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Firm-Level Training in Local Economic Systems

Complementarities in production and innovation strategies

Giovanni Guidetti and Massimiliano Mazzanti *

Abstract

The paper presents a conceptual review over the main aspects concerning the role of human capital investments and training activities within production processes, followed by empirical evidence on two Local economic systems in Northern Italy, based on recent survey data. Theoretical and empirical considerations are brought together in order to provide new insights on the role of training and the factors associated to training activities 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. We observe that training activities emerge positively associated with high-performance practices, innovative labour demand features, workforce skill level, firm size, and are affected by labour flexibility in various directions. Empirical evidence confirms most previous results of the literature, but also adds further important insights. The analysis suggests that a widening gap, between few innovatively evolving and many stagnant firms, could characterise the future dynamics of the Region. The high relevance of structural variables, labour demand factors and HRM/innovation practices shows that regional industrial policies and labour policies should be jointly implemented for increasing potential firm productivity. This is a key concern for the current debate on local systems economic development in the European and Italian environment.

Jel: J24, C21, C24

Keywords: firm training, labour demand, human resource management, techno-organisational innovations, firm performances, local systems

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1. Training in firms: a theoretical framework

1.1 Introduction

In his seminal contribution in modern economic theory about training in firms, Becker (1975) drew the crucial distinction between specific and general training and analysed 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 aims 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 accumulation 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 wages¹.

The paper is divided as follows. Next sections of part I present a critical conceptual framework regarding training and skills as critical elements in the analysis of production processes. Section II then presents empirical evidence, which grounds on recent survey data, for the critical factors correlated to firm training strategies in a local industrial system. Section III concludes by examining the main implications of empirical results and providing suggestions for regional policy.

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.

1.1.1 Developments in human capital theory after Becker

Taking into account this general model of training provision, Acemoglu and Pischke (1999) stress three different sources of deviations from the model of perfect competition in the labour market. Firstly, 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, 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 arises 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 programmes 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 need to be at work.

In the same spirit as Acemoglu and Pischke (1999) and Stevens (1994, 1999) develops a model based on an 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 increases 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, etc. The relevance of these variables stems from casual empiricism and is not explicitly rooted in any theoretical framework. In 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.

1.2 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 they 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, 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 and training practices adopted for skill development.
- 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).

These four units of analysis are the inputs of production, which is conceived as a process of coordination of continuous and ever-changing interactions among inputs.

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.

1.2.1 Complementarity and skills

Complementarity among inputs entails that the return of a single skills does not depend on the skill itself, but also on other skills and 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, definable 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 of knowledge. 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 outside a well-defined productive context and their development can

occur through some kind of formal and informal training. Skills used are assets whose specificity depends on the complementarity relationships established with other inputs².

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 establishment of complementarity relationships among skills acquired, and other inputs and skills existing in the firm, results into the set of skills used. Learning processes such as those implied by on-the-job training, learning by doing and other diverse training practices specify this cobweb of relationships among skills acquired and other inputs. In a sense, training can be also conceived as a tool for the implementation of complementarity relationships among inputs. However, 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.

Conclusively, the relationship between skills used, skills acquired and training implies that the effect of training on individual productivity can be rather complex. As far as general training is concerned, it affects directly the endowment of individual knowledge and the range of skills acquired. The setting up of new complementarity relationships, occurring (implemented) through some form of training, specifies the effect of general training on skills used. Therefore, it is not the content itself of general training, but the setting up of new complementarity relationships that different forms of training can favour, which determines the effect of general training on individual productivity.

This view of learning and the dichotomy between skills acquired and used cause the collapse of the identity between training and skill. Ever since seminal Becker's analysis (1975), 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. Actually, general training implies the acquisition of general skills. Nevertheless, skills used determine the actual range of employees' tasks and duties and her productivity. The widening of an employee's endowment of skills acquired does not entail an increase in the level of her productivity. Employees' productivity is

² This distinction between skills acquired and used is consistent with the classification of skills introduced by Stasz (2001).

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.

Becker did not draw the distinction between skills acquired and used. Accordingly, the effect of general training is only the 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 this paper this is not always the case. Indeed, even though general training improves potential employees' productivity in any firm, training can also widen the range of skills used, favouring the establishment of new complementary relationships. The degree of asset specificity of the skills used increases, making the trainees' productivity firm specific and creating the conditions for employees' financing of general training programmes.

This analysis of training, learning and skill development raises two crucial consequences. 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. If general training can develop specific assets, this occurs through the interaction of this kind of training with other inputs. General training practices fit with other inputs and training practices; their interactions favour the process of skill development described in the previous paragraphs. Especially, as far as training practices are concerned, that means that general training has always to be analysed jointly with other training practices in order to understand its impact on the firm's productivity. It is useful to emphasize that the effect of general training is not limited to individual productivity but spreads, due to the complementarity relationship among productive 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 profitability of general training for employees.

1.3 Some hints about the interaction between structural variables and skill development

To conclude with, it can be 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) tenure, 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.

(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.

This framework of analysis can be a useful basis to understand possible effects of short-term labour contracts. The framework developed in paragraph 1.2.1 implies that some form of training is always

required. Therefore, a positive association between the flow of short-term contract and provision of training is expected to hold. However, since employers' propensity to finance training depends on internal labour markets, provision of training and stock of short-term contracts should be negatively associated.

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.

2. Training in firms: empirical analyses

The empirical evidence on training is mainly grounding on micro-based contributions which take as unit of reference the worker. While a rich array of data on training is provided by cross sectional and longitudinal individual-based surveys, data regarding the nature of training investments and training typologies provided by establishments and firms are scarcer (Frazis et al., 1995), although they may provide critical insights on the management of high-performance practices in local economic systems, taking a firm-based perspective. We do not discuss here the more recent and interesting paper on firm training (among the others, Whitfield, 2000; Beckmann, 2002; Black et al, 1999). Most of those empirical studies exploit detailed information, but only for a limited set of explanatory variables. For others, information is deficient or lacking on some firm strategies, thus posing a well known problem of omitting critical factors. As far as this contribution is concerned, the empirical value therefore revolves around the investigation of a full set of training indexes and the introduction of a comprehensive set of possible correlated factors. Our datasets, presented below, allow a detailed and robust analysis on the most significant variables associated to firm training. We possess good measures of a number of establishment control variables and we can exploit past performance data stemming from official accounting data.

2.1 Case studies: local production systems in the Emilia Romagna Region

The applied analysis concerns the Province of Ferrara and the Province of Reggio Emilia, both located in the Emilia Romagna Region. Those areas may be defined as local economic systems within the Region. Emilia Romagna is an area of Northern Italy characterised by a high density of industrial districts and it represents the 7% of the Italian population. The Region ranks 10th among the 122 regions of the European Community in terms of GDP per person (taking the EC regional average GDP index as 100, the Regional value is 127.6), with an average unemployment rate of 5%. Half of the enterprises are involved in the service sector, the rest is equally divided in agricultural and manufacturing. The latter is indeed the main source of economic development, with the following production sectors: chemical, textile, ceramic, motor-cycle, packaging machinery, farming machinery, biomedical, wood-processing, machine tool, food. We recall that Italian production systems are based on small-medium enterprises. The industrial local system of Reggio Emilia is especially characterised by a high degree of dynamics of the system and high innovation intensity. The two case studies aim at providing new empirical evidence on training practices and other human resource management activities in local production systems, from a firm-based viewpoint. Since labour and industrial policies are often implemented at a regional level, and always with a strong involvement of local authorities, our studies provide food for policy making aimed at fostering economic development targeting firm techno-organisational innovation practices.

Two independent surveys were administered respectively in 2003 and 2002³, with the aim of collecting detailed and extensive data at firm level, usually quite rare regarding training and high performance practices. While both questionnaires dealt extensively with training decisions issues intended as high performance practices (training practices adopted, coverage, etc.)⁴, the survey administered to firms in the Ferrara province was then more devoted to the investigation of workforce features (skills, tenure, competencies⁵) and labour demand characteristics. On the other hand, the survey administered in the Province of Reggio Emilia focused more on HRM, techno-

³ Within research projects that witnessed local public authorities and trade unions cooperative involvement in support of the research efforts.

⁴ On innovative-oriented high performance practices at firm level see Altman (2002), Tomer (2001), Kling (1995) and Huselid (1995).

⁵ See Ashton et al. (1999), Green et al. (2001) for discussions on and definitions of skills and “competencies” within an organisational-oriented perspective of the firm.

organisational innovation practices and industrial relations as well⁶. We refer to Pini (2004) for a detailed analysis of main results concerning innovation dynamics and firm performance.

The firms included in the Reggio Emilia universe are all manufacturing firms (257) with at least 50 employees located in the Province of Reggio Emilia in 2001. The firms responding to the survey were 199. Balance sheet data are available for 166 firms out of the 199 interviewed, for the period 1995-2001: thus the applied exercise is performed on these 166 firms. The survey concerning Ferrara has been carried out on industrial and market-service firms with at least 20 employees and establishments in the Province, excluding agriculture and public administrations. We identified 436 firms, out of which a random sample of 250 firms was selected (57% of the universe). The survey ended up with an outcome of 243 interviews. Sample representativeness with respect to the population is good in both cases.

The potential driving forces of training here analysed compounds firm 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 that may explain training decisions, reducing the possible distortions arising from omission of relevant variables.

2.2 The set of Conceptual Hypotheses

On the basis of the theoretical framework presented in section 1, two different sets of hypotheses are tested. Since the two datasets include somehow different data, hypotheses are not always tested in both cases, depending on data availability.

Set of hypotheses 1. Complementarity among training practices

Data used in this paper allow singling out two diverse types of training. The analysis is articulated into two diverse ways to conceive complementarity among training practices:

⁶ Interviewees were firm managers and human resources managers. Surveys were directly conducted at firm establishments by specialised interviewers, who administered detailed structured questionnaires of around 30 pages. Interviews thus took generally one hour or even more. A follow up of telephone interviews was then carried out in order to check data and fill gaps.

⁷ Interviewees in both surveys were generally top managers and human resources managers. Surveys were directly conducted at firm establishments by administering structured questionnaires of around 30 pages. Interviews thus took generally one hour or more. A follow up of telephone interviews was then carried out in order to check data and fill gaps.

H1.a) Complementarity among training practices in general, defining training according to the distinction between formal and informal.

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 is investigated.

Set of hypotheses 2. The role of firm structure and human resource management in training strategies.

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, the firm sector, intended as a proxy of capital equipment and technology, is expected to affect the firm's choice as far as training is concerned.

H2.b) Practices of human resource management (HRM). The effect of innovative HRM practices such as task rotation, quality circle, total quality management and team work, just-in-time is investigated exploiting the Reggio Emilia dataset. 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.

H2.c) 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.d) Variables connected to internal labour market. In this respect, the empirical section analyses three hypotheses. Firstly, a positive association between training provision and flows of short-term labour contract is expected to hold (i.e. flows of short-term labour contract, information included in our index). 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 long tenure is a necessary but not sufficient condition for the employer to finance training, a positive link between tenure and training does not need to hold.

H2.e) Variables measuring performances of the firm. As to the relation between training and any indicator of economic performance, things can be rather complex. First, firm performance is a multi-dimensional framework; secondly, not all specific performance indicators present direct link to training. Productivity indicators are clearly close to training effects with respect to, say, profitability indicators. Then, in addition to that, the training-performance link is subject to reverse causality problems. 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. Anyway, a positive association between these two variables is firmly rooted in any approach to the analysis of training in firms. Our data allow to partially circumventing the problem, since performance indexes are lagged with respect to training practices.

2.3 Applied investigation: methodology and outcomes

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 as dependent variables. It is worth noting that the dataset *mainly* concerns cross-sectional data, although it is worth noting that we exploit data associated to different time periods⁸, and lagged performance data. Nevertheless, the causality links between variables are to be intended as “weak links” (Michie and Sheehan, 2005): the objective is not to test cause-effect relationships between training, performance, innovation, and HRM practices, but to assess the significance and intensity of correlation relationships between those variables⁹. We use as dependant variables different proxies for training in a simple reduced form regression model which may be sketched as it follows:

$$Training\ index_i = \beta_0 + \beta_1 [firm\ characteristics] + \beta_2 [internal\ labour\ market\ factors] + \beta_3 [workforce\ features] + \beta_4 [techno-organizational\ innovations] + \beta_5 [Performances] + \epsilon_i$$

⁸ In other words, training efforts are elicited for a defined year, while other main potential correlated factors are expressed by trend values (i.e. 2002; 2002-2000). The endogeneity bias is mitigated by such data structure.

⁹ Long panel data series would be needed to assess sound causal links. Those panel data are very rare and difficult to set up, when surveying firms with the aim of eliciting data on organisational strategies and HRM/HPWP practices, for which official datasets are usually rare.

We omit time references in the model (see note 8 and 9). We use training indexes of (i) total coverage, (ii) general/specific training content¹⁰ and (iii) indexes of training activities adoption¹¹ (see tab.1 for a comprehensive description of indexes).

We also analyse the eventual correlation between the two forms of training investment (formal and informal), specifying a two-equations bivariate probit; in each equation the variable is binary (value 1 if the practice is adopted). In the case of proved correlation, the use of a single-equation binary model is in fact not justified.

Table 1 provides a summary of descriptive statistics, showing the percentage of firms involved in the different forms of training¹². We note that indexes for formal and informal training practices adopted are relatively high. Nevertheless, figures for coverage are less than 50%, with a low 26% value for Ferrara, a less industrialised area. Data are consistent with the shared view and Italian evidence that firm tend to provide (formal) training for a limited percentage of, often, skilled workers. Firm tend to focus training efforts on a kernel of skilled workers. Indexes for the generality of training are similar in the two cases, and show that *most* training efforts are of a specific type, though formal training is not irrelevant for a sub-sample of (larger) firms which are more involved in high-performance practices. Those firms are exploiting economies of scale for managing training fixed costs. Table 2 provides a summary of explanatory factors used in the applied analysis, for both case studies, with a brief description regarding how variables were set up using the survey based information. The reader may also refer to Antonioli et al. (2003) for an extensive discussion of survey based information related to the innovation dynamics in the Reggio Emilia local system.

Econometrically speaking, we use different specifications¹³. Since indexes of training coverage, intensity or adoption of practices structurally range between zero and one, we deal with *fractional variables*, continuous within the 0-1 range but limited by their nature. It is possible to affirm, that there is not an “optimal” econometric model for studying fractional variables. Although OLS estimates may suffer from distortions, it is often possible to verify that estimates deriving from OLS

¹⁰ Assigning a specific weight to each training activity adopted by firms: the more specific is training (i.e. informal on the job), the lower the weight. Training activities take a weight valued *one* only in case of full general training (courses). The adoption of specific informal training reduces the value of the index.

¹¹ Synthesising all 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 elicited formal and informal activities.

¹² Acronyms identify key dependant variables when reported in the text.

¹³ For clarity of exposition, we do not explicitly present regression results. The reader may refer to Guidetti and Mazzanti (2005, 2004) for an extended discussion of results and econometric outcomes. Full estimates and the structured questionnaires are obviously available upon request.

and other more complex models do not differ significantly as far as coefficient absolute and relative significances are concerned (Pyndick and Rubinfeld, 1991). This was confirmed by a preliminary analysis on our data. Since our aim is not to estimate elasticities¹⁴, we thus decided to use OLS estimation procedures. Furthermore, given a sufficiently high number of firms not involved in training activities, we check the presence of sample selection by a two-stages model (probit plus OLS) in all specifications.

2.3.1 The Ferrara local system

Independent probit regressions do not take into account the eventual correlation between, for instance, formal and informal training (TRAIN-FOR, TRAIN-INF). Therefore, a two-equation bivariate probit analysis is carried out, in order to test the above-mentioned hypothesis of correlation (H1a). The first important result is that the null hypothesis of no correlation between the two training practices is rejected by data. 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. Nevertheless, the bundle of training driving forces is not the same for formal and informal training. 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 market revenue is quite relevant for informal, but not for formal training, while the opposite emerges for tenure, which emerges associated with a negative effect 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.

In order to provide a more significant analysis of training driving forces we move to discuss results for various indexes of training we have derived. First, an index of training “intensity” in terms of typologies of training activities adopted by firms is specified (TRAIN-ADOP). Highly significant and positive statistical effects emerge associated to large and service sector firms. Other positive significant effects are associated to “new competencies” and new product/processes oriented labour

¹⁴ Thus, since we do not study and emphasise elasticity values, the economic significance does not revolve around the level of such coefficients. We are well aware that statistical significance is not sufficient, if not linked to economic significance; in this case it is used as a mean for ranking the intensity of correlations between training and its potential drivers/associated factors.

demand, skill labour force intensity and *the flow* of atypical workers. On the other hand, *the stock* of atypical workers is negatively and significantly correlated with training. This outcome may be consistent with the conceptual framework developed in the theoretical sections. It is also worth noting that, while past mean performance indexes confirm to be not significant explanatory factors, the trend concerning productivity emerges as a positive force behind firm training: firms experiencing higher productivity trends over 2000-2002 are more likely to have then adopted a wider range of training practices.

Secondly, we focus on two indexes capturing only formal training activities. A first index captures various dynamics of formal training (TRAIN-EFF). The key role of size and sectoral factors is confirmed. The message is very clear: large and service sector firms do invest more 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. A second index captures instead the *coverage* for formal training (TRAIN-COV). The same size and sectoral effects outlined above are confirmed. A different outcome is associated to skill intensity, which is here also significant.

Finally, we focus on the index capturing the generality/specificity content of training activities (TRAIN-GEN). Size and sectoral effects are crucial and dominate other explanatory factors: large and medium size firms, service and metalwork firms do tend to 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 (which is a factor associated to a lower content in terms of “labour demand innovativeness”) . It is also worth noting that a very significant and positive correlation effect 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 possible correlated variable. The idea of complementarity among training practices emerges again neatly, and it is worth analysing further in future empirical works.

Summing up results for the first case study here presented, we note that smallest firms are less likely to invest in training, as expected. Moreover, a sector-oriented cut highlights that services firms, and to a lesser extent manufacturing firms, do invest more. The need of acquiring new competencies and introducing innovations are two factors associated to training adoption. Linked to the positive

effect of productivity levels on training, a widening gap may thus distinct small, non-innovative firms from larger and more innovative-oriented firms. Considering also the positive role associated to the current observed skill content of the workforce, the risk is one of observing a widening gap between (admittedly few) high-performance high-innovative firms and (many) low performance low innovative oriented ones. The insufficient level of training, which nevertheless characterise the most part of firms in the Province, may represent a lacking crucial element for stimulating an economic virtuous circle in this local area. Finally, a note on the role of labour flexibility, a crucial element of the current policy debate. 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. This may reinforce what said on the positive impact of productivity on training. Theoretically, the correlation sign between productivity and training is ambiguous: on the one hand it may be positive (more productive firms do invest more resources in training, given a complementarity between different investments in various high-performance practices and the exploitation/redistribution of the productivity gain; low-productivity firms do not want/do not have resources to invest and rather choose to cut costs to maintain competitiveness) or negative on the other hand (assuming (i) that lower performance firms aim and are able to close the gap devoting more resources to training and other high performance practices, and (ii) to some extent diminishing returns from human capital investments). We argue that the first effect (positive link) here may prevail: the (few) innovative firms are within a virtuous circle productivity-training, while the low-innovative low-performance firms, also managing a less-trained less-skilled workforce, rather decide to keep competitiveness levels by exploiting further cost reductions through a “defensive” use of labour contract-related flexibility.

2.3.2 The Reggio Emilia local system

As above, we investigate the correlation between different training practices (TRAIN-EMP, TRAIN-NEW) by means of bivariate probit model. The null hypothesis of no correlation is again rejected (H1b). Results show 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. Among innovation practices, task rotation

plays the main and only role for new hired, while TQM is the only significant factor in employee regressions.

Three further training indexes are specified and studied: the index concerning the variety of training practices adopted by firms (TRAIN-ADOP), the index related to formal training coverage (TRAIN-COV) and an index capturing the generality/specificity content of training (TRAIN-GEN).

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, process innovation, labour flexibility, and organisational innovation. We note that among organisational innovations, the leading factor is TQM, followed by JIT and QC¹⁶. Past performances indicators do not influence the “intensity” in training practices adoption (see also Storey, 2004). Finally, firm hierarchical intensity (hierarchical structure) is negatively associated to training.

Secondly, formal training coverage is mainly associated with size effect (medium size firms), cooperative-like firms, workforce education level, process innovation adoption, 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. Explanatory factors linked to a negative and significant effect are hierarchical intensity, again, and the share of revenue originating from the final market.

The third and final index concerns the general content of training. It is worth noting that in this case a two stages regression leads to results that are more robust. Building on that model, a slightly different picture arises: while size effects still dominates, workforce skill content and technological innovation are the only other two key factors correlated to general training. The impact of organisational innovation is weak and a detailed analysis shows a mixed outcome: only task rotation exerts a positive effect.

The database used for this second case study opens other directions of analysis and discussion. First, the pivotal role played by HRM practices, more specifically high-performance organisational

¹⁵ As far as Reggio Emilia is concerned, training indexes refer to the complete set of formal and informal practices.

¹⁶ At least one out of the five organisational practices studied in the literature on human resources management is present in 67,3% of firms. Among those, total quality management, job rotation and teamwork are the most widespread.

¹⁷ Though not significant, net profits are associated to a positive coefficient, as expected.

¹⁸ Nevertheless TQM is the only significant factor.

innovations, is confirmed. Those practices, using as proxy an index of HRM practices adoption, arise as strongly correlated with 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 positive task rotation correlation with training is instead more intuitive.

Nevertheless, 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. We thus 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 considered are adopted. The estimated coefficients show that the sign of the relationship between these variables and training differs. Therefore, the effect of HRM on training depends on the specific practices adopted and, especially, on how these are combined: this indicates both complementarity and substitution effects, when those practices are taken jointly. The synthetic index instead captures a comprehensive effect, wherein positive effects of HRM factors on training outweigh negative effects.

Size effects confirm to be relevant: larger firms are more involved in training and provide more general training. 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 comprehensive synthetic index, which includes various elements (see tab.2), exerts a positive impact on training. Past productivity arises as a positive determinant of training for some training indexes. Most firms are experiencing a virtuous evolution of performances characterised by increasing productivity, increasing adoption of high-performance practices and higher innovation. The role of “innovative” labour flexibility (as entangled with high-performance practices), which here is showing a positive correlation with training, is thus consistent with this perspective.

¹⁹ 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.

3. Conclusions

We conclude with a summary of results (table 3), which also allow some considerations on the current development of local systems and on regional policies. The applied investigation on the two local systems sheds light on diverse factors correlated to training activities at firm level.

Considering different training activities, we found a robust correlation both between formal and informal (H.1a) training and between training for employees and training for newly hired (H.1b).

As far as the structural characteristics of firms are concerned, a clear size effect in both local environments can be observed (H.2a). This outcome confirms the evidence, supported by other works in the field, that firm size is a key factor for both techno-organisational innovation and high-performance practices, including training. This further supports the view that major national and local policy efforts should be thus focussed toward providing incentives to size-enlargement and/or to networking/grouping strategies of Italian firms in the current scenario. Market variables, such as the share of revenue linked to foreign markets and to the final market, seem to play here a minor role: size effects dominate in the multi-variate analysis.

Then, the two case studies shed light on different important factors which might play a role in driving training decisions. Major results are the positive role played by Organisational Innovations (H.2b, Reggio Emilia local system), innovative labour demand features (H.2c, Ferrara local system) and high performance-oriented management of labour flexibility (H.2d, both cases), a multi-dimensional concept which is here proxied by various indexes.

Training is positively associated to other organisational high-performance practices. 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, but also that some HRM exert a greater impact, depending strictly on specific structural conditions.

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. An innovative content of 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.

Moving to labour flexibility issues, the different effects of flow and stock contract-related flexibility are a key element for firm labour management, which the present study addresses. The paper shows that, as expected, a positive association between training provision and *the flow* of short-term labour contract holds (H.2d). In addition to that, training provision is instead often negatively associated to *the stock* of short-term employees. This result may be worrying if we observe the tendency to increase the stock, not only the flow, of short term flexible workers in Italy, a dynamic which may be associated to non innovative management of human resources and reductions of firm investments in human capital. The management of labour flexibility in the Reggio Emilia local system confirms that functional and numerical flexibility may be integrated within firm productive processes following a performance-oriented approach. Finally, it is worth noting that tenure is not correlated with training in a multivariate setting (H.2d).

Finally, both case studies show a positive role played by (past) productivity levels, for indexes of training intensity. Financial variables, including profits, instead do not impact on training decisions (H.2e), maybe highlighting a mis-management at a dynamic level. In any case, productivity is conceptually the closest performance factor; the 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, which is 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 relationship will be confirmed by future data.

The analysis allows addressing some key questions regarding regional 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 in econometric models

<i>Variables (Reggio Emilia dataset)</i>	<i>Acronym</i>	<i>Type</i>	<i>Description</i>	<i>Mean value</i>
Training for employees	TRAIN-EMP	Dummy	Binary variable taking value 1 if the firm offer formal and/or informal Training for employees	0.80
Training for new hired employees	TRAIN-NEW	Dummy	Binary variable taking value 1 if the firm offer formal and/or informal Training for new hired employees	0.78
<i>Training Coverage</i>	TRAIN-COV	Continuous 0 1	Percentage of workers involved in training	0.45
Index of Training typologies adoption	TRAIN-ADOP	Continuous 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	Continuous 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
<i>Variables (Ferrara dataset)</i>				
Formal training	TRAIN-FOR	Dummy	Training adoption	0.49
Informal training	TRAIN-INF	Dummy	Training adoption	0.55
Training Coverage	TRAIN-COV	Continuous 0 1	Employee's training coverage	0.26
Index of Training typologies adoption	TRAIN-ADOP	Continuous 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	Continuous 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	Continuous 0 1	The index accounts for trends concerning financial resources, coverage and percentage of workers involved	0.43

Table 2- Explanatory variables in econometric models

Explanatory variables (Ferrara Province dataset)		Typology	Description
A	<i>Firm structural features</i>		
A.1	Firm size	2 dummies	small, medium and large firms
A.2	Firm typology	dummy	private firm; cooperative firm
A.3	Sector	2 dummies	Services, manufacturing, other industry
A.4	Share of revenue on domestic markets	Continuous 0 1*	
A.5	Share of revenue from subcontracting	Continuous 0 1	
A.6	Employees education level (skill index)	Continuous 0 1	The index captures both the educational level (from secondary school to degrees) and the professional status /from low skilled to high skilled jobs) of the workforce.
B	<i>Flexibility in labour services</i>		
B.1	Tenure index	Continuous 0 1	The index is set up defining tenure information by professional status as high when higher than 5 years, low when less than one year. Five tenure classes are present.
B.2	Turnover	Continuous 0 1	Ratio between job creation and job destruction flows on the total stock of employment
B.3	Flexibility of employment contracts for the stock of employees	Continuous 0 1	Share of flexible/atypical contracts (short-term) on total employment
B.4	Flexibility of employment contracts for the flow of employees	Continuous -1 1	Number of flexible/atypical contracts (short-term) on the flow of 2000-2002 net job creation
C	<i>Labour demand characteristics</i>		
C.1	Market demand growth	dummy	It takes the value 1 when this has been a driving force of job creation during 2000-2002
C.2	Firm growth	dummy	It takes the value 1 when this has been a driving force of job creation during 2000-2002
C.3	New competencies required	dummy	It takes the value 1 when this has been a driving force of job creation during 2000-2002
C.4	Introduction of new products and processes	dummy	It takes the value 1 when this has been a driving force of job creation during 2000-2002
D	<i>Performance variables</i>		
D.1	Synthetic index of performance trend 2000-2002 (employment, profit, productivity, value added, indebtedness)	Continuous -1 1	All performance trends are elicited from managers using an intensity scale ranging from -5 to 5
D.2	Index of productivity trend 2000-2002	Continuous -1 1	Productivity is calculated ex post using trends for value added and employment
Explanatory variables (Reggio Emilia Province dataset)		Typology	Description
A	<i>Firm structural features</i>		
A.1	Firm size	3 Dummies	small, medium, medium-large and large firms
A.2	Productive orientation à la Pavitt	3 Dummies	labour intensive, resource intensive, specialized suppliers, scale intensive
A.3	Firm typology	2 Dummies	Private firm, cooperative firms/cooperative group
A.4	Share of revenue on domestic markets	Continuous 0 1	
A.5	Share of revenue from subcontracting	Continuous 0 1	
A.6	Employees education level	Continuous 0 1	The index captures the educational level content of the workforce. Only

			theoretically it assumes 0,1 limit values
B	<i>Flexibility in production process and labour services</i>		
B.1	Synthetic index of labour flexibility	Continuous 0 1	Intensity index: it includes information on the use of short-term contracts, functional flexibility, and innovation/flexibility in working hour regimes.
B.2	Firm hierarchical structure	Continuous 0 1	hierarchical intensity structure is defined as the ratio of the number hierarchical layers on the number of formalised firm divisions (fifteen specified)
C	<i>Workers participation**</i>		
C.1	Synthetic index of worker's involvement in firm management initiatives	Continuous 0 1	Composite index which includes all information regarding the extent to which workers are involved in production and innovation oriented decisions: higher values are associated to consultation and bargaining processes on firm decisions
D	<i>Performance variables</i>		
D.1	Net profit / revenue	Continuous	Balance sheets data (<i>mean values period 1995-2001</i>)
D.2	Value added per employee (productivity)	Continuous	Balance sheets data (<i>mean values period 1995-2001</i>)
D.3	Net Investments per employee	Continuous	Balance sheets data (<i>mean values period 1995-2001</i>)
E	<i>Tecbno-organisational Innovations</i>		
E.1a	high-performance practices/organisational innovation (quality circles, team-working, just-in-time, task rotation, total quality management)	5 dummies	It takes the value 1 when the firm has introduced such organisational innovation practice over 1998-2001
E.1b	Synthetic index of organizational innovation	Continuous 0 1	Index capturing the intensity of innovation adoptions In terms of the aforementioned 5 organisational practices
E.2	Product Innovation	dummy	It takes the value 1 when the firm has introduced such technological innovation practice over 1998
E.3	Process Innovation	dummy	It takes the value 1 when the firm has introduced such technological innovation practice over 1998
E.4	Quality product innovation	dummy	It takes the value 1 when the firm has introduced such technological innovation practice over 1998
E.5	Technological Innovation index	Continuous 0 1	Index capturing the intensity of innovation adoptions (in terms of E.2-E.4 dummies)
E.6	Employee Formal Evaluation	Continuous 0 1	Share of employees subject to formal evaluation programmes, weighted by classes (from low skilled to top managers)

*Continuous 01 means that the index/variable takes values within the 0-1 range. Some variables assume limit values only theoretically but never in practice.

** We do not deal extensively with industrial relations issues in this paper. The paper by Antonioli et al (2003) provides a comprehensive analysis of direct and indirect participation processes in the Reggio Emilia manufacturing sector, where interactions between management, union delegates and workers is crucial and intense. On industrial relations and human resource management see also Mazzanti et al (2005).

Tab. 3- Firm Training-related variables

<i>Reggio Emilia Province</i>	<i>In terms of training practices adoption</i>	<i>In terms of formal training coverage</i>	<i>In terms of general training content</i>
Factors which are positively associated to training activities	Size Cooperative firm Past Productivity Workforce skill Organisational Innovation (TQM, JIT, QC)	Productivity Process Innovation Organisational Innovation (TQM) Size Cooperative firm Education level Worker's involvement Organisational Innovation (TQM) Labour flexibility index	Education level Size Organisational Innovation (TaskRot) Technological Innovation index
Factors which are negatively associated to training activities	Firm hierarchical structure	Firm hierarchical structure Market revenue's share	
<i>Ferrara Province</i>	<i>In terms of training practices adoption</i>	<i>In terms of formal training coverage/formal training effort</i>	<i>In terms of general training content</i>
Factors which are positively associated to training activities	Size Service sector Labour demand driven by need of new competencies Productivity Workforce skill Labour flexibility (<u>flow</u> of atypical workers) Labour demand driven by innovation introduction	Productivity Size Service sector Workforce skill content Labour demand driven by need of new competencies	Size Manufacturing sector Service sector Labour demand driven by need of new competencies Informal training
Factors which are positively associated to training activities	Labour flexibility (<u>stock</u> of atypical workers)		Labour demand driven by Demand growth
Factors not associated to training activities (both case studies)	Tenure, "Performance" and financial variables other than productivity (gross and net profits, labour costs, investments per employee)		

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