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Techno-organizational change and skill formation:

Evidence from Italian manufacturing firms

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Abstract

This paper emphasizes the role of labour demand as a determinant of working skill formation. In particular, we study the relationship between techno-organizational innovation and skill formation from a labour demand perspective. In this respect, we investigate if activities aimed at increasing the international commitment and the technological and organizational change do have an effect on both the propensity of firms to train and on the intensity of training.
On this purpose, by relying on a job-competition-like framework about the operation of the labour market in allocating skills, we first estimate which factors do affect the propensity of firms to invest in work-based training activities, and, secondly, we estimate if the same factors do also play a role in determining the degree of intensity of such a training activity.
Relying on a new dataset on Italian manufacturing firms active over the period 2001-2006, we first estimate a probit model on the probability for a firm to train; then we employ a Heckman two-stage selection model on the share of trainees with which we can control for selectivity bias.
Our results point to a positive and significant effect of both firms' characteristics, like size, specialization and capital intensity, and firms' techno-organisational activities on both training incidence and on training intensity. A particularly significant role, in this respect, is played by the combination of process innovation and the adoption of new organizational practices.

Keywords: human capital, international commitment, labour demand, organizational change, skill, technological innovation, work-based training

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1. Introduction

The aim of this paper is to investigate the determinants of training provision within firms. The paper focuses on the role played by labour demand and looks at the structural characteristics of firms as drivers of the employers' decision to train their employees.

The paper is divided into two main sections. The first develops a conceptual framework, which takes into account the role played by labour demand in the creation and development of employees' skills within firms. This approach contrasts sharply with mainstream human capital analysis which focuses mainly on the role played by labour supply. Relying on the hypothesis of complementarity among production factors, the relevance of the traditional distinction between general and specific training is disputed. The basic idea is that, as far as training is concerned, the employers' decisions about skill formation do not depend as much on the transferability of the employees' skills but on the techno-organisational structure of production which gives rise to training requirements. Such a structure is, in turn, determined by both firms' characteristics, like size, capital intensity and labour-force composition by skill, and by firms' strategic activities aimed at increasing, in particular, their expansion on foreign markets, their technological capability and their organisational design.

The second section, is devoted to the empirical analysis which is based on a newly developed database on Italian manufacturing firms. The first part of this section contains a brief presentation of the new data base, arising from the merge of the IX Survey on manufacturing firms (*Indagine sulle Imprese Manifatturiere*), carried out by Capitalia (formerly Mediocredito Centrale); the data-base Excelsior (*Sistema Informativo Excelsior*), carried out by the Italian Chambers of Commerce (*Centro Studi Unioncamere*) and the Observatory on the balance sheets of joint-stock companies (*Osservatorio sui bilanci delle società di capitale*), developed by *InfoCamere*.

The empirical analysis is conducted at two levels. First of all we estimate the determinants of the decision to train, i.e. training incidence, through a probit specification. Secondly, we estimate the determinants of the intensity of training, as measured by the share of trainees by employing a two stage Heckman selection model that allows correcting for possible selection bias in the data at hand.

Our results point to a positive and significant role played on the training incidence by attributes like size, capital intensity, the skill composition of the labour-force and the number of workers previously employed by the firm, while no effect is found for labour cost. Concerning the techno-organizational activities carried out by the firm, we find that the purchase of services from abroad, process innovation and the following adoption of new organizational practices as well as the outsourcing of production and service activities do positively affect the propensity of firms to form work-related skills through training.

When dealing with training intensity, instead, we find that the relative share of skilled workers and the firm's engagement in new organisational practices, especially after process innovation, play the most significant role.

2. The conceptual framework

2.1. Two different conceptions of the labour markets operation

In standard economic models, i.e. in "wage-competition models", the match between labour demand and supply is based on a wage-competition mechanism. In this framework, potential employees compete with each other for a job on the basis of wage bidding. When labour demand exceeds labour supply, potential employees underbid the prevailing level of wage, until equilibrium between demand and supply is reached. At the level of a single vacancy, the adjustment process works in the same way. Employees' selection occurs on the basis of wage underbidding concerning the applicants to the specific job position.

Potential employees are assumed to be homogeneous, so that individual characteristics, such as education, previous working experience, sex, race and the like, are irrelevant. Potential employees differ from one another only as far as their individual reservation wages are concerned. Even when the vacancy is specifically addressed to a well-defined professional profile, hiring occurs on the basis of a mechanism of wage-competition, in which the supply side is defined and limited with respect to the skills attached to the specific professional profile. The market for skills overlaps the market for labour services.

The adjustment process works differently according to Thurow's (1975) job-competition model. In this case a pivotal role is played by the labour demand side. This means that the employer's behaviour and firm's characteristics become relevant; the techno-organizational framework, the related organization of work, and, more generally, all features concerning the internal labour markets and institutional framework become key factors[3]. Therefore, in this model the focus is on the match between employees' characteristics and the firm needs. In order to maximise the return of this match, employers rank the applicants on the basis of the desired individual and specific traits, which are conceived as proxies of their degree of trainability and capability to adapt to the requirements attached to each specific job. Definitely, this ranking depends on the idiosyncratic features of the job and cannot be uniquely defined for all firms. For instance, in certain jobs the previous working experience can be relevant in defining the individual position in the ranking,

[3] See for instance, Antonelli (2003); Antonelli and Guidetti (2008); Antonelli, Antonietti and Guidetti (2008).

whereas, in other job positions, ranking mainly depends on the education or other specific characteristic. In any case the employer puts together a queue of applicants which runs from the most favoured applicant to the least preferred one.

As far as wage setting is concerned, in the job-competition model the wage level is exogenously determined with respect to the process of both hiring and individual positioning in the queue. Basically, one can point out two different types of drivers in the process of wage setting: external drivers and internal ones. External drivers refer to factors which affect a labour market, as a whole. In particular, centralized bargaining can determine the minimum wage attached to each specific job position. As far as the internal factors are concerned, the structure of the internal labour market, and namely the career paths and the hierarchy of relative wages, defines the structure of absolute and relative wage levels within the firms.

In summary, the main differences between the standard model and the job-competition model are threefold and concern, respectively: the wage setting process; the process of skill formation and development and the role of labour demand.

2.2 General vs. specific training

In his seminal contribution about training in firms, Becker (1964) 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 production factors, Becker shows that no employer is available to fund general training of employees, i.e: training for the acquisition of skills that affect positively employees' productivity in the firm financing training, as well as in other comparable firms. 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.

Further developments in human capital theory have shown that specific deviations from the strict hypotheses implied by the assumption of perfect competition can provide the rationale to the employer's financing of general training programmes. Particularly, imperfect competition on either the product or the labour market, asymmetric information and imperfect financial markets, can explain the employer's provision and financing of general training. Roughly speaking, these imperfections favour the rise of a wedge between marginal productivity and the level of wage such that the employer can find it convenient to finance general training.

2.2.1 The role of complementarity

In this framework of analysis a pivotal role is played by complementarity among inputs. Complementarity entails that the return of a single skill does not depend on the skill itself only, but also on how skills combine with other skills and inputs. The establishment of these complementarity relationships determines the process of conversion of skills acquired, i.e.: the endowment of individual knowledge regardless any productive context, into skills used: i.e.: the endowment of knowledge and competences referred to a specific productive context. Skills used are assets, whose specificity depends on the complementarity relationships established with other inputs. 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 notion of trainability, conceived in Thurow's analysis as a determinant factor for the ranking of the employee's position in the job queue, is consistent with this dualism between skills acquired and skills used.

The analysis of 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, 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 preliminary analysis of training, learning and skill development has an important consequence. As a matter of fact, 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. 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 production inputs.

As far as the financing of training is concerned, it can be the case that the employer finances general training, if she can establish profitable complementarity relationships. The degree of generality of training does not affect the employer's propensity to finance training.

2.2.2 The role of labour demand

The structure of labour demand, determined by the organization of knowledge within the firm and by firm's techno-organizational design, does not play any significant role in the standard model. As far as the process of conversion of skills acquired into skills used is concerned, in our conceptual scheme labour demand plays a central role.

Complementarities among skills and other inputs can be analysed with respect to three units of analysis:

a) employees' individual skills and training practices adopted for skill development;

b) 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, outsourcing);

c) capital equipment such as hardware (i.e.: lathe, computers), software (i.e.; computer-aided design, word processing program).

Particularly, three elements have to be emphasised. First of all, we have to take into account the operation of internal labour markets and, especially, the organization of knowledge and work, the architecture and the hierarchy of job positions, and the capability to introduce and exploit organizational innovations. Secondly, we have to consider the technological setting and the capability of firms to innovate both their products and productive processes. Thirdly, the value chain to which the firm belongs is relevant.

Summing up, one can state that the human capital stock depends on four different sets of drivers.

(a) The internal labour market, the organization of work and the coordination of tasks among job positions. These factors define the productivity of the single employee, along with the aforementioned individual characteristics. For instance, the employer's strategy to adopt one or more of the so-called High Productivity Working Practices (HPWP) such as task/job rotation, teamwork and so on define the range and the boundaries of each specific job position.

(b) The technology and the propensity of the firm to innovate. Machineries, capital equipment and in general the technology adopted by the firm constrains the skills which are actually used and their return in the work process. Any innovation introduced by the firm enriches (upskilling), but it can also decrease (deskilling), the skills required for the performance of production.

(c) The dynamics of skill development and the process of adjustment of individual characteristics to the techno-organizational framework. The strategies implemented by the firm for the employees' training affect directly the endowment of human capital available.

(d) The industrial network to which the firm belongs, intended as the position of the firm in the value chain. Positioning of the firm in the value chain define the level of dynamic transaction costs,

i.e.: “the costs of not having the capabilities you need when you need them” (Langlois, 1992). These costs can affect the firm's decision to outsource a specific stage of production, when the costs implied by the process of human capital formation are too high for the firm to meet. In a sense one can say that the position of the firm in the value chain limits the amount of investment in human capital that the firm can sustain and, hence, it fixes a maximum threshold to the stock of human capital.

3. Data

Data are drawn from the merge of three distinct data-sets: the IX Survey on manufacturing firms (*Indagine sulle Imprese Manifatturiere*), carried out by Capitalia (formerly, Mediocredito Centrale) for the period 2001-2003; the data-base Excelsior (*Sistema Informativo Excelsior*), carried out by the Italian Chambers of Commerce (*Centro Studi Unioncamere*) for the period 2004-2006; the Observatory on the balance sheets of joint-stock companies (*Osservatorio sui bilanci delle società di capitale*), developed by *InfoCamere*.

The IX Survey on manufacturing firms gathers information on a representative sample of 4.289 manufacturing firms over the period 2001-2003. In particular, while firms with more than 500 employees are fully represented, firms employing more than 11 and less than 500 employees are selected on the base of the region in which they are located, the firm size and the sector of economic activity (following ATECO 1991 classification, in line with ISIC Rev. 3.1 and NACE Rev. 1.1).

This Survey is of particular importance since it constitutes a rich set of information on firms’ characteristics and activities. For the purpose of the paper, we concentrate on sections concerning: (i) firm characteristics such as the size, industry (according to the ATECO 1991 classification and the Pavitt taxonomy) and the macro-region of localization; (ii) the annual labour force composition; (iii) the investments in new machinery, equipment, product, process and organizational innovation and R&D; (iv) the internationalization activities, with particular reference to exports, offshoring and the purchase of services from abroad; (v) market-oriented activities, like the outsourcing of goods and services to external suppliers.

The Excelsior data-base is conducted by Unioncamere in cooperation with the former Italian Ministry of Labour and Social Welfare and with the European Social Fund, and gathers information on the year-by-year labour demand of a sample of about 100.000 private firms with more than 1 employee and distributed all over the Italian territory (Centro Studi Unioncamere, 2007).

The survey covers 27 sectors of economic activity, primarily concentrated within the manufacturing industry, but ranging also over the agricultural and the public sector. Data on labour demand are collected according to two criteria: the ISCO-88 classification of occupations on the

one side, and the Excelsior classification on the other, which accounts for the individual worker's level of competence, as defined on the base of the complexity of the tasks operated at the workplace, and the degree of skill specialization, this latter based on the interaction between the knowledge content of tasks and their operating context , i.e. the economic sector.

The Excelsior data-base is composed by different sections which collect data provided by the local and regional Chambers of Commerce and other administrative archives, or from direct interviews to firms conducted in years 2003, 2004 and 2005, with predictions on labour demand for year 2006. In the present context, the sections utilized for the empirical analysis concern: (i) the annual stock of the labour force at the end of each year 2003, 2004 and 2005 and the annual entry and exit flows of labour in 2004, 2005 and 2006 by occupation (managers, executives/clerks, plant operators); (ii) the recruitment predictions for years 2004, 2005 and 2006 by occupation, education and typology of experience required; (iii) the modes of labour recruitment and the types of labour contracts employed; (iv) the volumes of work-based training in 2003, 2004 and 2005, with particular reference to the number of trainees, the duration, the costs and the typology of training activities supplied (internal, external, side-by-side coaching, distance learning).

Finally, the third data-set gives information on balance-sheet variables relative to joint-stock companies active in the period 2001-2003. The Observatory on the balance sheets is conducted and managed by InfoCamere on the base of the information contained on the national Register of firms, in which all Italian stock companies are recorded. This data-base represents a unique source of data since it covers the whole population of Italian stock companies: hence, it allows to handle more than 600.000 balance sheets every year and to calculate and analyse the main balance sheet and financial indicators. For our purposes, we focus on four variables: sales, labour costs, net capital stocks and value added for years 2001, 2002 and 2003.

After merging the three data-sets, we obtain a final sample of 1.545 manufacturing firms with more than 11 employees and active all over the period 2001-2006. As the second and third columns of Table 3.1 show, the merged sample is composed by a 20% of small firms (11-49 employees), a 56% of medium firms (50-249 employees) and a 24% of large firms (more than 250 employees), primarily located in the North of Italy (71%) and belonging to traditional (46%) and specialized sectors (31%)[4].

We further drop observations with missing values in balance sheet variables, negative value added and missing values in labour force variables. At the end of the cleaning process we obtain a

[4] Table A1 in the Appendix reports the structure of the merged sample by industry following the standard ATECO 1991 classification.

balanced dataset of 1398 firms suitable for the analysis. The last two columns in Table 3.1 show the distribution of these firms by size, location and industry.

Tables 3.2 and 3.3, instead, show the distribution of training incidence and intensity – this latter as measured by the number of trainees on firm's total employment - by firm size, geographical location and industry after the cleaning procedure. In line with cross-country evidence (Bassanini *et al.*, 2003), large firms, primarily located in the North and operating in science-based industries tend not only to be more willing to offer training but also to train relatively more employees. Finally, Tables 3.2 and 3.3 also show that both training incidence and training intensity are decreasing over time.

Table 3.1. Sample structure by size, geographical location and industry

	Before cleaning		**After cleaning**	
Firm size	**N.**	**%**	**N.**	**%**
Small (11-49)	306	19.81	286	20.46
Medium (50-249)	862	55.79	787	56.29
Large (≥ 250)	377	24.40	325	23.25
Area	**N.**	**%**	**N.**	**%**
North West	591	38.25	533	38.13
North East	508	32.88	474	33.91
Centre	237	15.34	218	15.59
South	209	13.43	173	12.37
Industry (Pavitt classification)	**N.**	**%**	**N.**	**%**
Supplier dominated	705	45.63	639	45.71
Scale intensive	271	17.54	239	17.10
Specialized suppliers	484	31.33	449	32.12
Science based	85	5.50	71	5.08
Total	**1.545**	**100.0**	**1.398**	**100.0**

Table 3.2. Training incidence by size, geographical location and industry (raw %)

	2003		2004		2005	
Firm size	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
Small (11-49)	26.92	73.08	26.22	73.78	25.17	74.83
Medium (50-249)	57.94	42.06	42.31	57.69	43.96	56.04
Large (≥ 250)	84.00	16.00	80.62	19.38	80.92	19.08
Area	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
North West	58.35	41.65	48.03	51.97	50.28	49.72
North East	60.76	39.24	54.80	46.20	52.95	47.05
Centre	55.05	44.95	44.50	55.50	43.12	56.88
South	50.29	49.71	35.84	64.16	39.31	60.69
Industry (Pavitt classification)	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
Supplier dominated	48.51	51.49	37.25	62.75	42.72	57.28
Scale intensive	61.92	38.08	53.97	46.03	49.79	50.21
Specialized suppliers	66.37	33.66	55.90	44.10	54.57	45.43
Science based	70.42	29.58	73.24	26.76	60.56	39.44
Total	**57.65**	**42.35**	**47.93**	**52.07**	**48.71**	**51.29**

Table 3.3: Training intensity (n. of trainees on total employees) by size, location and industry (%)

Size	**2003**	**2004**	**2005**
Small (11-49)	7.55	10.07	9.67
Medium (50-249)	17.45	12.53	12.10
Large (≥ 250)	28.77	30.95	28.77
Area			
North West	17.59	16.68	15.36
North East	20.00	16.58	15.70
Centre	15.05	14.99	15.38
South	18.00	16.11	15.37
Industry (Pavitt classification)			
Supplier dominated	13.31	10.71	11.37
Scale intensive	21.84	21.22	18.14
Specialised suppliers	21.65	19.05	18.48
Science based	25.33	32.90	24.53
Total	**18.05**	**16.31**	**15.48**

4. Model estimation

In the following empirical analysis we test the following hypotheses:

(i) the provision of training is positively affected by the degree of capital intensity of the firm;

(ii) the provision of training depends on the characteristics of the workforce, in terms of skills, training previously provided, educational level, type of task performed and so on;

(iii) the provision of training depends, from a static point of view, on the organisation of production and work and, from a dynamic perspective, on the propensity to introduce techno-organisational innovations and, more generally, on any structural change occurring at firm level;

(iv) the provision of training is negatively affected by labour cost.

4.1. Variables

The empirical analysis consists in estimating both the firms' propensity to engage in training activities and the intensity of training. Concerning the former, we estimate the probability for a firm to invest in any form of work-related training during the year 2004 as function of its characteristics and the activities developed in the period 2001-2003. In particular, we identify eight classes of explanatory variables: controls, capital intensity, labor cost, skill composition of the labour force, hiring behaviour, technological innovation, organizational innovation and international commitment.

As control variables we include three size dummies (*small*, *medium*, *large*), four geographical location dummies (*North West, North East, Centre, South*) and four dummies reflecting the industry to which the firm belongs, as measured according to Pavitt's (1984) taxonomy of economic sectors (*supplier dominated, scale, specialise, science*)[5] .

Firm's capital intensity is measured by the ratio between 2001-2003 average net material assets and the value added (*K/Y*). We include this variable in order to capture if, and to what extent, the degree of mechanisation of the firm impacts the process of skill formation.

Next to capital intensity we also include a variable measuring labor cost per unit of value added produced (*LC/Y*). Since we do not have a variable measuring the total wage bill paid by the firm, we use this proxy in order to capture the relationship between skill demand and the "price" of skills.

The skill composition of the labour-force is measured by the ratio between white collars and blue collars (*WC/BC*), the former being constituted by the number of managers, executives and clerks and the latter by the number of plant operators. With this variable we aim at estimating the possible relation of complementarity/substitutability between the level of skills previously acquired

[5] We adopt the more parsimonious Pavitt taxonomy instead of a standard ATECO classification in order to avoid the possibility of perfect prediction of the model and in order to better distinguish industries on the base of their status of technological development.

by employees and the further amount of skills acquired on-the-job. If skills are an input in the production of future skills, then a positive sign of the estimated coefficient is expected.

We also control for the hiring behaviour of the firm by including the average share of workers employed over the three years 2001-2003 (*HIRE/L*). If firms, like in job competition models of the labour market, select workers on the base of their characteristics and then train them on the job, a positive and significant relationship should arise. If a negative, or an insignificant coefficient arises, then the training behaviour of the firm at time *t* is not affected by the amount of workers hired at time *t*-1.

Technological innovation activities are captured by four dummies, equal to one when, along the three-year period 2001-2003 the firm: (i) invested in new machinery, equipment and ICT (*INVESTMENT*); (ii) engaged in R&D activities (*R&D*); (iii) introduced new products (*PROD_INN*); (iv) introduced new processes (*PROC_INN*). With these four specifications we aim at studying the impact of three different conceptualisations of technological innovation. Investments in new capital equipment can be thought as a proxy for embodied-technical change; R&D, instead, can be seen as an input in the innovation process and a measure of formal in-house of the firm and, finally, product and process innovation are a measure of the output of innovation activity.

Organizational innovation, instead, is measured through three groups of variables: organizational change linked to technological innovation, the outsourcing of production and service activities, and firm's internationalisation.

The first is further split into a dummy capturing the adoption of new managerial and organizational practices after the introduction of new products (*ORG_PROD*) and a dummy capturing the adoption of new managerial and organizational practices after the introduction of new processes (*ORG_PROC*).

The second, instead, is measured by three dummies: the first gathers information on the firm decision to outsource at least one activity to external suppliers in 2001-2003 (*OUTSOURICNG*), while the second and the third discriminate between the outsourcing of production activities (*OUT_PROD*) and the outsourcing of service activities[6] (*OUT_SERV*).

Finally, firms international commitment is measured by three dummies: the propensity to export goods and services (*EXPORT*), the propensity to relocate production activities abroad (*OFFSHORING*) and the propensity to purchase services from abroad (*EXT_SERV*), like transport, insurance, communication services, financial services, computer-based services, R&D and

[6] The service activities outsourced consist of: administrative-managerial services, accounting and bookkeeping, computer-based activities, R&D and project services, testing and technical analyses, advertising, personnel recruitment, storage and packing, cleaning and surveillance services, call center, other activities.

engineering[7]. We do not expect export to have a clear-cut impact on the firm's propensity to train: in fact, while on the one hand export can be conceived as a complex activity of the firm, thus increasing the requirement for managerial and language skills, on the other hand it can be seen a follow-up of training and production activities. Production re-location, i.e. offshoring, is conceived as the transfer of economic activities to foreign countries, traditionally to exploit factor costs differentials or the availability of missing skills at home. This strategy may involve either the opening of a new affiliate abroad as well as the subcontracting abroad of production activities, or the mere reproduction of domestic activities abroad. To the extent that firms transfer abroad low-skill intensive stages of the production process, they can focus on core activities, thus improving the process of skill formation. However, transferring abroad production activities may also decrease the number of workers employed by the firm, thus decreasing its general training intensity. Finally, to the extent that the acquisition of external services involves knowledge-intensive activities, the variable *EXT_SERV* may exert a positive role in affecting the firm's willingness to train.

Next to this set of variables, we also include a dummy equal to one if the firm invested in training activities in year 2003. Tables A2 and A3 in the Appendix report the description of the variables and some summary statistics, while Table A4 shows the correlation matrix among dependent variables.

4.2. The empirical models: training incidence and training intensity

We first estimate the training propensity of a firm in year 2004 ($TRAIN_{2004}$) by using a probit specification of the type:

$$(1)\ \Pr(TRAIN_{2004} = 1) = \Phi(\beta \mathbf{X} + \varepsilon),$$

in which **X** is the set of dependent variables previously described, and Φ represents the standard Normal distribution.

We then estimate if the same variables do have an impact, and of what magnitude, on the training intensity of firms, as measured by the share of trainees. Since we only observe this variable only for a subset of firms (i.e. for those firms which provided training in 2004), we are in presence of a truncated sample at a threshold level of c_i=0 and thus we need to correct for this problem which could bias our OLS estimates. To do this, we use the Heckman two-step estimator for selection models (Heckman, 1979).

[7] Unfortunately we do not have information on foreign direct investments, the purchase of technical or trade services, international trade agreements and the purchase or sell of patents on an international scale.

The methodology adopted is described below and aims to estimate an equation of the type:

(2) $s_i y_i = s_i(\beta_0 + \beta_1 x_1 + ... + \beta_k x_k + u)$ with $E(s_i u \mid x_1,...,x_k) = 0$

where s_i=1 is the selection indicator – in our case the variable $TRAIN_{2004}$ = 1 - that we observe only if $u_i \leq c_i$ - $\mathbf{x_i\beta}$ and the error term is normally distributed with zero conditional mean[8]. Since s_i depends directly on u_i, s_i and u_i will not be uncorrelated, even conditional on $\mathbf{x_i}$, so the standard OLS estimator is no longer consistent.

The usual way of tackling sample selection bias is to add an explicit selection equation to the population model of interest, e.g.:

(3) $y_i = \beta_0 + \beta_1 x_1 + ... + \beta_k x_k + u$ with $E(s_i u \mid x_1,...,x_k) = 0$

$s_i = 1[\gamma_0 + \gamma_1 z_1 + ... + \gamma_m z_m + \nu \geq 0]$

in which we assume that elements of x and z are always observed and $E(u \mid x_1,...,x_k; z_1,...,z_m) = 0$.

The Heckman two-stage estimation method (Heckit) is used first to estimate γ using the entire sample and, in the next step, to consistently estimate β on the subset of observations for which the selection variable is observed. Operationally, the Heckit first uses the n observations of the sample and estimates a probit model of s_i on z_i to obtain estimates of $\hat{\gamma}$. Then, it calculates the inverse Mill's ratio $\hat{\lambda}_i = \lambda(z_i, \hat{\gamma})$ for each i with s_i=1 (the selected sample). In the second stage, the selected sample is used to estimate y_i on x_i and $\hat{\lambda}_i$ and obtain estimates of β that are consistent and approximately normally distributed.

5. Estimations results

Tables 3.4 and 3.5 report the results of the two sets of estimations. Table 3.4 refers to probit estimates on training incidence. We estimate four different models, in which we separately investigate the effect of our technology and organization variables in order to avoid the inclusion of highly correlated independent variables. In model (1) technological change is measured by the propensity to invest in new equipment and in R&D. In model (2) we substitute R&D with product and process innovations, that can potentially represent the by-product of R&D and, thus, are more strongly correlated with such a variable (see Table A4 in the Appendix). In model (3) we specifically concentrate on variables of organizational change, i.e. the adoption of new

[8] It is easy to see that when s_i=1, we return to the standard initial model $y_i = \beta_o + \beta_1 x_1 + ... + \beta_k x_k + u$, whereas, when s_i=0 we get the null identity 0=0+0 that tells us nothing about β.

organizational practices after product and process innovations and the outsourcing dummy. In model (4), finally, we split this last variable into the outsourcing of product and service activities. As reported by the pseudo R^2 and the AIC statistics, this last specification is the one that fits better with data, while the general goodness of fit of the model is given by the Hosmer and Lemeshow test[9].

The estimations show that, as expected, large firms, operating primarily in science-based industries are more willing to train their workforce. Moreover, the training propensity is also positively affected by capital intensity and by the skill ratio: this results confirm both the complementary nature of the relationship between physical and human capital, and the fact that human capital is also an input in the production of further human capital. Labour cost, on the contrary, although showing the expected sign, is always not statistically significant, meaning that firms, when deciding on whether to train or not, do not seem to take into account factor prices. The share of workers previously employed, instead, is always highly significant: in particular, a 1% increase in the fraction of workers employed increases the probability of training by 4%. This can be interpreted as a sign in favour of job-competition-like models of the labour market in which firms hire workers on the base of their background characteristics and then form working skills by training them on-the-job. Past training experience also positively affects current training decisions, showing a sort of path-dependency in training activities.

Concerning firms internationalisation, we note that the only variable that significantly affects the propensity to train is *EXT_SERV*. In other words, while neither exports nor offshoring seem to have an impact on the skill formation of firms, the acquisition of new services from abroad may require firms to provide workers with the skills necessary in order to effectively operate them.

We now turn to the effect of technological innovations. All the four specifications of the model show, at first, that capital-embodied technological change do not have a significant effect on training incidence. Firms that engage in formal R&D activities, instead, have an average 8.5% probability to invest in work-based training. When we look at the output of innovation activities, we find that the previous introduction of new products does not seem to have any relevant effect on training incidence, while firms engaging in process innovations tend to have a 6.2% higher probability to offer training with respect to non innovative firms, even if this effect is only significant at 10%.

[9] The Hosmer and Lemeshow goodness-of-fit test divides subjects into deciles based on predicted probabilities, then computes a chi-square from observed and expected frequencies. The p-value=0.2 here means that we fail to reject the null hypothesis that there is no difference between the observed and predicted values, implying that the model's estimates fit the data at an acceptable level..

A stronger and higher effect seems to be exerted by organisational innovations. As model (3) and (4) estimations show, firms combining process innovation and the adoption of new organisational practices seem to be engaged in training activities by 7.5% more than non innovative firms, while the combination of product and organisational innovations does not have any significant impact. Finally, product and service outsourcing do positively affect training incidence: in other words, the externalisation of redundant phases of the production process may allow firms to focus on the most knowledge-intensive activities, thus increasing the propensity to create or update skills on the job.

Table 3.5 shows, instead, the results of the Heckit estimations on training intensity. As previously stated, this indicator is given by the natural logarithm of ratio between total trainees and total employees in year 2004. In the presentation of the results, we omit the first-stage estimates, and we put the attention on the second stage output. As before, we specify four models in order to look at the separate effect of the various techno-organisational innovation variables. Interestingly, only two variables seem to positively affect the training intensity of firms: the skill ratio and the purchase of services from abroad. In average, a 1% increase in the skill ratio, other than affecting the firm's decision on whether to train, increases the share of trainees by 10%. On the contrary, the purchase of services from abroad positively drives the choice to train but, once decided, it tends to decrease the intensity of training. This latter result may be due to the nature of the service purchased: for example, the acquisition of computer-services may require just a worker to be trained, or, once adopted, these service may work as substitute for labour inputs, thus reducing the pool of potential trainees.

Therefore, in contrast with the evidence on training incidence, we find that the core activities of the firm – i.e. international commitment, techno-organisational innovations and outsourcing - do hardly contribute to explaining the level of effort in the process of skill formation. In line with Hollenstein and Stucki (2008), we can think that these surprising results may be due to a lack of variability in our second-stage dependent variable. Therefore, in order to overcome this problem we transform the quantitative *TRAIN/L* variable onto an ordinal scale, by grouping firms on the base of their training intensity value in four ordinal classes of similar size ($TRAIN\_CAT_{2004}$).

We then first estimate a standard ordered logit model by using $TRAIN\_CAT_{2004}$ as the dependent variable. Since this class of models requires the assumption of proportional odds to hold – i.e. that the coefficients of the dependent variables to be the same for every dividing point – one should test if this restriction by means, for instance, of a likelihood-ratio test of whether the coefficients are equal across categories. Unfortunately, this is not the case of our estimates since the

p-value of the LR statistic is significant so that we reject the null hypothesis that the coefficients are equal across categories.

We therefore relax the proportional odds assumption by estimating a generalised ordered logit model (Kang Fu, 1997) which allows the effects of the explanatory variables to vary with the point at which the categories of the dependent variables are dichotomised. Our results (see Table A5 in the Appendix) show now that, while R&D and the outsourcing of service activities play an additional positive effect at lower levels of training intensity, variables like the purchase of services from abroad and the adoption of new organisational practices after the introduction of new processes do have a significant influence on the highest levels of training intensity, i.e. categories 3 and 4. In particular, *ORG_PROC* is the only variable, together with the skill ratio, that seems to have a positive and increasing effect in passing from category 3 to category 4.

We now conclude that techno-organisational innovations not only affects the propensity of firms to train, but also the intensity of training.

Table 3.4. Training incidence: Probit estimates

Dep. var. $TRAIN_{2004}$	(1)		(2)		(3)		(4)	
Variables	**dF/dx**	**Std. Err.**	**dF/dx**	**Std. Err.**	**dF/dx**	**Std. Err.**	**dF/dx**	**Std. Err.**
North West	0.009	0.060	0.022	0.060	0.019	0.060	0.021	0.060
North East	0.103	0.060*	0.119	0.059**	0.117	0.060*	0.118	0.060*
Centre	0.013	0.068	0.026	0.068	0.021	0.068	0.019	0.069
Scale	0.059	0.048	0.060	0.047	0.067	0.048	0.068	0.048
Specialised	0.112	0.039**	0.126	0.039***	0.126	0.039***	0.126	0.039***
Science	0.227	0081**	0.238	0.080**	0.240	0.081**	0.242	0.081**
Medium	0.050	0.046	0.056	0.045	0.057	0.046	0.061	0.046
Large	0.373	0.049***	0.383	0.048***	0.375	0.048***	0.377	0.049***
Ln (K/Y)	0.035	0.020*	0.033	0.020*	0.033	0.020*	0.034	0.020*
Ln (WC/BC)	0.042	0.022*	0.046	0.022**	0.042	0.022*	0.040	0.022*
Ln (LC/Y)	-0.020	0.061	-0.014	0.062	-0.019	0.061	-0.022	0.061
Ln_(HIRE/L)	0.043	0.018**	0.042	0.018**	0.041	0.019**	0.040	0.019**
$TRAIN_{2003}$	0.299	0.032***	0.300	0.033***	0.300	0.033***	0.302	0.033***
EXPORT	-0.083	0.048*	-0.061	0.048	-0.066	0.047	-0.068	0.048
OFFSHORING	-0.031	0.055	-0.027	0.056	-0.028	0.056	-0.027	0.056
EXT_SERV	0.073	0.041*	0.083	0.041**	0.075	0.041*	0.077	0.041*
INVESTMENT	0.093	0.062	0.089	0.064	0.082	0.063	0.084	0.063
R&D	0.085	0.036**						
PROD_INN			-0.018	0.035				
PROC_INN			0.062	0.035*				
ORG_PROD					0.042	0.042	0.044	0.042
ORG_PROC					0.078	0.039**	0.075	0.045*
OUTSOURCING					0.052	0.040		
OUT_PROD							0.103	0.057*
OUT_SERV							0.098	0.056*
N. Obs	1100		1100		1100		1100	
Pseudo R^2	0.1952		0.1937		0.1985		0.2010	
AIC	1263.665		1267.923		1262.671		1260.87	
H-L GOF test χ^2 (1081)	1105.5		1106.85		1114.79		1108.76	
Prob > χ^2	0.2926		0.2785		0.2188		0.2512	

Notes: dependent variable: dummy training in 2004 ($TRAIN_{2004}$). All standard errors are robust to heteroskedasticity. South, Small and Supplier dominated variables are taken as reference categories in order to avoid collinearity problems. Columns dF/dx report the marginal effects of independent variables on $TRAIN_{2004}$ evaluated at the mean of dependent variables.

Table 3.5. Training intensity: Heckit estimates

$\text{Ln}(TRAIN/L)_{2004}$	(1)		(2)		(3)		(4)	
Variables	**Coeff**	**Std. Err.**	**Coeff**	**Std. Err.**	**Coeff**	**Std. Err.**	**Coeff**	**Std. Err.**
Ln (K/Y)	0.027	0.053	0.027	0.054	0.023	0.053	0.020	0.053
Ln (WC/BC)	0.112	0.053**	0.111	0.053**	0.109	0.053**	0.103	0.053**
Ln (LC/Y)	-0.180	0.143	-0.179	0.143	-0.174	0.143	-0.180	0.143
HIRE	(1)	-	(1)	-	(1)	-	(1)	-
TRAIN_{2003}	(1)	-	(1)	-	(1)	-	(1)	-
EXPORT	-0.033	0.126	-0.027	0.126	-0.020	0.125	-0.020	0.125
OFFSHORING	0.001	0.130	0.006	0.130	0.012	0.130	0.012	0.130
EXT_SERV	-0.164	0.097*	-0.157	0.098	-0.177	0.097	-0.192	0.097**
INVESTMENT	-0.205	0.207	-0.205	0.207	-0.243	0.207	-0.270	0.207
R&D	0.046	0.096						
PROD_INN			0.004	0.088				
PROC_INN			0.012	0.418				
ORG_PROD					0.037	0.104	0.038	0.104
ORG_PROC					0.101	0.101	0.101	0.101
OUTSOURCING					0.013	0.097		
OUT_PROD							-0.112	0.143
OUT_SERV							0.154	0.131
Mills LAMBDA	-0.433	0.212**	-0.437	0.210**	-0.446	0.210**	-0.446	0.211**
Area dummies	Yes		Yes		Yes		Yes	
Industry dummies	Yes		Yes		Yes		Yes	
Size dummies	Yes		Yes		Yes		Yes	
N. Obs.	1364		1364		1364		1364	
Censored Obs.	714		714		714		714	
Wald χ^2	198.0 (p<0.000)		193.87 (p<0.000)		204.32 (p<0.000)		210.51 (p<0.000)	

Notes: all standard errors are robust to heteroskedasticity. South, Small and Supplier dominated are taken as reference variables in order to avoid collinearity problems. Variables HIRE and TRAIN2003 have been dropped from the first stage Probit estimation in order to avoid biased coefficients in the second stage OLS estimation (Wooldridge, 2002). All estimations include a constant term.

6. Concluding remarks

In this paper we study the relationship between techno-organizational innovation and skill formation from a labour demand perspective. In particular, we investigate if activities aimed at increasing the international commitment and the technological and organizational change do have an effect on both the propensity of firms to train and on the intensity of training.

On this purpose, by relying on a job-competition-like framework about the operation of the labour market in allocating skills, we first estimate which factors do affect the propensity of firms to invest in work-based training activities, and, secondly, we estimate if the same factors do also play a role in determining the degree of intensity of such a training activity.

Relying on a new dataset on Italian manufacturing firms active over the period 2001-2006, we first estimate a probit model on the probability for a firm to train; then we employ a Heckman two-stage selection model on the share of trainees with which we can control for selectivity bias.

Our results point to a positive and significant effect of both firms' characteristics, like size, specialization and capital intensity, and firms' techno-organisational activities on both training incidence and on training intensity. A particularly significant role, in this respect, is played by the combination of process innovation and the adoption of new organizational practices.

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Appendix

Table A1. Sample structure by industry (ATECO 1991 classification)

	Before cleaning		After cleaning	
Industries	**N.**	**%**	**N.**	**%**
15-Food products and beverages	116	7.51	109	7.80
17-Textile	118	7.64	108	7.73
18-Wearing apparel and dyering of fur	44	2.85	40	2.86
19-Leather, luggage, shoes	62	4.01	55	3.93
20-Wood (except furniture)	36	2.33	33	2.36
21-Paper and paper products	39	2.52	35	2.50
22-Publishing, printing and recorded media	38	2.46	32	2.29
23-Coke, petroleum products and nuclear fuel	9	0.58	8	0.57
24-Chemicals and chemical products	90	5.83	79	5.65
25-Rubber and plastics	83	5.37	77	5.51
26-Non-metallic mineral products	92	5.95	85	6.08
27-Basic metals	66	4.27	59	4.22
28-Fabricated metal products (except machinery)	182	11.78	169	12.09
29-Machinery and equipment	272	17.61	253	18.10
30-Office, accounting and computer machnery	5	0.32	3	0.21
31-Electrical machinery and apparatus	66	4.27	60	4.29
32-Radio, TV and communication equipment	34	2.20	29	2.07
33-Industrial process control equipment	36	2.33	30	2.15
34-Motor vehicles, trailers and semi-trailers	33	2.14	28	2.00
35-Other transport equipment	25	1.62	21	1.50
36-Other manufacturing, funriture, etc.	99	6.41	85	6.08
Total	**1.545**	**100.00**	**1.398**	**100.0**

Table A2. Variables description

Variables	Description
Area	*North West*: Liguria, Lombardia, Piemonte, Valle d'Aosta *North East*: Emilia-Romagna, Friuli Venezia-Giulia, Trentino Alto Adige, Veneto *Centre:* Lazio, Marche, Toscana, Umbria *South*: Abruzzo, Basilicata, Calabria, Campania, Molise, Puglia, Sardegna, Sicilia
Capital intensity	Ln (K/Y) Net technical assets over value added, average 2001-2003, natural logarithm
Hiring behaviour	Ln (HIRE/L) Average number of workers hired over total employment in 2001-2003, natural logarithm HIRE Dummy = 1 if the firm hired new workers during the period 2001-2003, 0 otherwise
Industry Pavitt taxonomy	*Supplier dominated*: textiles, clothes, food products, beverages, paper, printing, publishing *Scale intensive*: basic metals, motor vehicles *Specialised suppliers*: industrial machinery; office accounting and computer machinery *Science based*: chemicals, pharmaceuticals, electronics
Internationalization	EXPORT *Dummy*=1 if the firm exported goods in 2001-2003 OFFSHORING *Dummy*=1 if the firm delocalized abroad its activities in 2001-2003 EXT_SERV *Dummy*=1 if the firm purchased service activities from abroad in 2001-2003
Labour cost	Ln (LC/Y) labour cost over value added, average 2001-2003, natural logarithm
Organizational change	ORG_PROD *Dummy*=1 if the firm adopted new organizational practices after the introduction of new products in 2001-2003 ORG_PROC *Dummy*=1 if the firm adopted new organizational practices after the introduction of new processes in 2001-2003 OUTSOURCING *Dummy*=1 if the firm contracted out production or service activities in 2001-2003 OUT_PROD *Dummy*=1 if the firm contracted out only production activities in 2001-2003 OUT_SERV *Dummy*=1 if the firm contracted out only service activities in 2001-2003
Skill composition	Ln (WC/BC) white collars over blue collars, average 2001-2003, natural logarithm White collars: managers, executives, clerks Blue collars: plant operators
Size	Small 11-49 employees Medium 50-249 employees Large ≥ 250 employees
Technological innovation	INVESTMENT *Dummy*=1 if the firm invested in the acquisition of new machinery, equipment in 2001-2003 PROD_INN *Dummy*=1 if the firm introduced product innovations in 2001-2003 PROC_INN *Dummy*=1 if the firm introduced process innovations in 2001-2003 R&D *Dummy*=1 if the firm invested in R&D in 2001-2003
Training	TRAIN2003 *Dummy*=1 if the firm provided training in 2003 TRAIN2004 *Dummy*=1 if the firm provided training in 2004 (dependent variable) TRAIN/L 2004 number of trainees over total employment in 2004 (dependent variable) TRAIN_CAT 2004 categories of TRAIN/L 2004

Table A3. Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Area					
North West	1398	0.381	0.486	0	1
North East	1398	0.339	0.474	0	1
Centre	1398	0.156	0.363	0	1
South	1398	0.124	0.329	0	1
Capital intensity					
K/Y	1398	0.891	1.151	0	27.371
Hiring behaviour					
HIRE/L	1398	0.073	0.129	0	2.670
HIRE	1398	0.897	0.304	0	1
Industry					
Supplier dominated	1398	0.457	0.498	0	1
Scale intensive	1398	0.171	0.377	0	1
Specialised suppliers	1398	0.321	0.467	0	1
Science based	1398	0.051	0.220	0	1
Internationalisation					
EXPORT	1398	0.824	0.381	0	1
OFFSHORING	1398	0.104	0.306	0	1
EXT_SERV	1398	0.219	0.413	0	1
Labour cost					
LC/Y	1398	0.654	0.177	0.087	2.413
Organizational change					
ORG_PROD	1398	0.245	0.430	0	1
ORG_PROC	1398	0.314	0.464	0	1
OUTSOURCING	1398	0.215	0.411	0	1
OUT_PROD	1398	0.087	0.282	0	1
OUT_SERV	1398	0.090	0.287	0	1
Skill composition					
WC/BC	1370	1.038	8.145	0	274.9
Size					
Small	1398	0.205	0.406	0	1
Medium	1398	0.563	0.496	0	1
Large	1398	0.232	0.423	0	1
Technological innovation					
INVESTMENT	1398	0.919	0.273	0	1
PROD_INN	1398	0.476	0.499	0	1
PROC_INN	1398	0.487	0.500	0	1
R&D	1398	0540	0.499	0	1
Training					
TRAIN 2003	1398	0.577	0.494	0	1
TRAIN 2004	1398	0.479	0.500	0	1
TRAIN/L 2004	1398	0.163	0.259	0	1

Table A4. Correlation matrix

Variables	Ln(K/Y)	Ln WC/BC	Ln LC/Y	Ln HIRE	$TRAIN_{2003}$	EXP	OFFSH	EXT_SER	INVEST	R&D	PD_INN	PC_INN	ORG_PROD	ORG_PROC	OUT_PROD	OUT_SER
Ln(K/Y)	1.000															
Ln(WC/BC)	-0.2269	1.000														
Ln(LC/Y)	-0.0980	-0.0311	1.000													
Ln(HIRE/L)	-0.0364	-0.0317	-0.0318	1.000												
$TRAIN_{2003}$	-0.0089	0.1776	-0.0349	0.0262	1.000											
EXPORT	-0.0821	0.0462	0.0443	0.0263	0.0808	1.000										
OFFSHORING	-0.1030	0.0448	0.0333	-0.0059	0.0717	0.1145	1.000									
EXT_SERV	0.0047	0.0479	-0.0022	0.0589	0.1520	0.2046	0.1168	1.000								
INVESTMENT	0.0293	0.0039	-0.0725	0.0331	0.1235	0.0830	0.0026	0.0205	1.000							
R&D	-0.0228	0.1409	0.0326	-0.0174	0.1842	0.2863	0.1274	0.2203	0.1359	1.000						
PROD_INN	-0.0172	0.0849	-0.0129	0.0480	0.1312	0.2161	0.1166	0.1769	0.1411	0.4775	1.000					
PROC_INN	0.1193	-0.0029	-0.0495	0.0118	0.1196	0.0800	0.0685	0.0900	0.2139	0.2708	0.2712	1.000				
ORG_PROD	0.0079	0.0761	-0.0096	-0.0188	0.0797	0.1164	0.0364	0.0961	0.0702	0.2823	0.4922	0.2285	1.000			
ORG_PROC	0.0943	0.0496	-0.0316	0.0218	0.1029	0.0352	0.0519	0.1014	0.1469	0.1622	0.1360	0.5152	0.4679	1.000		
OUT_PROD	-0.0566	0.0350	0.0802	-0.0129	-0.0294	0.0325	0.0086	-0.0000	-0.0478	-0.0143	-0.0234	-0.0121	0.0414	0.0396	1.000	
OUT_SERV	0.0076	0.0698	-0.0048	0.0555	0.0701	0.0040	0.0460	0.0459	0.0686	0.0725	0.0602	0.0829	0.0079	0.0412	-0.1088	1.000

Table A5. Generalised ordered logit estimates on training intensity

train_cat04	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
mleq1						
NO	.0971202	.234362	0.41	0.679	-.3622208	.5564612
NE	.5447447	.2371746	2.30	0.022	.079891	1.009598
Cen	.1333587	.2795541	0.48	0.633	-.4145573	.6812747
medium	.2451549	.193665	1.27	0.206	-.1344215	.6247313
large	1.782223	.2867093	6.22	0.000	1.220284	2.344163
scala	.2198109	.1937687	1.13	0.257	-.1599688	.5995906
special	.6500992	.1641278	3.96	0.000	.3284147	.9717838
science	1.223319	.4188122	2.92	0.003	.402462	2.044176
ln_KY0103	.1051761	.0827962	1.27	0.204	-.0571015	.2674538
ln_wcbc0103	.1254013	.092208	1.36	0.174	-.0553231	.3061257
Llc_va0103	-.2364648	.2651288	-0.89	0.372	-.7561077	.2831781
ln_assuadd~3	.1846925	.0784565	2.35	0.019	.0309205	.3384645
flfor03	1.300844	.1487977	8.74	0.000	1.009206	1.592483
haesport	-.4090458	.2045141	-2.00	0.045	-.809886	-.0082056
deloca	-.2132963	.2458918	-0.87	0.386	-.6952353	.2686427
serveste	.224822	.1727676	1.30	0.193	-.1137962	.5634402
hainve	.289339	.2694445	1.07	0.283	-.2387625	.8174405
res	.259483	.1534439	1.69	0.091	-.0412615	.5602276
org_prod	.0834793	.175814	0.47	0.635	-.2611098	.4280684
org_proc	**.3506934**	.1663545	2.11	**0.035**	.0246446	.6767421
out_prod	.3184389	.248758	1.28	0.201	-.1691179	.8059956
out_serv	.2598565	.2341778	1.11	0.267	-.1991235	.7188365
_cons	-1.495347	.4743968	-3.15	0.002	-2.425147	-.565546
mleq2						
NO	-.3902544	.2653946	-1.47	0.141	-.9104183	.1299096
NE	.2431181	.2666297	0.91	0.362	-.2794665	.7657027
Cen	-.2082983	.299197	-0.70	0.486	-.7947137	.3781171
medium	-.3399222	.2128058	-1.60	0.110	-.7570139	.0771695
large	.8074357	.2726001	2.96	0.003	.2731492	1.341722
scala	.4452407	.2069254	2.15	0.031	.0396743	.8508071
special	.5665796	.1694099	3.34	0.001	.2345424	.8986168
science	1.379262	.3421631	4.03	0.000	.708635	2.04989
ln_KY0103	.0643207	.0884055	0.73	0.467	-.108951	.2375923
ln_wcbc0103	.1709702	.0975873	1.75	0.080	-.0202974	.3622378
Llc_va0103	-.1150361	.2566942	-0.45	0.654	-.6181475	.3880753
ln_assuadd~3	.0837271	.0832042	1.01	0.314	-.0793502	.2468043
flfor03	1.272053	.1739064	7.31	0.000	.9312028	1.612903
haesport	-.5600078	.211153	-2.65	0.008	-.97386	-.1461555
deloca	.201922	.2506768	0.81	0.421	-.2893956	.6932395
serveste	-.0621488	.179083	-0.35	0.729	-.413145	.2888474
hainve	.2583283	.2895476	0.89	0.372	-.3091745	.8258311
res	.362058	.1635855	2.21	0.027	.0414363	.6826797
org_prod	.1316698	.1776086	0.74	0.458	-.2164367	.4797763
org_proc	**.4072197**	.1706099	2.39	**0.017**	.0728305	.7416089
out_prod	.2368065	.2603769	0.91	0.363	-.2735228	.7471358
out_serv	.6022838	.2533368	2.38	0.017	.1057529	1.098815
_cons	-1.484775	.5240322	-2.83	0.005	-2.51186	-.4576912
mleq3						
NO	-.5824817	.3271024	-1.78	0.075	-1.223591	.0586272
NE	-.4298209	.3181504	-1.35	0.177	-1.053384	.1937424
Cen	-.5401867	.3511865	-1.54	0.124	-1.2285	.1481262
medium	-.1035894	.2604241	-0.40	0.691	-.6140113	.4068324
large	1.162464	.3154407	3.69	0.000	.5442111	1.780716
scala	.8387766	.2475607	3.39	0.001	.3535664	1.323987
special	.8159684	.2049337	3.98	0.000	.4143058	1.217631
science	1.27741	.384982	3.32	0.001	.5228594	2.031961
ln_KY0103	.0647475	.1061406	0.61	0.542	-.1432844	.2727793
ln_wcbc0103	.4147346	.1048005	3.96	0.000	.2093295	.6201398
Llc_va0103	-.4181863	.277614	-1.51	0.132	-.9622997	.1259271
ln_assuadd~3	.1164634	.1025017	1.14	0.256	-.0844362	.317363
flfor03	.9436497	.2461401	3.83	0.000	.461224	1.426075
haesport	-.5406375	.2548783	-2.12	0.034	-1.04019	-.0410852
deloca	-.0498505	.257261	-0.19	0.846	-.5540728	.4543717
serveste	-.32481	.1974659	-1.64	0.100	-.7118361	.062216
hainve	-.3385347	.4349804	-0.78	0.436	-1.191081	.5140111
res	.229912	.2213255	1.04	0.299	-.2038781	.663702
org_prod	.0514997	.2013024	0.26	0.798	-.3430457	.4460451
org_proc	**.4108312**	.1958172	2.10	**0.036**	.0270365	.7946259
out_prod	.0762555	.2969548	0.26	0.797	-.5057651	.6582762
out_serv	.5345251	.2514597	2.13	0.034	.0416732	1.027377
_cons	-1.155811	.6221137	-1.86	0.063	-2.375131	.0635099

mleq4						
NO	-1.416352	.4592971	-3.08	0.002	-2.316558	-.5161462
NE	-1.709808	.5244526	-3.26	0.001	-2.737716	-.6818995
Cen	-1.489353	.4925102	-3.02	0.002	-2.454655	-.5240509
medium	-.6211983	.3670952	-1.69	0.091	-1.340692	.0982952
large	.4466942	.3966452	1.13	0.260	-.3307162	1.224105
scala	1.232248	.3597876	3.42	0.001	.5270772	1.937419
special	.6301784	.3004223	2.10	0.036	.0413616	1.218995
science	.8309711	.5027695	1.65	0.098	-.1544391	1.816381
ln_KY0103	-.05845	.1615867	-0.36	0.718	-.3751541	.2582542
ln_wcbc0103	.410308	.1346223	3.05	0.002	.1464531	.6741629
Llc_va0103	-.3325067	.4120034	-0.81	0.420	-1.140019	.4750052
ln_assuadd~3	.170323	.1469869	1.16	0.247	-.117766	.458412
flfor03	.4069728	.3416248	1.19	0.234	-.2625996	1.076545
haesport	-.0788976	.3860406	-0.20	0.838	-.8355233	.6777281
deloca	-.0829738	.3534865	-0.23	0.814	-.7757946	.609847
serveste	-.0915938	.2733428	-0.34	0.738	-.627336	.4441483
hainve	.0556983	.6001589	0.09	0.926	-1.120592	1.231988
res	.2265514	.3520001	0.64	0.520	-.4633562	.9164589
org_prod	-.0092892	.2729278	-0.03	0.973	-.5442178	.5256395
org_proc	**.5430379**	.2829517	1.92	**0.055**	-.0115373	1.097613
out_prod	.3179318	.4812308	0.66	0.509	-.6252632	1.261127
out_serv	.4065619	.2981243	1.36	0.173	-.177751	.9908748
_cons	-1.130875	.934407	-1.21	0.226	-2.962279	.7005291