innovations.

frameworks, we may attempt to bring together the main results, with the purpose of sketching what similarities and differences emerge in terms of training driving forces.

We now move to the statistical and econometric analysis. Before starting the regression analysis, a preliminary selection is carried out by studying the full correlation matrix concerning covariates. A threshold was fixed at 0.35: above this value of correlation, variables were discarded, keeping the one with the least serious correlation problem overall. The first selection is aimed at reducing the collinearity problem. Then, variables showing a coefficient with associated a t ratio below the value of 1.282 (20%) are dropped at each stage of the econometric analysis. The backward stepwise method may result more consistent with the different biases arising when variables relevant variables are omitted or irrelevant ones are included: in the former case coefficient are biased, in the second case variances are inflated by using too much information and estimates are less efficient. Thus, the second problem, which we may encounter here in over fitting specifications starting from a conceptual model, is less severe and can be resolved by deleting non-significant variables.

Econometrically speaking, we use different specifications. Since indexes of training range between zero and one, we deal with the well-known issue of *fractional variables* (Papke and Woolridge, 1996). It is possible to affirm, building up on the empirical contributions which have dealt with such index variables (see, among the others, Antonioli et al., 2004; Mazzanti et al., 2004; Cellini et al., 2000; Fronstin and Holtmann, 1994), and on the empirical application concerning training which we have discussed above, that there is not an "optimal" econometric model for studying fractional variables. Although OLS estimates may suffer from the same distortions characterising binary variables, the often used one limit or two-limits Tobit models (Rosett and Nelson, 1975; Tobin, 1958) are not a panacea, and often it is possible to verify that estimates deriving from OLS and Tobits[31] do not differ significantly as far as coefficient absolute and relative significances are concerned (see also Pindyck and Rubinfeld, 1991)[32]. Since the aim in this literature is not the estimation of elasticity, this may be considered a less severe flaw.

We then decided to use different specifications, consequently comparing estimates deriving from OLS regressions, corrected for heteroskedasticity, and Tobit maximum likelihood models[33]. Furthermore, given

[31] It was noted that the set of explanatory variables presented in tables 3 and 4 derives from the analysis of a full correlation matrix concerning all explanatory variables initially considered as potential driving forces. This preliminary selection is relevant since the aim is to analyse the driving forces of training by exploiting a rich *but* selected vector of explanatory and control factors, mitigating eventual multi-collinearity problems deriving from too high correlations. This problem is often not considered or made explicit in most papers found in the literature.

[32] In the present case, since training indexes present many observations at zero and one, we are prevented from tackling the problem by transforming the dependant variable (y) using a log-function (log[y/1-y]), achieving a new variable which clearly varies over a non limited space (Papke-Woolridge, 1996). Data losses would be substantial if we dropped limit observations. When fractional variables are used and limit observations do not constitute a large share of observations, the above transformation is nevertheless a useful method for comparing and checking different specifications.

[33] Both one limit and two limits Tobit are considered. Given the limited but continuous nature of index variables, a two limits Tobit is justified only if double censoring is deemed to characterise data (Long, 1997). A 2 limit Tobit requires censoring in both tails, not just finite limits. The point is often not well addressed in the literature. As a rule, the correct model is generally dictated by the theory and the specific application.
In any case, strong differences between the two Tobit specifications did not arise in all cases analysed. We stress again that a general rule of thumb, when facing fractional variables without a clear model dictated by economic theory, is to

the large number of firms not involved in both formal and informal training, we check the presence of sample selection by moving from a Tobit to a two-stage Heckman model[34] (probit plus OLS). The correlation between formal and informal training, as said, is also tested by means of a bivariate probit model[35]. A single equation regression model is used in all cases for the estimation of a reduced form for firm investment/effort in training.

Summing up, we proceed as follows in the analysis of the two case studies. We first carry out simple probit regressions for formal and informal training, and for employee and new hired workers, as a preliminary analysis. We nevertheless also investigate the hypothesis of correlation between different training forms by using a bivariate probit model. Secondly, the driving forces of both training adoption and training coverage indexes are analysed. Finally, regressions using an index of general/specific training are studied. The next two paragraphs present and discuss econometric results for the two datasets. Tables 1 and 2 presents dependant variables for the two case studies; tables 3 and 4 the set of independent variables considered after filtering by means of correlation analysis. Finally tables 5 and 6 present econometric results for the main significant specifications.

*6.4 Econometric investigation*

*6.4.1 The Province of Ferrara: training, workforce features and labour demand*

As a preliminary analysis, we investigate training decisions by using formal and informal training binary indexes. The related probit analysis for any training, formal training and informal training leads to the following results. It shows a positive coefficient associated to larger firms and the service sector. Size and sectoral dummies are highly significant. Further, the share of foreign market revenue is also positively associated to training activities. As far as the labour demand features are concerned, the employment creation driven by new product and processes and new workers competencies is associated to a higher probability of adopting training practices. Training is thus linked to innovative decisions in employment dynamics. Finally, the variable capturing the flow of atypical workers is positively associated to training, while the stock of atypical workers is not.

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compare outcomes and performances of different econometric models – OLS, tobits, two-stages - and different specifications, rather than relying on a single model.

[34] For a useful discussion on the Heckman selection corrected estimation see Kluve and Schmidt (2002), who, though dealing with the issue of ex post program evaluation, stress another useful point: "Most of the evaluation literature has focussed on advances in methodology, but even the most sophisticated estimators will fail if applied to poor data, and one should not forget that good informative data are essential for meaningful evaluation" (p.430). This is crucial for the empirical literature on performance, innovation, and training, where both methodological and data issues are key factors for achieving robust results from the specified empirical models. As far as training empirical analysis is concerned, we also refer to Storey (2004), who stresses in his conclusion the need to take into account selection biases.

[35] Two recent applications of the model within the field of labour economics are Battu et al. (2002) and Xiao-Tsiang (2001), which study the correlation between informal training and adult education, for applications of the bivariate model. In brief, the bivariate probit is employed when one wants to tests the hypothesis of inter-relationship between two key variables. In other words, under the null hypothesis that the covariance between the error terms of the two distinct regressions is zero, the bivariate probit consists of two independent regressions. If the null hypothesis is rejected, we face a joint co-determination of the two investigated variables. In statistical terms, the errors of the two equations are related (a part of the errors term is common to both).
For example, formal and informal training may have interdependent impact one each other in terms of firm investment decisions.

Independent probit regressions do not take into account the eventual correlation between, for instance, formal and informal training. Therefore, a bivariate probit analysis is attempted, in order to test the above-mentioned hypothesis of correlation. The important result is that the null hypothesis of no correlation between the two training practices is highly rejected by data[36]. A joint distribution is therefore more robust. The point is often not underlined in the literature, though it is extremely relevant for analysing firm training decisions, wherein joint investments and complementarities between different practices are a key issue. Table 5 presents the results, which mainly confirm what previously said. Nevertheless, the bundle of training driving forces is not the same for formal and informal training[37]. Private and larger firms, and service sector firms are more likely to provide informal training, but only size and sectoral factors arise for formal training. Foreign revenue is quiet significant for informal but not for formal training, while the opposite emerges for tenure, which appears linked to a significant negative coefficient in the informal training regression. The firms hiring workers with motivations associated to new competencies are more likely to provide both forms of training. We stress the non-significant role of performance variables; only past productivity trends are positively linked to training but do not overcome the minimum significance threshold.

In order to provide a more significant analysis of training driving forces we move to present and discuss results for other indexes of training we derived from the information collected. We remark that all indexes vary between zero and one.

First, an index of training "intensity" in terms of the number of training activities adopted by firms is specified as dependant variable. The index takes the value of one when a firm adopts all informal and formal training activities. Results are shown in table 5 and we may sum up as it follows. Highly significant and positive coefficients emerge associated to large and service sector firms. Other positive significant effects are associated to "new competencies" and new product/processes oriented labour demand, skill labour force intensity and the flow of atypical workers. On the other hand, the stock of atypical workers emerges with a less significant but negative coefficient.

It is also worth noting that, while past mean performance indexes confirm not to be significant explanatory factors the trend concerning productivity emerges as a driving force for firm training: firms experiencing higher productivity trends over 2000-2002 are more likely to adopt a wider range of training practices[38].

Secondly, we focus on two indexes capturing only formal training activities. Results are always presented in the final column of table 5.

A first index captures various dynamics of formal training over the 2000-2002 period, from financial resources invested to coverage and hours devoted to training. We decided to summarise those information in a synthetic index since the elicited information is of qualitative nature (trends). The key role of size and sectoral factors is confirmed. The message is very clear: large and service sector firms do invest more

[36] As the joint log-likelihood is the sum of the two likelihoods, we can compare the independent probit and the bivariate probit likelihood using a simple LR test. All regressions are estimated by using LIMDEP 7.0.
[37] The model is identified if the same variables are included in both regressions.
[38] For this index, a Tobit analysis lead to similar results; estimates are OLS corrected for heteroskedasticity. A two stage heckman-like regression proves that a sample selection is may be present but weak. In fact, the inverted mill ratio coefficient does not overcome the 90% significance level (t ratio=1,258).

resources in formal training. Weaker but still significant factors emerging from this regression are the skill intensity, the flow share of atypical workers and a new competence content characterising labour demand. Linking to what said above for past productivity effect, in this case the coefficient associated to the productivity index does not overcome the 90% significance level, although has a positive sign attached.

A second index captures instead the *coverage* for formal training[39]. The same size and sectoral effects outlined above are confirmed. A different outcome is associated to skill intensity, which is here highly statically significant. Productivity trends also explain coverage levels for formal training. Finally, a negative sign here emerges for the variable capturing net employment creation (low significance nonetheless)[40].

Finally, we focus on the index capturing the generality/specificity content of training activities. Size and sectoral effects are crucial and dominate other explanatory factors: large and medium size firms, service and metalwork firms do provide more general training. Other significant factors emerging from the econometric exercise are the flow of atypical workers and a "new competencies" oriented labour demand (positive signs); a negative sign is instead linked to labour demand driven by market demand expansion. It is worth noting that a very significant positive coefficient is associated to a variable capturing the trend of informal training in terms of workers involved and hours per worker provided, when included as additional explanatory variables. Once again, the idea of complementarity among training practices emerges neatly[41].

As an additional analysis, we restricted the dataset to the sole 170 firms providing training, in order to analyse eventual different results and to include new driving forces related to the motivations of training provision (a set of dummy variables). Results (not presented here) show that among the main driving forces of formal training, using different proxies, are the motivations associated to "professional roles", specific mansion" and educational level, while the duration of contract and hierarchical position within the firm do not result being relevant driving motivations for firms. The outcome may reinforce the counterintuitive irrelevant role played by tenure in this case (recalling that long-term tenure was defined over 5 years), and the predominance of skill effect in explaining training at the level of workforce characteristics.

Summing up results for the first case study here presented and comparing to the set of hypothesis we find that (i) strong size effects emerge significant. The smallest firms are less likely to invest in training in all its specifications. A sector-oriented cut also highlights that services firms and, to a lesser extent, manufacturing

[39] Results derive from OLS regression corrected for heteroskedasticity. The two stage Heckman-like analysis is not associated to significant outcomes. Sample selection between training and non-training firms seems do not generally occur. A possible explanation may be related to the fact that eliciting information on training by surveys concerns a certain degree of vagueness on what is considered to be training, mainly for small/medium firms (what is the threshold for defining "training" a specific formal or informal HRM activity?). If this is true, the revealed zero values could be in reality one values; in other words, training as a whole could be underestimated when discrete training variables are observed, although it remains true that as far as training intensity is concerned the elicitation problem is less problematic, as the variable lies on a continuous ground.

[40] Coverage indexes were available also for informal training. The same size and sectoral factors emerge. As for the probit analysis, private firms seem to be more involved in informal training. Past productivity keeps its positive and significant coefficient. Two new labour demand characteristics (motivations) now arise among significant explanatory factors of informal training coverage: market demand expansion and substitution of workers. The bundles of explanatory factors for informal and formal training seem to suggest and confirm that a more innovative behaviour is positively associated to the provision of higher levels of formal training.

[41] For the Specificity index, a Tobit analysis lead to similar results; estimates are OLS corrected for heteroskedasticity. A two stage Heckman-like regression does not prove to be robust for this index.

firms do train more. The need of acquiring new competencies and of introducing techno-innovations are two factors, concerning labour demand, positively and strongly associated to training adoption; (ii) While the share of contractual flexibility in terms of flow enhances the probability of adopting training practices, the share in terms of stock decreases this probability; (iii) among firm performances, only productivity emerges as significantly and positively linked to training adoption; (iv) formal and informal training adoption result being correlated.

Building on the positive effect of productivity performances[42] on training, we may note that a widening gap may distinguish small, non-innovative firms from larger and more innovative-oriented firms. Considering also the positive role associated to the skill content of the workforce, the risk is one of observing a dynamic sharp and widening gap between (admittedly few) high-performance high-innovative firms and (many) low performance low innovative oriented ones.

*6.4.2 The Province of Reggio Emilia: training, innovations, workforce features and past performances*

The analysis of training efforts by firms for the dataset concerning Reggio Emilia begins with two probit regressions concerning the provision of (formal and informal) training to employees and to new hired workers[43]. This preliminary analysis highlights the positive role played by size (medium-large firms in the Reggio Emilia survey[44]), by labour flexibility and by the adoption of organisational innovation (see table 6 for a full definition of variables). A lesser important role, though still significant, is played by past productivity performances (a real account data indicator) and process innovation adoptions.

As above, we investigate the correlation between different training practices (employees and new hired here) by means of bivariate probit model, which specifies a joint distribution. The null hypothesis of no correlation is rejected. Results show (table 6) that size factors are more important for new hired training than for employee's training. Then, while education/skill workforce content explains both forms of training, labour flexibility is only crucial in explaining employee training. Organisational innovation is explaining both forms, although it is statistically not highly significant. Among innovation practices, task rotation plays the main and only role for new hired, while TQM is the only significant factor in employee regressions. Finally, the variable capturing industrial relations dynamics arises with a medium level significance if included, slightly lowering the effect of organisational innovations (this is explained maybe by the positive correlation between the two variables).

Those are the outcomes for the preliminary probit analysis. Three further training indexes are specified and studied: the index concerning the variety of training practices[45] adopted by firms, the index related to

[42] It is worth noting that productivity is indirectly elicited from firm's responses, by using revenue and occupation trends related answers.

[43] We recall that there is no aim to compare results for the two provinces, given the different sets of dependant variables and covariates used for the econometric analysis, deriving from two different surveys. We decided not to test the correlation between formal and informal training in this case given that informal training data only concerned co-workers training.

[44] We also recall that all firms belong to the manufacturing sector. Pavitt indicators are used as sectoral control dummies.

[45] As far as Reggio Emilia is concerned, training indexes refer to the complete set of formal and informal practices.

formal training coverage and an index capturing the generality/specificity content of training. Results, presented in table 6, are summed up below.

For the first of the three listed dependant variables, the most significant and positive explanatory factors are: size (large and medium-large firms), cooperative-like firm[46], process innovation, labour flexibility, the share of manual workers and organisational innovation. Industrial relations enter as a positive factor but statistically weak. We note that among organisational innovations, the leading factor is TQM, followed by JIT and QC. The other two elements considered are not significant. Past performances indicators do not influence the "intensity" in training practices adoption (see Storey, 2004)[47]. Among variables entering the regression with a negative sign on the coefficient, we note hierarchical levels on functions and plant flexibility.

Secondly, formal training coverage is mainly explained by size effect (medium size firms), cooperative-like firms, workforce education level, share of manual workers, process innovation intensity, workers involvement in management initiatives and organisational innovation (TQM as only significant driving force). Together with workers involvement, also past productivity levels emerge as being positively associated to training performances for this second index considered. Other past performances indicators included, as investments per employee, net profit/revenue, labour cost per employee, and gross wages, never reach a minimum significant threshold, for all the specified training indexes[48]. Like above, explanatory factors linked to a negative and significant coefficient are plant flexibility, hierarchical levels and the share of revenue originating from the final market[49].

As a further exercise, we study coverage indexes for different worker groups: non-manual workers, manual workers, both skilled and unskilled. Coverage figures are weighted for the share of each group of workers in setting up the new indexes[50]. Table 6 (cont) shows results for coverage. This more detailed analysis on coverage indexes confirms on the one hand outcomes we already commented but also show further insights. Size effects are now more ambiguous: medium and medium-large firms explain size effects (with a negative surprising sign for non manual workers) and the large-firm dummy do not arise significant. Further, Education plays a positive role for non-manual, while labour flexibility is negatively affecting training for manual workers. Concerning HRM practices, TQM confirms its pivotal role for both manual and non-manual; while for non-manual skilled workers alone practices seem to be significant only their

[46] For this first training index, the two-stage heckman analysis does not lead to meaningful results.
[47] It is worth noting that when considering the same index only for new hired workers, slightly different results emerge: while size effect are present as before, labour intensive and private firms seem less likely to provide different typologies of training. in addition, organisational innovation is not among the significant factors.
[48] Though not significant, Net profits are associated to a positive coefficient, as expected. We remark that even if productivity emerges as the key driving factor, productivity is positively correlated to all the other performance indicators, which we included one at a time.
[49] Tobit estimates do not differ. While the Heckman model is associated to higher significance level of the inverse mill ratio covariate, the sample selection is weak; we then do not comment results.
[50] In this case, given the absence of limit values at one, we transformed the fractional index variable in a censored at zero one adopting the transformation y/1-y; estimates by OLS and Tobit show that results do not change. The transformation by using log (y/(1-y)) suggested by Papke and Woolridge (1996) is prevented given the bulk of zero values. When fractional variables are used and limit observations do not constitute a large share of observations, the above transformation is nevertheless a useful method for coping with index variables.

sum/intensity effect is considered. Interestingly, process innovation and productivity are positively linked to training for non-manual total and non-manual skilled alone samples. To finish, the analysis on workforce sub-samples is the only case where wages seem to exert an effect on training: this effect is negative but low for non-manual and highly significant and positive for skilled manual workers.

The third and final index concerns the general-specific content of training. The size effect is here dominant, since all three dummies are very significant. Private and labour intensive firms are instead less likely to provide general training, while cooperative firms are still associated to a positive effect on training. As far as other driving forces are concerned, we note the very significant impact of education level (skills), and the positive while less significant role exerted by labour flexibility, organisational innovation[51], technological innovation and employee formal evaluation. It is worth noting that while a Tobit analysis does not change the outcome, here the two stage Heckman-like regression leads to results that are more robust[52]. Building on the selection model, a slightly different picture arises: while size effects still dominates, workforce skill content and technological innovation are the only other two key driving forces for general training. The impact of organisational innovation is weak and a detailed analysis shows a mixed outcome: task rotation exerts a positive effect while team working, though not overcoming the 90% threshold, seems to produce a negative effect on general training provision.

The database used for this second case study opens other directions of analysis and discussion. First, it confirms the pivotal role played by HRM practices, more specifically high-performance organisational innovations, already suggested by past works. Those practices arise as a complement for training activities. Nevertheless, we further note that, among the five practices here considered, mainly TQM and to a lesser extent task rotation seem to play a key role. It is worth noting that in Reggio Emilia TQM practices are widespread in large and even small-medium size firms, since the latter are also characterised by a high degree of organization complexity and they face fierce market competition in product innovation. TQM is thus a key element of firm strategies toward market demand requirements (i.e. product quality) and its dominant role in driving HRM and high-performance dynamics is thus plausible. The task rotation effect is more intuitive. Among HRM practices, the task/job rotation is associated to higher training efforts.

The question on whether it is meaningful to consider specific separated effects, or a joint index of higher-performance practices intensity to capture the main relationships is open. For this purpose we have generated HRM interaction variables, grouping practices in bundles of two and three. Interaction variables take the value 1 when all the two/three practices are adopted. The estimated coefficients show that the sign of the relationship between these variables and training differ. Therefore, the effect of HRM on training depends on the specific practices adopted and, especially, on how these are combined. The synthetic index captures a comprehensive effect that indicates how the positive effects of HRM factors on training outweigh negative effects.

[51] Nevertheless, TQM is the only significant factor; for this index the explanatory power of organisational innovation is definitely lower.
[52] The t ratio of the inverted mill ratio ranges from 1.5 to 1.7 in different specifications.

Size effects confirm to be relevant: larger firms –with more than 100 employees and more- are more involved in training and provide more general training. The size effect is reinforced by the negative and positive signs associated respectively to private and cooperative firms[53]. Among other variables considered, we observe a minor role played by market-related features, while a negative association is found between training and both hierarchical levels and plant flexibility. Labour flexibility, here captured by a general synthetic index, which includes various elements, exerts a positive impact on training. Past productivity arises as a positive determinant of training for some training indexes, while net profits, though linked to positive coefficients, never reaches statistical significance. The positive link training-productivity is explained, recalling what said above for the first case study, by a strong innovative dynamic in the Province. Most firms are experiencing a virtuous evolution of performances characterised by increasing productivity, increasing adoption of high-performance practices and higher innovation. The different role of labour flexibility, here positive driving force, is thus consistent with this perspective.

## 7. Conclusions

We conclude summarising the results of our applied investigation in comparison with the set of hypothesis outlined in paragraph 6.2 (see also table 7 for a qualitative summary).

H1.a and H1.b) Considering different training activities, we found a robust correlation both between formal and informal training and between training for employees and training for newly hired. The set of significant driving forces associated to each form of training may be different. We thus recommend analysing the correlation between different training activities, as single (probit) regressions could be not always meaningful.

H2.a) As far as the structural characteristics of firms are concerned, a clear size effect in both local environments can be observed. This outcome confirms the evidence that firm size is a key factor for both techno-organisational innovation and high-performance practices, including training. This supports the shared view that major national and local policy efforts should be thus focussed toward providing incentives to size-enlargement and/or networking/grouping strategies of Italian firms. Market variables, such as the share of revenue linked to foreign markets and to the final market, although usually associated to higher patterns of technological innovations, seem to play here a minor role: size effects dominate in terms of "structural" explanatory factors in this multi-variable analysis.

H2.b) Training is positively associated to other organisational high-performance practices (HRM). When different practices are considered separately, only TQM and task rotation exert a positive impact. This could suggest both that it is the intensity of high-performance practices adoption which is relevant (the number of practices adopted) but also that some HRM exert a greater impact, depending strictly on specific structural conditions. For example, it should be noted that TQM is the most widespread and used practice in

[53] In fact, the "coop" dummy included both cooperative firms and firms belonging to cooperative groups, while the private firm dummy did not include firms belonging to "groups", which is the baseline – thus not estimated- variable.

the majority of Reggio Emilia firms, exerting its influence along the productive process; this is an explanation of its impact.

H2.c) It is worth noting that firms recruiting workers for motivations associated to the necessity of acquiring "new skills" and introducing "process-product innovation" seem to invest more in training. Innovative-like labour demand is thus a driving force for training. As far as workforce characteristics are concerned, we note the predictable key role played by education levels and skills embodied in workers, which positively affect training efforts in both environments. The quality of labour demand and the skill levels embodied in workers matter to explain firm training decisions.

The different effects of flow and stock contract-related flexibility is a key issue, which the present study has addressed. The paper shows that, as expected, a positive association between training provision and the flow of short-term labour contract hols. In addition to that training provision is negatively associated to the stock of short-term employees. As to tenure the association between this variable and training is negative, even though the parameter is not highly significant. As outlined in the theoretical section, this might indicate a poor level of quality of labour demand in terms of trainability.

H2.d) Both case studies show a positive role played by productivity levels. Financial variables, including profits, do not have an impact, maybe highlighting a mis-management by firms at a dynamic level. Interestingly only wages are associated to training when disaggregated data for specific workers are considered (the association is found for skilled manual). Although it is worth noting that performance variables are quite obviously correlated to each other, the pivotal role played by (past) productivity levels could suggest that a dynamic virtuous circle is present, characterised by co-evolutionary increases in productivity and training efforts, probably mainly financed by sources external to the firm. The gap between high performance and low performance firms, if this is true, is widening. Further data on future productivity, when available, could reinforce this statement, if a productivity → training/HRM → productivity dynamic relationships is confirmed by data. Summing up, empirical evidence shows that labour demand characteristics, performances and HRM factors thus appear highly entangled in the explanation of firm training efforts.

On a methodological ground, the study also shows that in presence of fractional variables, the use of different econometric models is worthwhile to make the analysis more robust, but often leads to similar outcome in terms of coefficients significances. In the present case study, sample selection effects are generally not a relevant issue; the reason may be found in the often subtle difference between "training firms" and "non training firms", given that data derives necessarily from surveys which are characterised by a certain degree of subjective interpretation (by firm management) on the meaning of what is considered to be effectively training. A general statement concerns the complexity of the analysis of firm training efforts, deriving from the very diverse proxies, deriving either from official surveys, or elicited from specific case study surveys. This complexity is tackled by presenting results for different indexes of training, from binary variables to coverage to intensity to general training content. The analysis of diverse indexes, using different econometric specifications, help generalising results and highlighting eventual differences

concerning the driving forces of training or, in a weaker sense, the variables positively or negatively associated with training activities.

The analysis allows addressing some key questions of labour policies. Training activities emerge positively associated with productivity, high-performance practices, innovative labour demand features, workforce skill level, firm size, and affected by labour flexibility in various directions. The high relevance of both structural variables (i.e. size, sector), labour demand factors (specifically the innovation content of labour demand and labour management) and HRM/innovation practices (also positively correlated with structural variables and labour demand dynamics) shows that regional industrial policies must support labour policies within an integrated policy effort aimed at increasing potential firm productivity. The analysis also suggests that a widening gap, between innovatively evolving and more stagnant firms, could characterise the future dynamics of those local areas. This is a key concern for the current debate on local systems in the European and Italian environment.

**Table 1- Training dependant variables (Reggio Emilia)**

| Variable | *Acronym* | Type | Description | Mean value |
|---|---|---|---|---|
| Training for employees | TRAIN-EMP | Discrete 0-1 | Training adoption | 0,80 |
| Training for new hired employees | TRAIN-NEW | Discrete 0-1 | Training adoption for new employees | 0,78 |
| *Training* Coverage | TRAIN-COV | Continuos 0 1 | Employee's training coverage | 0,45 |
| Index of Training typologies adoption | TRAIN-ADOP | Continuos 0 1 | The index captures the number/variety of formal and informal training activities adopted by firms | 0,71 |
| Index of Training generality | TRAIN-GEN | Continuos 0 1 | The index captures the specific/general content of training activities: it takes the value of one if training is completely general; specific forms of training reduces the index | 0,38 |

**Table 2- Training dependant variables (Ferrara)**

| Variable | *Acronym* | Type | Description | Mean value |
|---|---|---|---|---|
| Formal training | TRAIN-FOR | Discrete 0-1 | Training adoption | 0.49 |
| Informal training | TRAIN-INF | Discrete 0-1 | Training adoption | 0.55 |
| *Training* Coverage | TRAIN-COV | Continuos 0 1 | Employee's training coverage | 0.26 |
| Index of Training typologies adoption | TRAIN-ADOP | Continuos 0 1 | The index captures the number/variety of formal and informal training activities adopted by firms | 0.61 |
| Index of Training Generality | TRAIN-GEN | Continuos 0 1 | The index captures the specific/general content of training activities: it takes the value of one if training is completely general; specific forms of training reduces the index | 0.28 |
| Index of formal training firm effort/intensity | TRAIN-EFF | Continuos 0 1 | The index accounts for trends concerning financial resources, coverage and percentage of workers involved | 0.43 |

**Table 3- Explanatory variables* (Reggio Emilia)**

| | Variables | **Type** | acronym |
|---|---|---|---|
| A | ***Firm typology*** | | |
| A.1 | Firm size (small, medium, medium-Large and large firms)[54] | 3 Dummies | MEDIUM, MEDIUM-LARGE, LARGE |
| A.2 | Productive orientation à la Pavitt (labour intensive LI, resource intensive RI, specialized suppliers SS, scale intensive SI) | 3 Dummies | LI, SI, SS |
| A.3 | Private firm, cooperative firms/cooperative group | 2 Dummies | PRIV, COOP |
| A.4 | Share of revenue on domestic markets | Continuos 0 1 | NAT-REV |
| A.5 | Share of revenue from market or subcontracting | Continuos 0 1 | MKT-REV |
| A.6 | Firm hierarchical structure (hierarchical levels/firm functions) | Continuos 0 1 | HYERARC |
| A.7 | Employees education level | Continuos 0 1 | EDUC |
| A.8 | Share of manual workers | Continuos 0 1 | MANUAL |
| B | *Flexibility in production process and labour services* | | |
| B.1 | Plant flexibility | Continuos 0 1 | PLANT-FLEX |
| B.2 | Labour services flexibility in work organizations | Continuos 0 1 | LABSERV-FLEX |
| B.3 | Synthetic index of labour relation flexibility | Continuos 0 1 | FlEX-REL |
| B.4 | Synthetic index of labour flexibility | Continuos 0 1 | LAB-FLEX |
| C | ***Industrial relations*** | | |
| C.1 | Synthetic index of worker's involvement in firm management initiatives | Continuos 0 1 | INVOLV |
| D | *Performance variables (mean values period 1995-2001)* | | |
| D.1 | Net profit / revenue | Continuos | PROF |
| D.2 | Value added per employee (productivity) | Continuos | PRODUC |
| D.3 | Labour cost per employee | Continuos | LAB-COST |
| D.4 | Net Investments per employee | Continuos | NET-INV |
| D.5 | Gross employee wage | Continuos | WAGE |
| E | Innovations | | |
| E.1a | Synthetic index of organizational innovation (5 high-performance practices) | Continuos 0 1 | INNO-ORG |
| E.1b | high-performance practices (quality circles, team-working, just-in-time, task rotation, total quality management) | dummies | QC, TEAM, JIT, TASK, TQM |
| E.2 | Product Innovation | dummy | INNO-PROD |
| E.3 | Process Innovation | dummy | INNO-PROC |
| E.4 | Quality product innovation | dummy | INNO-QUAL |
| E.5 | Technological Innovation index | Continuos 0 1 | INNO-TECH |
| E.6 | Employee Formal Evaluation | Continuos 0 1 | FORM-EVAL |

[54] 100-249; 250-499; >500.

**Table 4- Explanatory variables (Ferrara)**

| | **Variables** | Type | acronym |
|---|---|---|---|
| A | *Firm typology* | | |
| A.1 | Firm size (small, medium and large firms)[55] | 2 Dummies | MEDIUM, LARGE |
| A.2 | Private firm; cooperative firms/cooperative group | 2 Dummies | PRIV, COOP |
| A.3 | Sectors: Services, manufacturing/metalwork, other industry | 2 dummies | SERV, MANUF |
| A.4 | Share of revenue on domestic markets | Continuos 0 1 | NAT-REV |
| A.5 | Share of revenue from market, from subcontracting | Continuos 0 1 | SUBCONTR |
| A.6 | Employees education level (skill index) | Continuos 0 1 | SKILL |
| B | *Flexibility in labour services* | | |
| B.1 | Tenure index | Continuos 0 1 | TENURE |
| B.2 | Turnover | Continuos 0 1 | TURNOV |
| B.3 | Flexibility of employment contracts for the stock of employees | Continuos 0 1 | FLEX-STOCK |
| B.4 | Flexibility of employment contracts for the flow of employees (2000-2002) | Continuos -1 1 | FLEX-FLOW |
| C | *Labour demand driving forces* | | |
| C.1 | Market demand growth | dummy | GROWTH-DEM |
| C.2 | Firm growth | dummy | GROWTH-FIRM |
| C.3 | New competencies required | dummy | NEW-COMP |
| C.4 | Introduction of new products and processes | dummy | INNO-PROC-PROD |
| D | Formal Training *driving forces* | | |
| D.1 | Professional status | dummy | |
| D.2 | Education | dummy | |
| D.3 | Specific task | dummy | |
| D.4 | Individual characteristics | dummy | |
| D.5 | Seniority | dummy | |
| D.6 | Hierarchical level | dummy | |
| E | *Performance variables* | | |
| E.1 | Synthetic index of performance trend 2000-2002 (employment, profit, productivity, turnover, indebtedness) | Continuos –1 1 | PERF-TREND |
| E.2 | Index of productivity trend 2000-2002 | Continuos –1 1 | PRODUC |
| F | Training indexes | | |
| F.1 | Intensity of informal training practices | Continuos –1 1 | INT-TR-INF |

[55] 20-49; 50-99; >99.

**Table 5- Training regressions (Ferrara)**

| | TRAIN-FOR/ TRAIN-INF | | TRAIN-ADOP | TRAIN-COV | TRAIN-GEN | TRAIN-EFF |
|---|---|---|---|---|---|---|
| | Bivariate probit | | OLS corrected for heteroskedasticity | OLS corrected for heteroskedasticity | OLS corrected for heteroskedasticity | OLS corrected for heteroskedasticity |
| | informal | formal | | | | |
| Cons_ | 0.652 | -0.582 | 0.101* | 0.031 | 0.103*** | 0.749 |
| PRIV | -0.567*** | -0.253 | | | | |
| MEDIUM | -0.330* | -0.053 | | | 0.088** | 0.097* |
| LARGE | 0.897§ | 0.719§ | 0.116§ | 0.140§ | 0.010*** | 0.263§ |
| SERV | 0.496*** | 0.636*** | 0.094§ | 0.168§ | 0.116§ | 0.244§ |
| MANUF | -0.019 | 0.512** | | | 0.833** | 0.078* |
| NAT-REV | -0.769** | -0.387 | | | | |
| TENURE | -1.338** | -0.165 | -0.114* | | | |
| FLEX-FLOW | 0.557*** | 0.539*** | 0.069** | | 0.070* | 0.096** |
| FLEX-STOCK | | | -0.132* | | | |
| SKILL | 0.230 | 0.518* | 0.126§ | 0.174§ | | 0.125* |
| NEW-COMP | 0.657*** | 0.764§ | 0.082** | | 0.098*** | 0.162*** |
| INNO-PROC-PROD | | | 0.072** | 0.065 | 0.054 | 0.083 |
| GROWTH-DEM | | | | | -0.0739*** | |
| PRODUC | 0.192 | 0.168 | 0.059§ | 0.085*** | | 0.048 |
| INT-TR-INF | | | | | 0.207§ | |
| correlation value (bivariate probit) | 0.600§ | | | | | |
| F test (significance level) | 0.0000 | | 0.0000 | 0.0001 | 0.0000 | 0.0000 |
| Adj-$R^2$ | | | 0.196 | 0.107 | 0.126 | 0.183 |
| N | 243 | | 243 | 243 | 243 | 243 |

We recall coefficients are not to be interpreted as elasticities; we emphasise coefficients which arise significant at 20%, 10%, 5% and 1% (*, **, *** and § in table).

**Table 6- Training regressions (Reggio Emilia)**

| | **TRAIN-EMP TRAIN-NEW** | | **TRAIN-ADOP** | **TRAIN-GEN** | **TRAIN-GEN** |
|---|---|---|---|---|---|
| | Bivariate probit | | OLS corrected for heteroskedasticity | OLS corrected for heteroskedasticity | 2-stage Heckman |
| | New hired | Employee | | | |
| Cons- | -2.37*** | -3.14§ | 0.325 | 0.153* | -0.097 |
| MEDIUM | 0.773*** | 0.132 | 0.123** | 0.125§ | 0.107§ |
| MED-LARGE | 1.045* | 1.478* | 0.259§ | 0.119*** | 0.145§ |
| LARGE | | | 0.186*** | 0.157§ | 0.091** |
| PRIV | | | | -0.077*** | |
| COOP | | | 0.2873§ | 0.193*** | |
| SI | | | | | 0.060* |
| SS | | | | | |
| LI | -0.764*** | -0.010 | | -0.066** | |
| NAT-REV | | | | | |
| MKT-REV | | | | | |
| EDUC | 6.906*** | 5.92*** | | | 1.298§ |
| MANUAL | | | 1.34§ | | |
| HYERARC | | | -1.569§ | | |
| PLANT-FLEX | | | -1.306§ | | |
| LAB-FLEX | 2.048 | 5.816§ | | 0.3805** | |
| INVOLV | | | | | |
| INNO-ORG[56] | ** | ** | § | * | * |
| *TEAM* | -0.739 | -0.150 | -0.0214 | -0.0307 | -0.041 |
| *QC* | 0.353 | 0.872 | 0.080* | -0.0234 | -0.034 |
| *JIT* | -0.658 | 0.633 | 0.100* | 0.0327 | -0.030 |
| *TASK* | 0.599* | -0.162 | 0.035 | 0.0423 | 0.070** |
| *TQM* | 0.291 | 0.801*** | 0.148*** | 0.0471* | 0.003 |
| *INNO-PROC* | | | | | |
| INNO-PROD | | | | -0.107* | |
| INNO-QUAL | | | | -0.093*** | |
| INNO-TECH | | | | 0.148*** | 0.103** |
| FORM_EVAL | | | | 0.170** | |
| PRODUC | | | | | |
| INVERSE MILL RATIO | | | | | -1.781** |
| correlation value (bivariate probit) | 0.655§ | | | | |
| F test (significance level) | 0.0000 | | 0.00017 | 0.0000 | 0.0000 |
| Adj-$R^2$ | | | 0.1638 | 0.3198 | 0.3062 |
| N | 166 | | 166 | 166 | 136 |

We recall coefficients are not to be interpreted as elasticities; we emphasise coefficients which arise significant at 20%, 10%, 5% and 1% (*, **, *** and § in table).

[56] When INNOORG is significant (as shown), an additional regression is estimated using the 5 high performances practices instead of INNOORG, in order to see what driving forces lie behind INNOORG.

**Table 6 (CONTINUED)**

| | **TRAIN-COV** | **COV- NONMAN** | **COV-MAN** | **COV-MAN-SK** |
|---|---|---|---|---|
| | OLS corrected for heteroskedasticity | OLS corrected for heteroskedasticity | OLS corrected for heteroskedasticity | OLS corrected for heteroskedasticity |
| Cons- | -0.980§ | 0.070 | -0.165 | -1.618*** |
| MEDIUM | 0.104§ | | 0.049§ | |
| MED-LARGE | | -0.020*** | | 0.107*** |
| LARGE | -0.076* | | | |
| PRIV | -0.976** | -0.014** | -0.046*** | |
| COOP | 0.243*** | 0.059§ | | |
| SI | | | -0.044** | -0.128§ |
| SS | -0.060* | | -0.046*** | -0.084§ |
| NAT-REV | 0.001* | | 0.000** | |
| MKT-REV | -0.208*** | | -0.000*** | -0.001*** |
| EDUC | 1.368§ | 0,4531§ | | |
| MANUAL | 0.628*** | | | |
| HYERARC | -0.624** | | | |
| PLANT-FLEX | -0.707§ | | | |
| LAB-FLEX | | | -0.204** | |
| INVOLV | 0.114* | | | |
| INNO-ORG | *** | ** | *** | 0.138*** |
| *TEAM* | 0.056 | 0.007 | 0.027 | [Single HRM practices do not are significant when included as dummies. Only TQM does at 20% level] |
| *QC* | 0.045 | 0.004 | -0.004 | |
| *JIT* | 0.022 | 0.007 | 0.008 | |
| *TASK* | -0.005 | -0.006 | 0.004 | |
| *TQM* | 0.118*** | 0.020§ | 0.059§ | |
| INNO-PROC | 0.170§ | | 0.053§ | 0.088§ |
| PRODUC | 0.465§ | 0.041** | 0.182§ | 0.213** |
| PROFIT | | -0.013* | | |
| WAGE (WHITE COLLARS) | | -0.081* | | |
| WAGE (BLUE COLLARS) | | | | 0.446*** |
| F test (significance level) | 0.0000 | 0.0000 | 0.00001 | 0.0000 |
| Adj-$R^2$ | 0.266 | 0.423 | 0.198 | 0.183 |
| N | 166 | 166 | 166 | 166 |

**Table 7- Firm Training-related variables**

| | *In terms of training adoption* | *In terms of training coverage* | *In terms of general training content* |
|---|---|---|---|
| Factors which are **positively and highly** associated to training activities | Size<br>Cooperative firm/cooperative group<br>Service sector<br>Workers' New competencies<br>Productivity<br>Workforce skill | Productivity<br>Process Innovation<br>Wages (skilled manual workers)<br>Organisational Innovation (TQM)<br>Size<br>Service sector<br>Cooperative firm/cooperative group<br>Education level/ Workforce skill content<br>Workers' New competencies | Education level<br>Size<br>Service sector<br>Workers' New competencies<br>Informal training |
| Factors which are **positively and moderately** associated to training activities | Labour flexibility (flow of atypical workers)<br>Labour demand driven by innovation introduction | Organisational Innovation (TaskRot) | Organisational Innovation (TaskRot)<br>Technological Innovation<br>Manufacturing sector |
| Factors which are **negatively and moderately** associated to training activities | | Hierarchical levels<br>Labour flexibility (general index) | |
| Factors which are **negatively and highly** associated to training activities | Hierarchical levels<br>Plant flexibility<br>Labour flexibility (stock of atypical workers) | Plant flexibility<br>Market revenue's share | Labour demand driven by Demand growth |
| Factors not associated to training activities | "Performance" and financial variables other than productivity (gross and net profits, labour costs, investments per employee)[57] | | |

[57] Nevertheless, all performance variables are highly correlated over the period considered.

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