DOES INNOVATION FOSTER TRAINING INVESTMENTS? EVIDENCE FROM A LOCAL PRODUCTION SYSTEM

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Abstract. The main objective of the present work is to verify the relations between innovative strategies and the training activities, deepening the understanding of the relations between technological and organisational innovations and the training activities implemented by the firms. The firm level analysis is based on a unique 'two-periods' panel dataset which include data on manufacturing firms for an Italian, highly industrialised, local production system (the Milan area). The results suggest that the firms use specific training activities in accordance with the innovation introduced. As a whole it emerges that the upskilling phenomenon is more related to the organisational changes than to technological innovation. In addition, the contextual introduction of organisational and technological change does not seem to favour more training activities.

Keywords. Technological change, organisational change, training

Introduction

In recent years, it is prevalent in organizational and economic debates a new approach to work organization and human resource management that aims to achieve competitive advantages for the company through the increase of the degree of commitment (identification, commitment, confidence) of workers to the organization [1,2,3]. In this view, investments in job training and skills development of human resources represent a crucial element for firm superior performance [4,5]. Combining training with incentive compensation systems and the opportunity to participate in decisions that affect the working processes, workers increase their degree of identification and satisfaction to the firm and are thus driven to provide their "discretionary effort" to the organization [6].

The organizational and economic literature has devoted much attention to the impact of training on workers - in terms for example of skills development and employability [7,8,9] - and on firm performance, especially in terms of labour productivity [10,11,12] and firms survival and development [13,14].

Less studied are the relationships between firms investments in technological and organizational innovations and training policies. Theoretically, firms have two main reasons to decide to invest in training policies when technological and organizational innovations are introduced: to institutionalise the innovations, i.e. to routinise and legitimise the new procedures; and to exploit the complementarities between techno-organisational capital and human capital. However, economic literature have shown that several factors can discourage investment in training by enterprises as well [15,16].

This paper addresses these aspects of innovation and training strategies adopted by Italian firms, seeking to supply some evidence useful for the understanding of the role that innovation plays in training processes developed within manufacturing firms. The main question that arises is: do firms that innovate in technologies of production and work organisation adopt training policies to accompany these change processes? In other word, are innovations drivers for training investments?

To use the well-known formulation of James March [17], responding to this question allows us to verify whether the innovative processes of the companies follow an exploratory or an exploitative logic, according to the with significant implications for the firms competitiveness and chances of success.

Moreover, the question is relevant because at firm level the linkage between human capital and innovation is not trivial at all, especially when the interactions between innovation and high/low skilled workers are considered. For example, on the one hand, we may question whether technological change complements the high skilled workforce performance or if it acts as a substitute for less skilled workers or both. On the other hand, it can be argued that technological change may efficaciously complements some high skilled workers performances but not others, or it may substitute for some less skilled activities but not for others [18].

The same argument goes for the linkages between organizational changes and skills. It has been argued [19] that recent trends in organizational change, involving decentralisation, reduction of hierarchical levels and introduction of high performance work practices, are potential factors explaining the increasing demand for skilled workers. At the same time, the changes in labour organization may be called for supporting high levels of workers' skills [20].

In the present work we acknowledge the role of human capital and workers skills as complementary to innovation activities. The micro focus of the work, which relies on empirical data stemming from original surveys on manufacturing firms, allows us to use a wide set of information. The panel structure of our data allows us to consider the role of innovation on training programs implemented by the firm, deepening our understanding of the determinants of firm strategic decisions concerning the human capital development of the workforce.

The paper is organized as follows. Section 2 outlines the data and the empirical model. Section 3 illustrates the main results of the empirical investigation. Finally, section 4 is left to some preliminary concluding remarks.

1. Data and Methodology

Our empirical analysis is conducted using a single data set, which results from the match of two survey waves on manufacturing firms located in the area of Milan (in the Lombardy region in Italy). Milan is one of the top-ranked OECD metropolitan regions and the first contributors to national GDP among the Italians cities, accounting for more than 10% [21].

The sample on which the analysis is conducted consists of 140 manufacturing enterprises enrolled with the Lombardy Industrial Association (Assolombarda), the largest territorial association of the General Confederation of Italian Industry (Confindustria).

Both in 2005 and in 2008, the questionnaire was sent to the HR managers of around three thousand firms, and the replies amounted to 334 in 2005 and to 416 in 2008.

Given the small number of services firms (less than 10% of the sample in the two years), we decided to analyse only the manufacturing firms. Careful selection of the quality of the replies and matching between the respondents of two years generate a sample of 140 manufacturing firms for the development of our analysis.

Table 1. Distribution of the firms: sample vs. universe

	Universe (Istat 2001)		Sample	
	n	**%**	**n**	**%**
Food	462	3.5	7	5.0
Chemical	990	7.5	34	24.3
Rubber	835	6.3	9	6.4
Metal-Machinery	6915	52.5	74	52.9
Textile	1044	7.9	5	3.6
Other manufacturing	2922	22.2	11	7.9
Total	13168	100.0	140	100.0
SME (<250 emp.)	12940	98.3	119	85.0
Large (≥250 emp.)	228	1.7	21	15.0

The distribution of firms reported in Table 1 shows that firms in our sample have a good representativeness in terms of sectoral distribution (though chemicals firms are over represented), while the representativeness by size classes is decidedly lower. However, firms that can be classified as SME (Small and Medium Enterprises) are 85% of the sample: this substantial proportion of small and medium firms was indubitably a strength of the sample. Indeed, existing studies tend to focus on large-sized firms; nevertheless, in order to reach a higher comprehension of the phenomenon, we think that it would be really better to cover also smaller units. This is true especially in country, like Italy, characterized by a particularly low average size of firms in comparative terms.

The model used in the econometric analysis is based on the following regression function:

$$[Training]_{i,t} = a + b_{0i,t}[controls] + b_{1i,t}[technological\ innovation] + b_{2i,t}[organisational\ innovation] + b_{3i,t}[innovation\ interactions] + u_{i,t} \quad (1)$$

where the dependent variables are different indexes of training activities as explained below; *i* represents each observation; *b* represent vectors of coefficients, which are related to each vector of independent variables (covariates); *a* represents the constant of the model and *u* represents the error terms. Among the covariates on the right hand side we can distinguish (see Table A.1 in Appendix for detailed descriptions of the variables): (i) firm structural variables (controls), which give information on sector, size, group belonging, as well as labour contracts (labour flexibility); (ii) technological innovation variables, which include product and process innovations, captured through dummy variables that are used to construct a composite index of innovation intensity; (iii) organisational innovation variables, which are synthesised as well in a composite index, providing information on the intensity of innovation activities in the organisational sphere. It is convenient to underline that frequently, in the skill bias empirical literature, the innovation variables, especially the organizational ones, have been measured as simple dummies [22,23,24]. In our case, the richness of micro-level data not only reduces, to some extent, the likelihood of relevant variables being omitted, but also gives an original and essential value added to this study.

The dependent variables are four and capture two main training instruments: internal and external training courses (tab.2). The first two dependents are the share of employees involved in internal courses (EMPSHARE_INTTRAIN) and the hours per capita (over all the employees) devoted to such courses (HOURS_INTTRAIN); the other two dependents provide the same information, but they are referred to external courses (EMPSHARE_EXTTRAIN and HOURS_EXTTRAIN).

Table 2. Summay statistics and description of the dependent variables

Variable	Description		Mean	Std. Dev.	Min	Max	Obs.	
EMPSHARE_INTTRAIN	Number of employees involved in internal training courses/Total number of employees	overall	0.1900	0.2861	0	1	N =	280
		between		0.2354	0	1	n =	140
		within		0.1642	-0.3099	0.6900	T =	2
HOURS_ INTTRAIN	Amount of training hours for internal course/Total number of employees	overall	0.3976	0.4499	0	1	N =	280
		between		0.3705	0	1	n =	140
		within		0.2563	-0.102	0.8976	T =	2
EMPSHARE_EXTTRAIN	Number of employees involved in external training courses/Total number of employees	overall	0.1344	0.2077	0	1	N =	280
		between		0.1613	0	0.6407	n =	140
		within		0.1312	-0.342	0.6116	T =	2
HOURS_ EXTTRAIN	Amount of training hours for external course/Total number of employees	overall	0.4703	0.4591	0	1	N =	280
		between		0.4034	0	1	n =	140
		within		0.2207	-0.029	0.9703	T =	2

The empirical analysis is based on simple panel data econometrics. Pooled, fixed effects and random effects estimations are carried out in order to provide a comparison of the results. In particular, we wanted to test, through standard Hausman tests, which model between fixed and random effect was to be preferred. As it is possible to see from the tables showing the results in the next section, the RE model is always preferable, but in the last specification, with HOURS_EXTTRAIN as dependent variable, where FE is slightly preferred to the RE model.

Another point it is worth stressing concern the use of an interaction variable between technological and organizational innovation indexes constructed as the product of the two indexes. Such a product is obtained using the mean-centered indexes so that the centered indexes (c_InnoTech and c_InnoOrg) and the interaction term (InnoTech*InnoOrg) can be simultaneously included in the regression specification avoiding potential problems of multicollinearity.

2. Results

In the following Tables 3 and 4 the first sets of results deriving from the equation (1) specification, alternatively using our different dependent variables, are reported. The tables report the RE results, which are similar to the simple OLS pooled and which are preferred to the FE results by the implementation of the Hausman test as reported at the bottom of each table.

Starting from Table 3, we can appreciate, at first, the negative impact given by the small size (SME dummy) on the share of workers involved in training programs (Models 1 and 2). Small firms may have less resources to devote to training activities and they may be less interested in improve the workforce skills because they are less interested by international competition that calls for continuous investment in human capital in order to remain competitive.

The role of the workforce composition is also relevant. In particular, having higher shares of high skilled white collars, that is to say managers and supervisors, positively impact on the coverage of training programs in terms employees involved. Possibly because high skilled white collars are those more involved in training activities, because they need to avoid their competences to become obsolete. As far as the main covariates of interest are concerned we notice that nor technological innovation neither organisational innovation impact on the training coverage for the internal courses, although organisational innovation gain a weak significance in the specification with the interaction between innovations is included.

Turning now to Models 3 and 4, which have the hours per capita devoted to training activities when using internal courses, it possible again to appreciate the role of firm size. Moreover, it is now the presence of firm level union representative to gain a high level of significance. We may hypothesise that where the workers are able to make their voice listen through the instrument of the union, then they are able to obtain more in terms of training intensity: the training coverage is unaffected by the presence of union representative, but the hours of training per capita is affected by the union presence. We cannot exclude the possibility that part of such hours are devoted to standard types of training, directly bargained at firm level and involving safety and security issues, probably more felt and discussed in unionised context rather than in non-unionised ones. Finally, what is more important is the result of the organisational innovation variable (InnoOrg) that is now highly significant, implying a positive impact of organisational changes in the intensity of training activities. In presence of changes in the work organisation the firms do not react widening the ‘audience’ of training activities, but they react providing more training to ‘the same audience’ that probably would have received some training also in the absence of organisational changes. We may concluded that the upskilling of the competences, at least as far as internal programs are concerned, is likely to involve the same workers, which are called to further improve their skills in presence of organisational changes.

Looking at the results for the external training activities (Table 4) we can see that the role of firm size weakens. Such a result seems to imply that the investment capacity is not relevant for the implementation of training programs outside the firms boundaries, telling us that to some extent such training activity is compulsory for the firms. More than firm size, with respect the coverage of training programs it is the sector belonging to be important (Models 5 and 6, results on sectors not reported in table): firms belonging to the rubber, metal-machinery and textile sectors have a worse performance in comparison to the benchmark sectors, that is the food one in our case.

Table 3. Random Effect Estimations for Internal Training

	Coverage (1)	Coverage (2)	Hours p.c. (3)	Hours p.c. (4)
Industry	yes	yes	yes	yes
SME	-0.227***	-0.223***	-0.302***	-0.289***
	(0.068)	(0.068)	(0.097)	(0.097)
Flexdip	0.106	0.136	0.838	0.783
	(0.384)	(0.386)	(0.598)	(0.600)
ShareHighSkilledWC	0.333**	0.339**	0.186	0.186
	(0.144)	(0.144)	(0.208)	(0.208)
ShareLowSkilledWC	0.059	0.055	0.144	0.149
	(0.091)	(0.091)	(0.131)	(0.131)
UnionRepresentative	0.038	0.036	0.208***	0.209***
	(0.045)	(0.045)	(0.065)	(0.064)
Compet	-0.015	-0.023	-0.002	-0.017
	(0.098)	(0.098)	(0.144)	(0.144)
InnoTech	-0.010		0.081	
	(0.046)		(0.070)	
InnoOrg	0.149		0.361**	
	(0.092)		(0.141)	
c_ InnoTech		0.008		0.134*
		(0.049)		(0.075)
c_ InnoOrg		0.174*		0.360**
		(0.095)		(0.145)
InnoTech*InnoOrg		-0.293		-0.206
		(0.215)		(0.338)
_cons	0.258*	0.303**	0.350*	0.483**
	(0.145)	(0.145)	(0.207)	(0.208)
N	215	215	215	215
r2_o	0.200	0.209	0.285	0.291
sigma_u	0.154	0.154	0.135	0.137
sigma_e	0.222	0.221	0.383	0.382
rho	0.326	0.327	0.111	0.114
Hausman test:				
FE vs RE				
Chi2	9.54	1.70	4.43	4.27
Prob>Chi2	0.2986	0.2310	0.8160	0.8928

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Coupled with such a result we notice that the presence of high skilled white collars and that of union representatives remain important and find the same explanation for the internal training programs. Focusing on the innovation variables the evidence points to an absence of influence for the training coverage in terms of employees involved, consistently with the case of internal courses.

On the side of training hours per capita (Models 7 and 8) the sole control variable to remain significant is the presence of union representatives. However, the role of innovation re-emerges in the specification with the interaction term. In particular, is now the technological innovation to spur a high intensity in training activities. The result seems to be consistent with a strategic behaviour of the firms more oriented to innovation implementation rather than innovation ‘creation’. In fact, it might be the case that once a new product or technology is adopted a quota of training hours goes to training provided by the producer of the technology adopted, since the knowledge related to the new technology adopted is external to the firm. Hence, the training channel that needs to be activated in order to acquire the competences to fully exploit the innovation adopted regards external training courses but the share of personnel involved may be unaffected (Models 5 and 6) because the courses are likely addressed to the group of employees that deals with the relevant innovation introduced and not to all the workers, so that for the workers involved the hours spent in external training activities rises.

Table 4. Random Effect Estimations for External Training

	Coverage (5)	Coverage (6)	Hours p.c. (7)	Hours p.c. (8)
Industry	yes	yes	yes	yes
SME	0.072	0.074^{*}	-0.072	-0.051
	(0.044)	(0.044)	(0.109)	(0.108)
Flexdip	-0.121	-0.128	-0.422	-0.517
	(0.278)	(0.279)	(0.559)	(0.562)
ShareHighSkilledWC	0.283^{***}	0.284^{***}	0.268	0.266
	(0.095)	(0.095)	(0.225)	(0.224)
ShareLowSkilledWC	0.061	0.062	0.271^{*}	0.277^{*}
	(0.060)	(0.060)	(0.143)	(0.142)
UnionRepresentative	0.045	0.044	0.222^{***}	0.225^{***}
	(0.029)	(0.029)	(0.070)	(0.070)
Compet	0.046	0.042	0.058	0.049
	(0.066)	(0.066)	(0.150)	(0.149)
InnoTech	0.022		0.090	
	(0.033)		(0.067)	
InnoOrg	0.041		0.039	
	(0.065)		(0.135)	
c_ InnoTech		0.032		0.159^{**}
		(0.034)		(0.073)
c_ InnoOrg		0.049		0.022
		(0.067)		(0.139)
InnoTech*InnoOrg		-0.111		-0.031
		(0.158)		(0.309)
_cons	0.020	0.043	0.339	0.379^{*}
	(0.094)	(0.094)	(0.231)	(0.228)
N	215	215	215	215
r2_o	0.200	0.203	0.271	0.282
sigma_u	0.041	0.041	0.283	0.280
sigma_e	0.179	0.180	0.291	0.293
rho	0.051	0.050	0.487	0.478
Hausman test: FE vs RE				
Chi2	8.59	7.70	19.49	18.06
Prob>Chi2	0.3781	0.5644	0.0125	0.0345

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

3. Preliminary conclusions

With respect to our main research question, i.e. whether or not the intensity and the coverage of training activities are driven by the implementation of organizational and technological innovations, the analysis described above show two main results. First, innovation seems to act as driver for training firms investments only with regards to some specific occupational group, i.e. the ones involved in the innovation processes, while it seems to have none effect for the employees not involved in such processes. Second, organizational changes seem to matter more than technological innovation in explaining firms' training strategy. In this regard, an explanation concerns the nature of organizational changes: autonomous teams, rotation over tasks and polyvalent workers call for a more skilled workforce. Indeed, the introduction of such organizational changes leaving the skill base unaltered does not seem to be a consistent strategy.

Other relevant findings concern the role of firm size, which is strictly related to the adoption of internal training courses. The reason here is quite intuitive and lies in the costs of this kind of training activities. Indeed, internal training requires firms to have space, competencies (or money to acquire it), time, and a consistent number of employee to involve in training courses; it is very hard for small businesses to meet all these requirements.

Finally the presence of structured workplace industrial relations (i.e. the presence of trade union employees' representatives) positively influences the adoption of training initiatives. However, unions seems not able to influence the coverage of training programs; this represents one of the main challenges for unions in the modern workplace and future studies in this field should devote greater attention to this aspects.

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Appendix

Table A1. Variable description

CONTROLS	
Sectors	Dummies (Food, Chemical, Rubber, Metal-Machinery, Textile, Other Manufac.)
Size (SME, Large)	Dummies
UnionRepresentative	Dummy: 1 if union representatives are in the firms; 0 otherwise
Compet	Index of competition level for the firm: 0 local, 1 regional, 2 national, 3 international - Rescale in the interval (0,1)
Flexdip	Share of employees with non-permanent contracts
ShareBC	Blue Collars/Total employees
ShareHighSkilledWC	HighSkilled White Collars (Managers and Middle Managers)/Total employees
ShareLowSkilledWC	LowSkilled White Collars (Clerks)/Total employees

INNOVATIONS	
InnoTech	Index of technological innovation. Average of the sum of product and process innovation dummies. Interval (0,1)
InnoOrg	Index of organisational innovation. Average of the sum of organizational innovation dummies: delayering, autonomous teams, semi-autonomous teams, task 'polyvalence', task rotation - Interval (0,1)
c_InnoTech	InnoTech index centered around its mean
c_InnoOrg	InnoOrg index centered around its mean
InnoTech*InnoOrg	Product between c_InnoTech and c_InnoOrg