The Effect of Vocational Training on Italian Firms' Productivity: Cross-Sectional Evidence from INDACO-CVTS*

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Abstract

In this paper, I explore the effect of vocational training on the productivity of a cross-sectional sample of Italian firms and I sketch the impact of training on economic growth across European countries. Specifically, retrieving data from INDACO 2009, I test the impact of on-the-job training measured as the percentage of trained workers on the production value and value-added per worker. On both indicators, training displays a positive and significant effect. However, in comparison with companion longitudinal evidence, the magnitude of this impact appears quite narrow. Untangling the determinants of training provision at the firm level and exploring the consequences of training on observed growth rates by means of CVTS4 records, I show that this finding is the outcome of microeconomic and macroeconomic size effects that influence, respectively, the identification of the training impact on corporate productivity and the aggregate performance of the whole economy.

JEL Classification: J14; M53.

Keywords: On-the-job training; Productivity; INDACO 2009; CVTS4; Cross-sectional data; Economic growth; Size effects.

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1 Introduction

The impact of vocational training on firms' productivity is an intensively debated issue on theoretical (e.g. Becker, 1962, 1993; Acemoglu and Pischke, 1999; Malcomson et al., 2003) and empirical (e.g. Bassanini et al., 2005; Sepúlveda 2010; Sala and Silva, 2013) grounds. The conventional wisdom is that labour market frictions usually enhance firms' profitability towards sponsoring training programs while on-the-job training is able to boost corporate productivity and sometimes wages as well.

Among developed countries, the analysis of training provision in the Italian context and the consequent assessment of the training effects on labour productivity display quite puzzling features. On the side of incentives, despite the documented presence of substantial labour market frictions that should allow firms to recover training investments in the form of lower wages (cf. Acemoglu and Pischke, 1999), Italian firms are instead the tail end in sponsoring training provision.[1] This striking attitude is still tending to persist even though Italy is suffering a long-lasting productivity decline that – on the contrary – should urgently call for interventions aimed at reversing the route. Furthermore, on a quantitative ground, the impact of training on productivity measured at the firm level in Italy is far below the figures retrieved in other European countries (e.g. Konings and Vanomerlingen, 2010; Sala and Silva, 2013).

Consequently, a fair assessment of the training impact on corporate productivity as well as a quantitative appraisal of its magnitude may provide some guidance in explaining the ranking of Italian firms in the international tables of training provision. Moreover, reckoning how training investments impact on labour productivity can provide support to policy interventions aimed at overturning the bad productive performance of the whole economy observed during the last twenty years.[2]

In this paper, I explore the effect of vocational training on the productivity of a large cross-sectional sample of Italian firms and I sketch the impact of training on economic growth across a set of European countries. Specifically, retrieving data from INDACO 2009 - one of the most reliable survey on the training policies implemented by Italian firms - I test the effect of on-the-job training measured on the extensive margin on the main corporate performance indexes. Furthermore, I use data retrieved from the latest Continuous Vocational Training Survey (CVTS4) to address the macroeconomic consequences of training provision on observed growth rates across the European Union (EU).

The results of this empirical exploration are the following. First, at the micro level, after having controlled for a set of relevant firms' characteristics such as workforce composition, re-

[1] According to Continuing Vocational Training Surveys (CVTS) carried out by EUROSTAT in 2005 and 2010, Italian firms are below the European average both for the percentage of workers involved in training activities and the amount of hours spent in training. Additional details are provided in Bassanini et al. (2005).

[2] In Italy, since 2000 and after a decade of stagnation, labour productivity is declining in a continuous manner. Moreover, in 2009 the Italian GDP suffered a loss of more than 5% (cf. Cardullo and Guerrazzi, 2013).

search and development (R&D) investments, sector, geographical localization and the amount of employed capital, the extensive measure of training displays a positive and significant effect on firms' productivity. However, in comparison with similar works that exploit longitudinal data, the magnitude of this effect is quite narrow no matter the exploited measure of corporate performance. Untangling the determinants of training provision at the firm level and exploring the effect of training on economic growth, I show that this finding is the outcome of microeconomic and macroeconomic size effects that influence, respectively, the identification of the impact of training on corporate productivity and the aggregate performance of the whole economy. In other words, I show that taking into account the effect of firms' size on the provision of vocational training improves the identification of training effects by delivering results closer to the most recent longitudinal micro-evidence (cf. Colombo and Stanca, 2014).

Furthermore, exploring international macro data, I show that countries in which the employed labour force is less involved in training activities experienced more severe GDP losses during the reference year of the microeconometric analysis. Consistently with an endogenous growth model in which human capital and innovations are the main drivers of the economic development, this pattern may be the culprit of the significant gap that characterizes the training impact on productivity in Italy vis-à-vis the figures retrieved in other countries.

To the best of my knowledge, the present analysis is the first contribution aimed at assessing the cross-sectional impact of training on Italian firms' productivity measured at the plant level by addressing the consequent identification issues implied by this specific kind of analysis. Moreover, exploring the consequences of training supply on economic growth, another novel feature of this work is the attempt to build a bridge between the microeconomic and macroeconomic perspectives underlying the training/productivity relationship.

The paper is arranged as follows. Section 2 reviews some related literature. Section 3 introduces the microeconometric methodology implemented to estimate the impact of training on productivity. Section 4 describes the sample of firms. Section 5 shows the estimation results. Section 6 explores the determinants of training provision at the firm level and the macroeconomic impact of training on growth rates. Finally, section 7 concludes by offering some possible developments and discussing the policy implications implied by the empirical analysis.

2 Literature review

Probably for the poor diffusion of the phenomenon with respect to other countries, there is a small set of contributions that try to assess the impact of vocational training on the productivity of Italian firms (cf. Angotti 2010). Within this set, Conti (2005) is the first attempt to provide longitudinal evidence of training effects on productivity. Specifically, her contribution is grounded on an ad-hoc data set build by merging training information retrieved from the

Italian Labour Force Survey with balance sheet data extrapolated from the AIDA archive.[3] In this way, the author sets forth a panel with 176 industries – defined as homogenous clusters of firms – for which she's able to observe training, wages, productivity and a number of corporate characteristics over the years 1996-1999. Thereafter, using several modelling specifications and a variety of econometric techniques, Conti (2005) finds that training, measured as the stock of accumulated human capital, significantly boosts industries' value-added while its effect on paid wages is definitely less important.[4] In terms of elasticity, i.e., in terms of the percentage increase in productivity triggered by an increase of 1% in the share of trained workers, the measure of the impact of training on productivity is about of the same order of magnitude of the corresponding figures retrieved in foreign industries (e.g. Dearden et al., 2006; Sepùlveda 2009).

In addition, Brunello (2007) tests the effects of vocational training on the productivity of a sample of Italian firms with more than 100 employees by retrieving data from INDACO 2000-2001 and the corresponding waves of the AIDA archive. In that contribution, the author collects a panel of about 150 businesses and explores the impact of training - measured as the fraction of employed workers involved in training activities and the corresponding average amount of hours spent in training - on the production value and the value-added per worker. Implementing standard econometric techniques, i.e., testing for random and fixed effects, Brunello (2007) finds that the extensive measure of training significantly affects in a positive way both measures of productivity while the effect of the intensive measure is positive but not statistically significant. Similar findings are retrieved by Ballot et al. (2001) in French firms of comparable size.

More recently, aiming at avoiding the possible aggregation biases of the work by Conti (2005) and the size limitations of the contribution by Brunello (2007), Colombo and Stanca (2014) explore the effect of training on the productivity of a large representative panel of Italian business all over the period 2002-2005. Specifically, the authors set forth an original data set of about $11,000$ firms by retrieving training and wage information from the Excelsior survey and extrapolating the corresponding balance sheet statements from the AIDA archive.[5] Using a variety of panel estimation techniques, Colombo and Stanca (2014) show that training intensity - measured as the percentage of trained workers - has a positive and significant impact

[3]The former is the quarterly survey that provides the harmonized indicators of the Italian labour markets, the latter is a private database provided by Bureau van Dijk that collects accounting information from the balance sheets of Italian firms with an annual turnover higher than 500,000 Euros (see www.bvdep.com/en/aida.html). A similar procedure is followed by Dearden et al. (2006).

[4]Along the lines of Boon and van der Eijekn (1998), Conti (2005) builds her indicator for the stock of accumulated human capital as the sum between the proportion of trained workers in a given time and stock of the previous period reduced by a certain depreciation rate.

[5]Excelsior is a survey carried out each year by the Italian Association of Chambers of Commerce (UNIONCAMERE) on a sample of about 100,000 firms. This private survey aims at assessing firm's occupational needs and providing detailed information about the qualification of expected new hirings. See www.excelsior.unioncamere.net.

on corporate value-added. Moreover, within occupational groups, the two authors find that training has a larger impact on blue-collars than on executive and clerical workers.

In comparison with similar works focoused on different countries, a striking feature of the work by Colombo and Stanca (2014) is the thin amplitude of the impact of training on corporate productivity. For instance, Konings and Vanormelingen (2010) - exploring a panel of Belgian firms - find results well above the figures retrieved by the mentioned Italian authors. Equivalent conclusions are achieved by comparing the average impact of training measured for the totality of the European countries (cf. Sala and Silva, 2013).

In a subsequent part of the paper, I will show how this result as well as the ones retrieved below at the micro level can be linked to the low willingness of Italian firms towards training provision and the consequent macroeconomic impact of this kind of attitude on observed growth rates.

3 The model

The microeconometric part of the present empirical analysis is grounded in the estimation of a production function which is assumed to depend on a number of firm-specific characteristics. Specifically, along the lines of Black and Lynch (1996), I suppose that the production possibilities of each surveyed firm can be described by a Cobb-Douglas function such as

$$Y_i = A_i K_i^{\alpha} L_i^{1-\alpha} \qquad 0 < \alpha < 1 \tag{1}$$

where i is an index for the individual firm, Y_i is the corresponding level of output, A_i is a measure of residual factors' productivity, α $(1-\alpha)$ is the elasticity of output with respect to capital (labour), K_i is the stock of employed capital and L_i is the number of employed workers.[6]

Following Brunello (2007), I also assume that residual factors' productivity is a log-linear function of firms' individual characteristics and a measure of the intensity of vocational training activities. Hence,

$$\ln A_i = \beta' X_i + \phi T_i \tag{2}$$

where β is a vector of regression coefficients, X_i is a vector of firm's characteristics, ϕ is a coefficient that measures the impact of training on residual factors' productivity, while T_i is a variable that quantifies the intensity of the training activity carried out by the single productive unit.

Dividing both members of eq. (1) by L_i in order to cancel out dimensional factors and taking logs allows to derive the traditional intensive linear representation of the Cobb-Douglas production function, that is

[6]According to the production function in eq. (1) productivity improvements are 'neutral', i.e., they leave marginal rates of substitution among productivity factors unaltered (e.g. Solow, 1957).

$$\ln\left(\frac{Y_i}{L_i}\right) = \ln A_i + \alpha \ln\left(\frac{K_i}{L_i}\right) \tag{3}$$

In addition, taking into account the term in eq. (2) and adding an erratic component, it is possible to derive the following expression:

$$\ln\left(\frac{Y_i}{L_i}\right) = \beta' X_i + \phi T_i + \alpha \ln\left(\frac{K_i}{L_i}\right) + \varepsilon_i \tag{4}$$

where ε_i is the stochastic disturbance.

After the selection of a set of regressors, the expression in eq. (4) will be used to estimate the impact of vocational training on firms' productivity. The exploited proxies for the dependent variable will be, alternatively, the value of production and the value-added per worker. The former is one of the most relevant operating performance ratio useful to compare companies in the same industries (cf. Johannisson, 1993), while the latter is the most common measure of the efficiency of the employed workforce (cf. Lieberman and Kang, 2008). In addition, consistently with the large majority of the contributions reviewed above, intensity of training will be proxied by the extensive measure of training provision, i.e., the percentage of trained workers.

4 Data description

The micro data set exploited to estimate eq. (4) is mainly build by retrieving information from INDACO 2009. INDACO is a survey on vocational training carried out by the Italian Institute for the Development of Vocational Training (Istituto per lo Sviluppo della Formazione Professionale dei Lavoratori - ISFOL) and the 2009 release is currently the latest available after some years of stop. This survey aims at collecting information about training policies of firms, the role of learning and training processes and the diffusion of knowledge inside productive units.[7] Specifically, for each surveyed firm is it possible to have information - among the other things - about training activities, R&D investments, the number of employees grouped in age classes sorted by gender, the sector of the business, the geographical localization, the use of social safety valves, and so on.[8]

INDACO's wave of 2009 surveyed $7,306$ firms with six or more employees. However, the Italian Official Archive of Active Firms (Archivio Statistico delle Imprese Attive - ASIA) kept by the National Institute of Statistics (Istituto Nazionale di Statistica - ISTAT) allows to retrieve the required balance sheet statements, i.e., the value of production - or revenue - per worker and the corresponding measure of employed capital, only for a pooled sample of $4,921$ productive units. Moreover, as far as the value-added per worker is also concerned, this figure falls to

[7] For instance, Neirotti and Paolucci (2013) exploit INDACO 2005 to explore the relation between training and technological/organizational changes on a sample of large Italian enterprises. More recently, Guerrazzi (2014) uses INDACO 2009 to explore the age-training patterns observed among Italian firms.

[8] Additional details on INDACO can be found in Angotti (2013).

4, 870 firms. As a consequence, the present analysis covers about 65% of the total number of surveyed firms that - in turn - according to ASIA records, represents about 0.5% of Italian firms that were active at least for six months during the reference year.[9]

In what follows, taking into account the employment size, the sector and the geographical localization, I provide some descriptive diagrams of the pooled sample of firms vis-à-vis the corresponding population references. Moreover, focusing on the former, I show how training intensity and balance sheet records vary with respect to selected corporate characteristics. In addition, I present all the descriptive statistics exploited in the subsequent microeconometric analysis.

First, the set of productive units for which the effect of training is evaluated employed - on the whole - 604, 631 workers and only about 32% of them were females.[10] The corresponding distribution of firms according to the number of employees is illustrated in figure 1. The histograms reveal that the pooled sample of businesses taken into consideration is mainly concentrated towards small and medium size productive units; indeed, more than 65% of them have less then fifty employees. However, in comparison with the population distribution, the pooled sample is somehow biased towards larger firms; in fact, according to the ASIA archive, in 2009 about 80% of Italian firms with six or more employees are found in the initial grouping ($6 - 9$ employees).

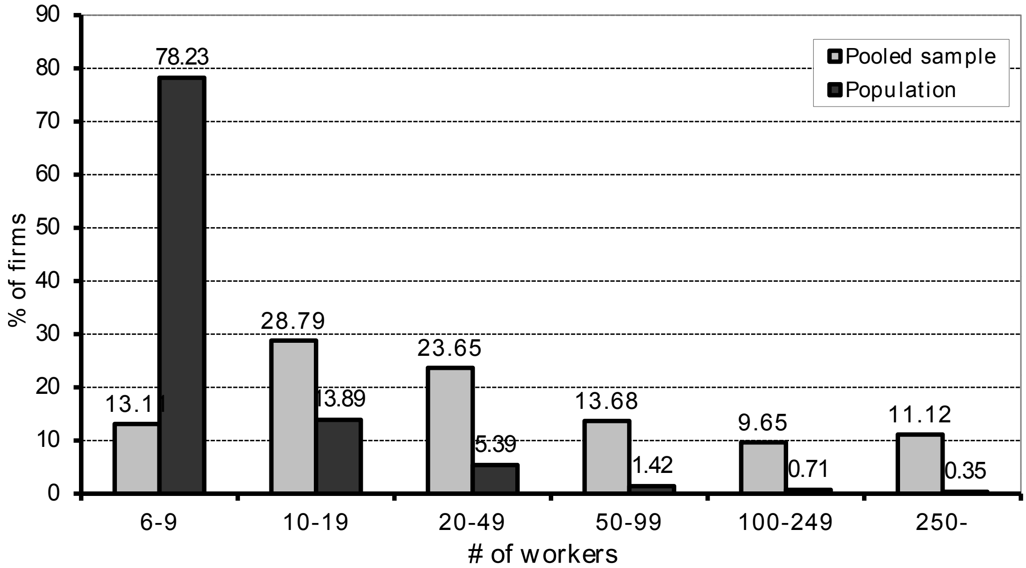

Figure 1: Distribution of firms' size, pooled sample versus population; OCSE/EUROSTAT classification

Second, figure 2 reports the distribution of businesses according to the sector in which

[9]An assessment of the selection bias induced by the adopted merging procedure is given in Appendix.

[10]According to the corresponding wave of the Italian Labour Force Survey, this figure represents about 3% of total salaried.

they were active in 2009. The diagram shows that the pooled sample is mainly concentrated towards manufacturing firms while the proportions of productive units involved in construction and services are fairly close to their respective population references. In other words, in the pooled sample, manufacturing firms are over-represented while the opposite holds for trading businesses.

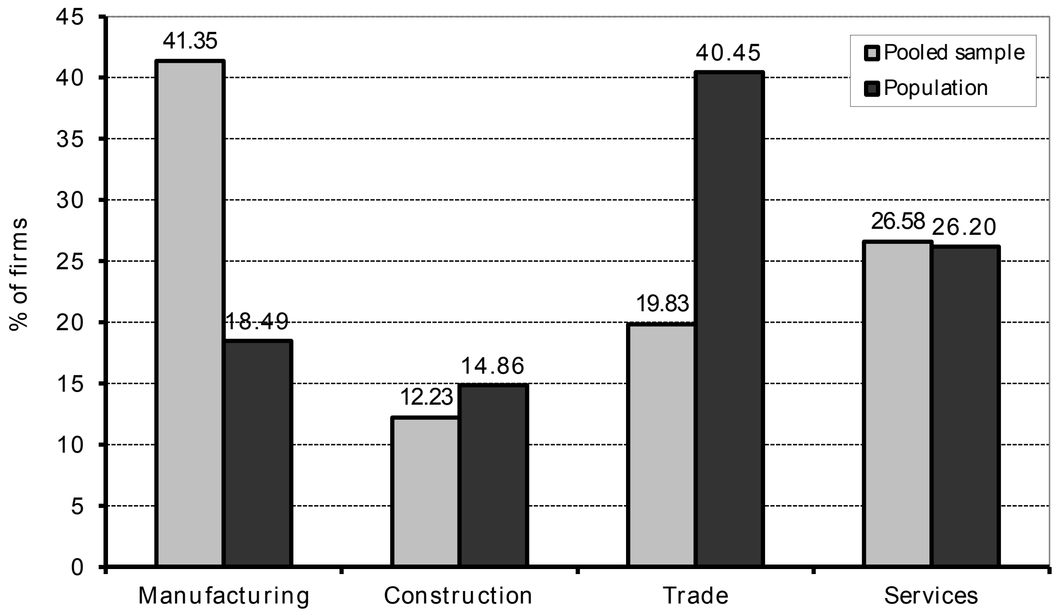

Figure 2: Sector distribution, pooled sample versus population; ATECO 2007 macro-sectors

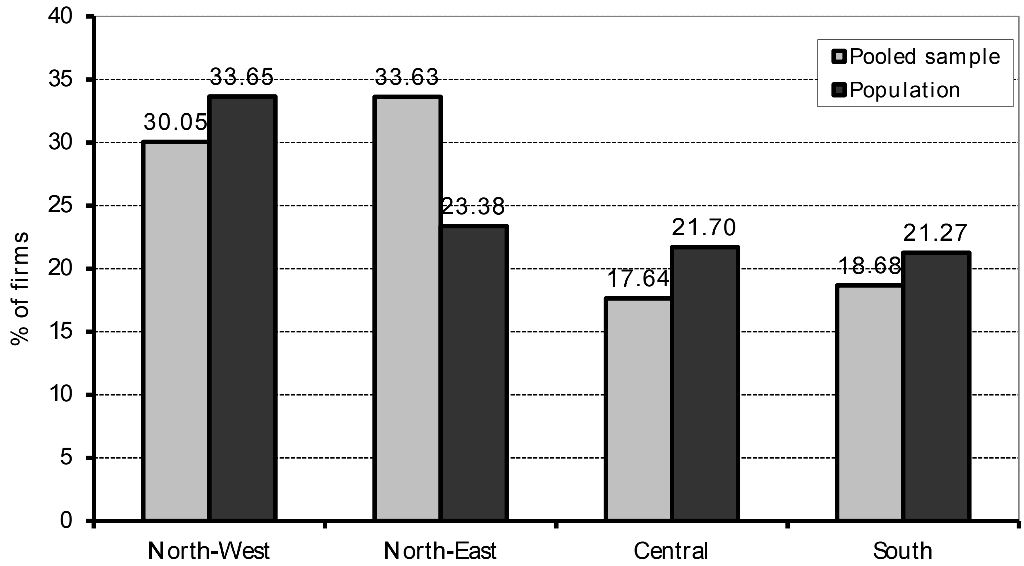

Figure 3: Spatial distribution, pooled sample versus population

In addition, figure 3 shows the distribution of productive units according to their geographical localization around the country. The histograms illustrate that the pooled sample has a spatial distribution quite close to the population reference; indeed, more than half of the productive units taken into consideration are in the North while the Central area has a number of firms of the same order of magnitude of those localized in the South.

Table 1 links some characteristics of businesses in the pooled sample with the balance sheet statements retrieved from the corresponding wave of ASIA. Specifically, it shows how the percentage of trained workers, capital, production value and value-added per worker vary according to the corporate characteristics described by figures $1-3$.[11]

# Of Employees	% Of Trained Workers	Capital Per Workers (§)	Value Of Production Per Worker (§)	Value-Added Per Worker (§)
$6-9$	19.2016	9.6457	11.7299	10.4093
$10-19$	24.3383	9.8079	11.9417	10.6706
$20-49$	28.2278	9.9454	11.9163	10.7201
$50-99$	30.1621	9.9927	11.9517	10.7552
$100-249$	38.8217	10.1580	12.0214	10.8928
$250-$	42.1473	9.9848	11.9950	10.8641
Sectors				
manufacturing	28.2899	10.4486	11.9476	10.7501
construction	36.0481	9.6322	11.9274	10.7701
trade	23.3727	9.9234	12.6755	10.7489
services	31.8830	9.1866	11.3526	10.5943
Areas				
North-West	29.9326	9.8722	12.0241	10.7868
North-East	31.8878	9.9395	11.9228	10.7200
Central	27.4931	9.8529	11.9860	10.7160
South	24.8934	9.9672	11.7459	10.5663

Table 1: Training intensity and balance sheet records, pooled sample; (§) logarithmic scale

The collected figures disclose some interesting regularities. Firstly, larger firms appear - on average - more willing to provide training, more intensively capitalized and more productive. The only exception is given by very large firms with 250 or more employees that - despite a

[11] The percentage of trained workers is given by the proportion of employees involved in formal training activities without considering workers hired with apprenticeship contracts. Capital is retrieved by the book value of fixed assets. Moreover, the figures for value-added are obtained by adding up personnel expenditures, depreciation allowances, financial costs, taxes and profits.

considerable training provision - display a capital intensity and a productivity slightly below the figures of productive units with an employed labour force between 100 and 249 employees. In all likelihood, this non-aligned pattern observed among the largest businesses has to be ascribed to a selection bias.

Moreover, as far as sectors are concerned, no clear relationship is uncovered between training intensity, the industry business classification and balance sheet statements. However, it worth noting that firms operating in construction appear as the more prone towards training provisions. This finding is probably due to the fact that these kinds of firms usually implement training programs not only to boost productivity but also for safety reasons (see the Act of the Italian Parliament 626/1994).

Furthermore, in sharp contrast with respect to the fuzzy patterns observed across business sectors, a clear picture can instead be drawn along the geographical dimension; indeed, firms localized in the North are - on average - more productive and more willing towards training provision.

Characteristics Of Firms	Mean	Standard Deviation	Minimum	Maximum
# of workers	122.870	510.753	6	23,491
production value per worker (§)	11.9314	0.9580	5.3985	17.3452
value-added per worker (§)	10.7108	0.6814	3.8407	16.1237
% of women	31.0445	24.4072	0	100
% of young workers	4.4277	7.9168	0	100
% of blue collars	51.5440	30.3761	0	99.3671
% of trained workers	29.2188	34.5002	0	100
R&D	0.213	0.410	0	1
social valves	0.2977	0.4572	0	1
manufacturing	0.4135	0.4925	0	1
construction	0.1223	0.3277	0	1
trade	0.1983	0.3987	0	1
services	0.2658	0.4418	0	1
Central	0.1764	0.3811	0	1
North-East	0.3363	0.4724	0	1
North-West	0.3005	0.4585	0	1
South	0.1868	0.3897	1	0
capital per worker (∗)	9.9091	1.8202	−0.8938	17.8918

Table 2: Descriptive statistics, pooled sample; (§) logarithmic scale

The whole set of descriptive statistics exploited in the microeconometric analysis is collected in table 2. In addition to what I said so far, those figures convey some interesting features about the willingness to undertake R&D investments and the composition of the labour force of firms in the pooled sample as well as a clear signal of the macro-economic situation that characterized the reference year of the survey. First, as stressed by Hall et al., (2012), it immediately comes clear the low propensity to finance R&D projects; indeed, only 21% of businesses taken into consideration declared to be involved in such a strategic activity. Second, the age-profile of the labour force reveals that - on average - firms in pooled sample employed a share of young employees (workers in the $15 - 24$ age grouping) of about 5%. This small figure immediately mirrors the troubles of Italian young workers in entering the labour market (cf. Brugiavini and Peracchi, 2010). Third, consistently with the concentration of businesses in the manufacturing sector signaled by figure 2, the labour force of those firms was made up for more than 1/2 of blue collars. Furthermore, about 30% of the examined productive units exploited social safety valves in the form of redundancy payments (cassa integrazione guadagni). This fraction dramatically conveys the seriousness of the recession experienced by the Italian economy in 2009.

5 Results

In this section, I show results of the estimation carried out by exploiting the regression model developed above.[12] Specifically, in order to retrieve a straightforward interpretation of the marginal effects on productivity played by the different corporate characteristics, I estimate eq. (4) with the ordinary least square (OLS) method. Moreover, aiming at avoiding multicollinearity issues, I provide estimates for a hypothetical manufacturing firm localized in the Central area. The former feature is common to the large majority of the firms in the pooled sample, the latter should allow to identify the well-assessed productivity differential among businesses in the North and those in the South (e.g. Di Giacinto and Nuzzo, 2006). The OLS regression details are collected in table 3 (standard errors in parenthesis).

The regression results reveal that the suggested model provides a quite reasonable explanation of the productivity profile of the firms in the pooled sample described in section 3; indeed, about all the covariates are statistically different from zero with a good degree of significance. More precisely, as far as the value of production (value-added) per worker is concerned, the set of firms' characteristics taken into consideration is able - on the whole - to explain about 41% (27%) of the phenomenon under investigation. Furthermore, the values of point estimates suggest the following considerations:

- firms' productivity depends in a negative way from the percentage of employed women. This finding is statistically significant and revels that businesses that employ a larger number of females suffer a productivity gap with respect to firms in which the number of males is higher. This pattern is probably due to reconciliation issues that usually lead

[12]Estimations are run with GRETEL 1.9.14. See http://gretl.sourceforge.net. The dataset is available from the author upon request.

Italian women to be over-represented in part-time employment (cf. Solera and Bettio, 2007). Furthermore, the related literature reviewed in section 2 stresses that such a gap usually impacts also on wages in the sense that - on average - females often earn less the males (e.g. Conti, 2005);

- similarly, the percentage of workers in age class $15-24$ and the proportion of blue collars have a negative influence on corporate productivity. As argued by Dearden et al. (2006), for the former group this finding is often the consequence of missing worker experience while for the latter production destination matters may be quite relevant; indeed, firms with a larger share of blue collars usually produce to export their outputs so that they may be more liable to adverse aggregate demand shocks such as the one suffered in the reference year;

- consistently with the contributions reviewed in section 2, vocational training measured as the percentage of trained workers employed by each firm boosts corporate productivity in a statistically significant manner. Specifically, point estimates reveal that whenever firms increase the proportion of employed trained workers by 1%, productivity increases by 0.001%. Honestly, this result appears quite modest; indeed, Colombo and Stanca (2014) report figures among 0.045 and 0.080. In the next section, exploring the determinants of training provision at the firm level and addressing the consequences of training on economic growth, I will show how microeconomic and macroeconomic size effects may be responsible of this finding;

- R&D investments have a positive influence on businesses' productivity. In this direction, the literature on technical change points out that differences in the performance of firms and industries can be explained to a large extent by R&D spending (cf. Nelson and Winter, 1977);

- while the direction of the causal link probably goes in the opposite direction, the use of social safety valves affects productivity in a negative way; indeed, in order to save on expensive firing (and re-hiring) costs, firms that experience bad economic conditions may find profitable to call for redundancy payments instead of shrinking their labour force;

- in comparison with the baseline sector, construction and service-providing firms display, respectively, a positive and a negative productivity gap. More uncertain instead the distance from the performance of trading firms; indeed, as far as the production value (value-added) per worker is concerned, the point estimate delivers a positive (negative) productivity gap.[13] As shown in table 2, this diverging pattern is probably due to the

[13] INDACO 2009 allowed to distinguish manufacturing (service providing) firms among engineering, chemical, food and textile (transport, entertainment and bank & insurance) productive units. Unfortunately, the sub-sector break down is available only for 61% (15%) of the surveyed firms. Taking into account available data, it

fact that for trading businesses there is largest difference between the average references of two endogenous variables;

- some divergences are also observed along the geographical dimension. First, the productivity of firms localized in the North-East is not statically different from the performance of businesses in the Central area and this holds also for the value of production per worker of firms in the North-West. By contrast, as far as the value-added is concerned, those firms display a positive productivity gap. Furthermore, corroborating a well-established evidence, businesses in the South - especially along the value-added index - suffer an extensive performance divide;

- in both regressions, the point estimates attached to the capital per worker, usually labelled as capital share, are the most significant among the other covariates. However, their figures are far below the conventional value of 1/3 usually referred in the literature (e.g. Conti 2005; Brunello 2007). Nevertheless, Colombo and Stanca (2014) obtain similar values in their OLS regressions.

is possible to show that the performance of manufacturing (service-providing) businesses varies as follows. First, as far as manufacturing firms are concerned, chemical, food and textile productive units have a positive revenue gap with respect to engineering firms. By contrast, according to the value-added index, this gap is statistically significant only for food producing firms. Furthermore, among service-providing businesses, entertainment as well as bank & insurance productive units have higher revenues with respect to transport firms. Finally, no statistically significant difference is found along the value-added dimension.

	Dependent Variable	
Corporate Characteristic	Production value per worker	Value-added per worker
constant	10.7874 (∗ ∗ ∗) (0.0778)	9.7559 (∗ ∗ ∗) (0.0623)
% of women	−0.0046 (∗ ∗ ∗) (0.0004)	− 0.0047 (∗ ∗ ∗) (0.0003)
% of young workers	−0.0027 (∗∗) (0.0013)	− 0.0034 (∗ ∗ ∗) (0.0010)
% of blue collars	− 0.0081 (∗ ∗ ∗) (0.0004)	− 0.0056 (∗ ∗ ∗) (0.0003)
% of trained workers	**0.0012** (∗ ∗ ∗) (**0.0003**)	0.0016 (∗ ∗ ∗) (**0.0002**)
R&D	0.0795 (∗ ∗ ∗) (0.0275)	0.0945 (∗ ∗ ∗) (0.0219)
social valves	− 0.1991 (∗ ∗ ∗) (0.0255)	− 0.1818 (∗ ∗ ∗) (0.0204)
construction	0.1109 (∗ ∗ ∗) (0.0365)	0.1125 (∗ ∗ ∗) (0.0291)
trade	0.6381 (∗ ∗ ∗) (0.0322)	− 0.0432 (∗) (0.0258)
services	−0.5386 (∗ ∗ ∗) (0.0308)	− 0.0707 (∗ ∗ ∗) (0.0246)
North-East	0.0205 (0.0311)	0.0239 (0.0248)
North-West	0.0375 (0.0316)	0.0785 (∗ ∗ ∗) (0.0281)
South	−0.2253 (∗ ∗ ∗) (0.0351)	−0.1399 (∗ ∗ ∗) (0.0281)
capital per worker	0.1767 (∗ ∗ ∗) (0.0060)	0.1418 (∗ ∗ ∗) (0.0048)
R^2	41.31%	26.78%
# of observations	4,921	4,870

Table 3: The effect of vocational training on firms' productivity, OLS estimation; (∗ ∗ ∗) significant at 1%; (∗∗) significant at 5%; (∗) significant at 10%

6 Microeconomic and macroeconomic size effects: identification issues and the impact of training on economic growth

The cross-sectional effect of training on firm's productivity conveyed by the point OLS estimates in table 3 is quite narrow; indeed, the regression coefficients attached to the extensive measure of training - while strongly significant - is far below the one retrieved in the longitudinal contributions reviewed in section 2. A visual appraisal of this pattern is apparent from the two panels of figure 4.

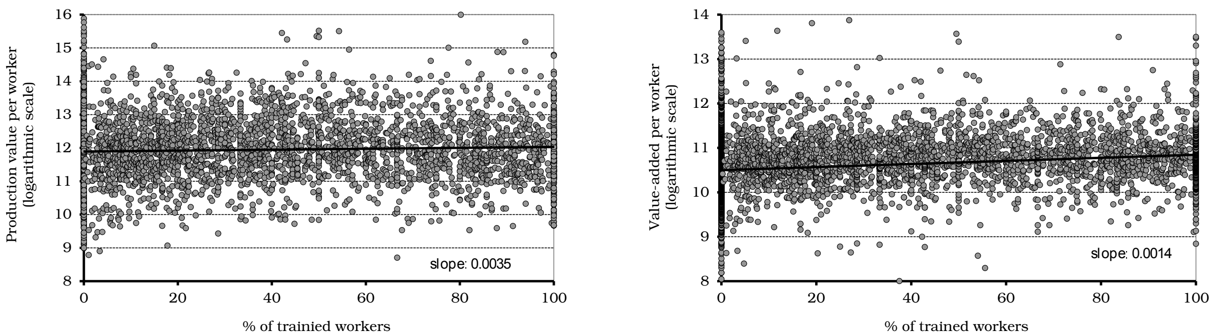

Figure 4: Percentage of trained workers and productivity

The two diagrams plot the linear relation between the percentage of trained workers and, respectively, the production value per worker and the value-added per worker both tracked on a logarithmic scale to be consistent with the regression model outlined in eq. (4). Straightforward observation reveals that in both cases the relation is positive but nearly flat. This pattern corroborates the mild impact of training on corporate productivity.

How a rationale for this pattern can be provided? First, it is worth noting that - at the micro level - the cross-sectional perspective of the estimations collected in table 3 does not consider the refined identification techniques that usually are implement in longitudinal studies (e.g. Bartel, 1994; Ichniowski et al., 1997; Colombo and Stanca, 2014). Truthfully, conventional theoretical models of training provision suggest that desired productivity and the optimal level of training are found together by balancing - at the margin - the costs and revenues of additional training (cf. Acemoglu and Pischke, 1999). The endogeneity implied by this theoretical framework reveals that the correct identification of training effects on corporate productivity may be actually blurred by a problem of simultaneity.

In order to address this issue, I implement a two-stage least-square (TSLS) estimation technique in which I explicitly take into account that the percentage of trained workers may actually be an endogenous explanatory variable of corporate productivity. This estimation technique is made of two distinct steps. Specifically, in the 1^{st} stage is explored the effect of firms' size on the percentage of trained workers by conditioning on the other covariates that – together with the number of employed workers of each productive units – are assumed to be genuinely exogenous. In other words, firms' size is used as an instrument for identification.[14] Moreover, in the 2nd stage regression the theoretical values of the percentage of trained workers retrieved from the 1st stage are exploited to measure the impact of training on firms' productivity. Since the predicted values of the percentage of trained workers derived from the 1st stage regression are linear combinations of a set of (alleged) exogenous variable, in large samples they should be free of endogeneity problems (Greene, 2003, Chapter 15).[15] The TSLS details can be found in table 4 (standard errors in parenthesis).

The TSLS regression results revel that taking into account the effect of firms' size on training provision significantly magnifies the impact of training on corporate productivity by leading only to minor changes in the values and the significance of the other estimates. In datails, as far as the regression coefficients and the respective standard errors reported in table 4 are concerned, two results deserve to be highlighted. First, in comparison with the estimates in table 3, the TSLS regression gives back a training coefficient which is about ten times higher. This figure significantly comes closer to the most recent panel evidence derived by Colombo and Stanca (2014). Consequently, taking into account that firms with labour force of different size have different attitudes towards training provision is a first step in the direction of a more consistent identification of training effects on corporate productivity. Furthermore, R&D investments lose their statistical significance in explaining businesses' performance. As argued by Cohen and Levinthal (1989), this latter finding reveals that firms often invest in R&D to improve their ability to evaluate options driven by innovations and outside technical opportunities, rather than produce proprietary techniques or products.

[14] The results of the 1st stage regression are discussed in Appendix.

[15] A similar instrumental variable approach is implemented by Tan and Batra (1996). However, in order to address the criticisms raised by Bartel (2000), in the 1st stage regression I take into account the whole set of regressors included in the productivity equation. In this way, the risk of model misspecification as well as the overstatement of the 'true' effect of training on productivity should be minimized.

	Dependent Variable	
Corporate Characteristic	Production value per worker	Value-added per worker
constant	10.5332 (∗∗∗) (0.1274)	9.4896 (∗∗∗) (0.1092)
% of women	−0.0035 (∗∗∗) (0.0006)	− 0.0036 (∗∗∗) (0.0005)
% of young workers	− 0.0025 (∗) (0.0015)	−0.0032 (∗∗∗) (0.0012)
% of blue collars	−0.0077 (∗∗∗) (0.0004)	− 0.0052 (∗∗∗) (0.0004)
% of trained workers	**0.0121** (∗∗∗) (**0.0039**)	**0.0131** (∗∗∗) (**0.0034**)
R&D	−0.0518 (0.0571)	−0.0444 (0.0491)
social valves	− 0.1364 (∗∗∗) (0.0365)	− 0.1169 (∗∗∗) (0.0312)
construction	−0.0019 (0.0581)	−0.0073 (0.0500)
trade	0.6683 (∗∗∗) (0.0377)	−0.0093 (0.0326)
services	− 0.6038 (∗∗∗) (0.0419)	−0.1378 (∗∗∗) (0.0357)
North-East	−0.0294 (0.0392)	−0.0280 (0.0336)
North-West	0.0017 (0.0377)	0.0406 (0.0324)
South	− 0.2015 (∗∗∗) (0.0402)	− 0.1149 (∗∗∗) (0.0346)
capital per worker	0.1708 (∗∗∗∗) (0.0071)	0.1351 (∗∗∗) (0.0061)
R^2	31.21%	14.39%
# of observations	4,921	4,870

Table 4: The effect of vocational training on firms' productivity, TSLS estimation; (∗∗∗) significant at 1%; (∗∗) significant at 5%; (∗) significant at 10%

What now remains to be addressed is the large difference existing among the impact of training in Italy and the corresponding effect estimated in different countries. As I said above, authors testing the training/productivity relationship in other geographical contexts retrieved figures of very different order of magnitude. Specifically, the already mentioned work by Konings and Vanormelingen (2010) place the training coefficient in the interval $(0.215, 0.460)$. Moreover, the European level, Sala and Silva (2013) estimate an acceleration of labour productivity of 0.55 percentage points for each extra hour of training per employee. Those figures reveal a significant gap that seems to go beyond the identification issues that - at the micro level - appear so important in assessing the impact of training on corporate productivity.

From a macroeconomic perspective, the TSLS regression results in table 4 - as well as the longitudinal ones retrieved by Colombo and Stanca (2014) - may be somehow affected by the critical position that Italian firms occupy in the international tables of training provision. For instance, relying on growth accounting models, Barrell et al. (2011) find that improvements in measured skills positively contributed to output growth and labour productivity in a number of European countries. In a similar manner, Timmer et al. (2010) show that upgrading the skills of the employed workforce enhanced economic growth in Europe. More recently, O'Mahony (2012) finds that failure to account for continuous training leads to an underestimate of the impact of intangible assets on output growth in the European Union. From a theoretical point of view, this empirical literature is consistent with an endogenous growth framework in which human capital in the form of on-the-job training together with technological innovations are the main drivers of the economic development and it implies that countries in which firms are less prone to provide vocational training are likely to display unsatisfying performances at the macro level (cf. van Zon & Antonietti, 2005).

In order to shed some light on this matter, in figure 5 I plot the results of a log-linear regression between the average percentage of workers involved in training activities all over a set of European countries and the corresponding rates of GDP growth experienced in 2009. Information on training provision is retrieved from CVTS4. This survey, carried out in 2010, gives an overview of corporate training policies all over the EU. Specifically, CVTS4 surveyed firms from the 27 EU members as well as productive units from Norway and Croatia and it is based on interviews with companies – establishments with ten employees or more – in the industrial production and marketing services sectors. Furthermore, growth rates are taken from official account data disclosed by EUROSTAT.

The diagram shows that countries whose firms provided more training suffered a less severe reduction of GDP in the reference year. In other words, countries in which the size of the trained workforce is higher appear less seriously hit by the fall of aggregate demand that triggered the Great Recession. Regression details of figure 5 are outlined in table 5 (standard errors in parenthesis).

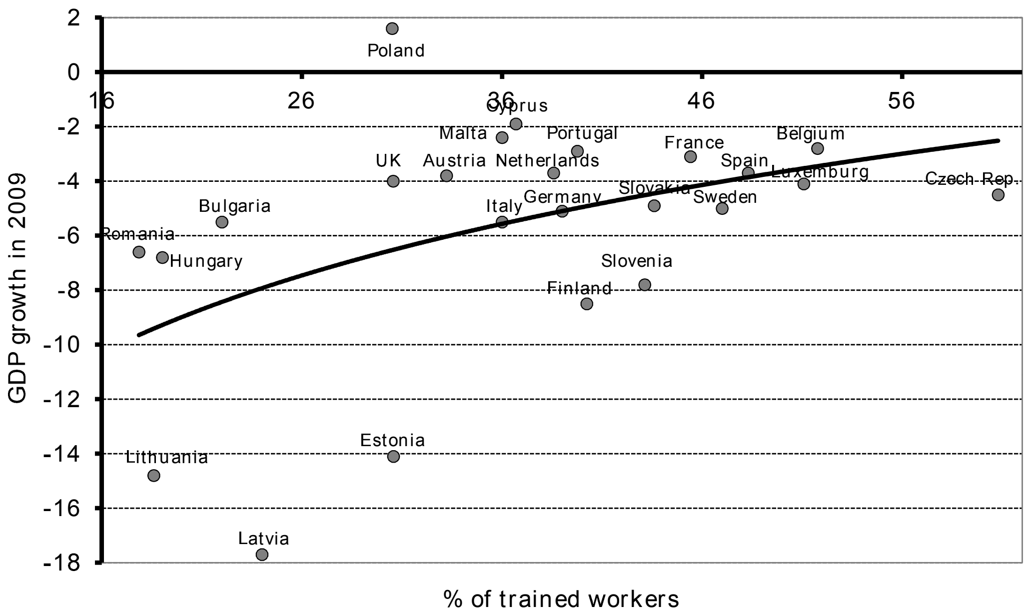

Figure 5: Training and GDP growth

Covariate	GDP Growth in 2009
constant	-26.4186 (∗∗∗) (8.6586)
% of trained workers (§)	5.8190 (∗∗) (2.4252)
$R^2 = 20.74\%$	
# of observations: 24	

Table 5: Training and GDP growth
(§) logarithmic scale; (∗∗∗) significant at 1%; (∗∗) significant at 5%

The figures in table 5 reveal that more than 20% of the economic growth observed in 2009 is explained only by a constant and a measure of training provision. This fraction is of the same order of magnitude of the productivity variance explained – on average – by the TSLS microeconometric model outlined in table 4. In addition, the regression coefficient attached to the percentage of trained workers is statistically significant at 5%.

One might suspect that the latter result may be mainly driven by the three European country with the lowest GDP growth, i.e., Estonia, Latvia and Lithuania. However, the positive link between training and macroeconomic growth conveyed by figure 5 has a certain degree of robustness at least on a descriptive level; indeed, running additional regressions (not shown in the paper), it is possible to show that a positive coefficient on training provision with at least a significance of 10% can actually be obtained provided that Lithuania is not removed from the sample. Furthermore, even if the three mentioned countries are completely dropped, the correlation between GDP growth and the percentage of trained workers remains positive despite the small number of (residual) observations.[16]

Within the picture of figure 5, Italy displays a percentage of trained workers just below the European average (36% against 37%) and – at the same time – it is apparent that the Italian economy suffered a GDP loss well above the one experienced by the other biggest European countries such as Germany, France and Spain. By contrast, Belgium – whose firms are targeted by the empirical analysis of Konings and Vanormelingen (2010) – is one of the European country in which workers are more involved in vocational training and it actually suffered a quite moderate GDP contraction.

Obviously, correlation does not means causality and one may also argue that countries with better resilience are the ones that invest more in vocational training. However, it remains true that in the right positions of the diagram there are countries such as the Czech Republic, Slovenia and Slovakia that usually are not classified among the best performers in terms of GDP growth.

Considering the arguments developed above, it becomes possible to argue that the low propensity of Italian firms towards training provision may be one of the determinants of the gap retrieved among the effect of training on corporate productivity estimated at the plant level in Italy and in other European countries. In other words, the small percentage of trained workers observed among Italian productive units may be among the factors responsible of a substantial slowdown of the Italian economy that hampered – at the aggregate level – the detection of more considerable training effects. This unsatisfying macroeconomic pattern is likely to persist as long as Italy will remain trapped in the mentioned low-training equilibrium.

7 Concluding remarks

In this paper, I explore the cross-sectional effect of vocational training on the productivity of a large cross-sectional sample of Italian firms and I quickly consider the impact of training provision on economic growth in the EU. Specifically, retrieving data from INDACO 2009, I test the effect of on-the-job training measured as the percentage of trained workers on the main performance indexes, i.e., the value of production and the value-added per worker derived from balance sheet data collected in the corresponding wave of the ASIA archive. In addition, I use CVTS4 data to explore the macroeconomic consequences of training provision on observed growth rates.

[16] In addition, regressing growth rates against a set of intangible asset indicators such as the percentage of trained workers, the percentage of GDP allocated in R&D, the percentage of individuals with tertiary education, it comes up that only the extensive measure of training has a positive coefficient statistically significant. Details are available from the author.

At the plant level, after having controlled for a set of relevant corporate characteristics, training displays a positive and significant effect. However, in comparison with similar works, the magnitude of this effect is quite narrow no matter the measure of corporate productivity. Untangling the microeconomic determinants of training provision and exploring the macroeconomic effect of training on economic growth, I show that considering the effect of firms' size on the corporate willingness to offer vocational training considerably magnifies the impact of training on productivity while the tail-end position of Italian firms in the international tables of training provision may be able to curb the detection of substantial performance improvements driven by human capital endowments.

This work could be developed in different directions. First, from a microeconometric perspective, the TSLS procedure implemented above does not completely consider the fact that firms' decision to train may be also determined by its productivity level (Bartel, 2000). This possible shortcoming could be handled by estimating a dynamic model in which the *change* of corporate productivity is regressed on *changes* in the independent variables. Unfortunately, before 2009, the latest available wave of INDACO refers to 2005 and this does not allow to build a consistent longitudinal panel of firms for which the evaluation of productivity improvements is feasible.

Moreover, from a macroeconomic point of view, the simple bivariate growth regression outlined in the previous section should be further expanded in order to consider the contribution to economic growth pushed by other strategic components such as physical investments, fiscal and monetary policy indicators, indexes of openness and competitiveness of the economy and other institutional factors (cf. Barro, 2013). In this way, it will become possible to have a deeper understanding of the magnitude of the training impact on economic growth as well as a more consistent guidance on the direction of causality between human capital accumulation and economic development. However, even in this case, data collection – especially on the side of intangible assets – is far from being exhaustive (cf. Wilson and Briscoe, 2004).

Despite the limitations mentioned above, the policy implications that can be drawn from the empirical results presented in this paper are definitely in favour of interventions aimed at increasing training supply as actually recommended by a number of prominent international organizations (cf. ILO, 2010; European Commission, 2012). On the one hand, some form of training incentive may lead the Italian economy to escape the low-training equilibrium by enhancing the profitability of further training investment from the private sector; indeed, an increase in the percentage of trained workers may increase the impact of training on productivity. On the other hand, additional training may lead the productive system as a whole to be less vulnerable to adverse macroeconomic shocks such as the one observed in the neighbourhood of the Great Recession. Specifically, an increase of training provision may be helpful in restraining the recessive effects of falls in aggregate demand that usually characterize economic crises.

Appendix 1: Selection bias

Here I provide a quantitative assessment of the selection bias induced by merging INDACO data with the official balance sheets records collected in ASIA. Specifically, adding the number of employees and omitting the capital per worker among the set of regressors, in table A1 I give the probit estimates of the probability to enter the pooled sample of firms for which the productivity effects has been evaluated in sections 5 and 6 (standard errors in parenthesis).

The probit regression results show that (*i*) larger firms; (*ii*) firms with more male employees; (*iii*) firms with a more aged workforce; (*iv*) firms that provide more training; (*v*) firms that invest more in R&D; (*vi*) firms that exploited social valves more intensively; and (*vii*) trading firms have a higher probability to enter the pooled sample of productive units for which the training effect on productivity is evaluated. As consequence, in comparison the whole sample of firms surveyed by INDACO 2009, the regression results outlined above should have some bias towards the mentioned dimensions. Similar features are also found in the work by Colombo and Stanca (2014).

	Dependent Variable	
Covariate	Pr(∃ production value = 1)	Pr(∃ value-added = 1)
constant	0.4664 (∗∗∗) (0.0656)	0.4316 (∗∗∗) (0.0653)
# of employees	0.0001 (∗∗∗) (< 0.0001)	0.0001 (∗∗∗) (< 0.0001)
% of women	−0.0054 (∗∗∗) (0.0006)	−0.0054 (∗∗∗) (0.0006)
% of young workers	− 0.0068 (∗∗∗) (0.0016)	− 0.0066 (∗∗∗) (0.0016)
% of blue collars	0.0008 (0.0005)	0.0012 (∗∗) (0.0005)
% of trained workers	0.0020 (∗∗∗) (0.0004)	0.0021 (∗∗∗) (0.0004)
R&D	0.7085 (∗∗∗) (0.0537)	0.7091 (∗∗∗) (0.0530)
social valves	0.3904 (∗∗∗) (0.0428)	0.3388 (∗∗∗) (0.0423)
construction	− 0.2560 (∗∗∗) (0.0535)	−0.2346 (∗∗∗) (0.0533)
trade	0.1270 (∗∗∗) (0.0486)	0.1228 (∗∗) (0.0483)
services	− 0.1741 (∗∗∗) (0.0450)	−0.1588 (∗∗∗) (0.0448)
North-East	−0.0412 (0.0464)	−0.0385 (0.0462)
North-West	0.0406 (0.0482)	0.0317 (0.0479)
South	−0.0608 (0.0517)	− 0.0722 (0.0515)
pseudo R^2	7.68%	7.31%
# of observations	7,306	

Table A1: Probability to enter the pooled sample, probit estimation; (∗∗∗) significant at 1%; (∗) significant at 10%

Appendix 2: The effect of firms' size on training provision

The 1st stage OLS regression underlying the figures in table 4 describes how the percentage of trained workers is influenced by the set of remaining regressors augmented by the size of firms. Its details can be found in table B1 (standard errors in parenthesis).

COVARIATE	% OF TRAINED WORKERS
constant	24.0903 $(***)$ (3.5466)
% of women	− 0.1083 $(***)$ (0.0225)
% of young workers	−0.0241 (0.0617)
% of blue collars	− 0.0412 $(**)$ (0.0184)
# of workers	**0.0058** $(***)$ (**0.0009**)
R&D	11.3093 $(***)$ (1.2556)
social valves	−6.2051 $(***)$ (1.1653)
construction	10.6430 $(***)$ (1.6634)
trade	− 3.1845 $(**)$ (1.4770)
services	5.4856 $(***)$ (1.4100)
North-East	4.4985 $(***)$ (1.4212)
North-West	2.8254 $(*)$ (1.4504)
South	−2.0984 (1.6092)
capital per worker	0.5388 $(*)$ (0.2773)
R^2	5.36%
# of observations	4,921

Table B1: The effect of firms' size on training provision, OLS estimation; $(***)$ significant at 1%; $(**)$ significant at 5%

The figures of the 1st stage regression show that there is a quite strong relation among the percentage of trained workers and the large majority of regressors used in the estimations of tables 3 and 4. Among the others, two results appear particularly remarkable. First, one of the strongest link holds exactly with the number of employed workers; indeed, confirming the descriptive results in table 2, larger businesses are likely to be more prone towards training supply with respect to smaller productive units. Rationales underlying this result are found in the typical features that characterize investment expenditures in larger firms, i.e., economies of scale in the provision of formal and informal training (cf. Black et al., 1999; Blundell et al., 1999) and better and cheaper access to capital markets to finance investments in human capital (cf. Hashimoto, 1979). In addition, the strongest marginal effect on the percentage of trained workers is driven by the dummy on R&D investments. Even this finding is far from being surprising; indeed, a number of authors convincingly argue that R&D expenditures are strictly connected with training costs for the employed workforce (cf. Cohen and Levinthal, 1989; Rosemberg, 1990; Pavitt, 1991). A visual appraisal of the relationship between firms' size and the percentage of trained workers is given in figure B1.

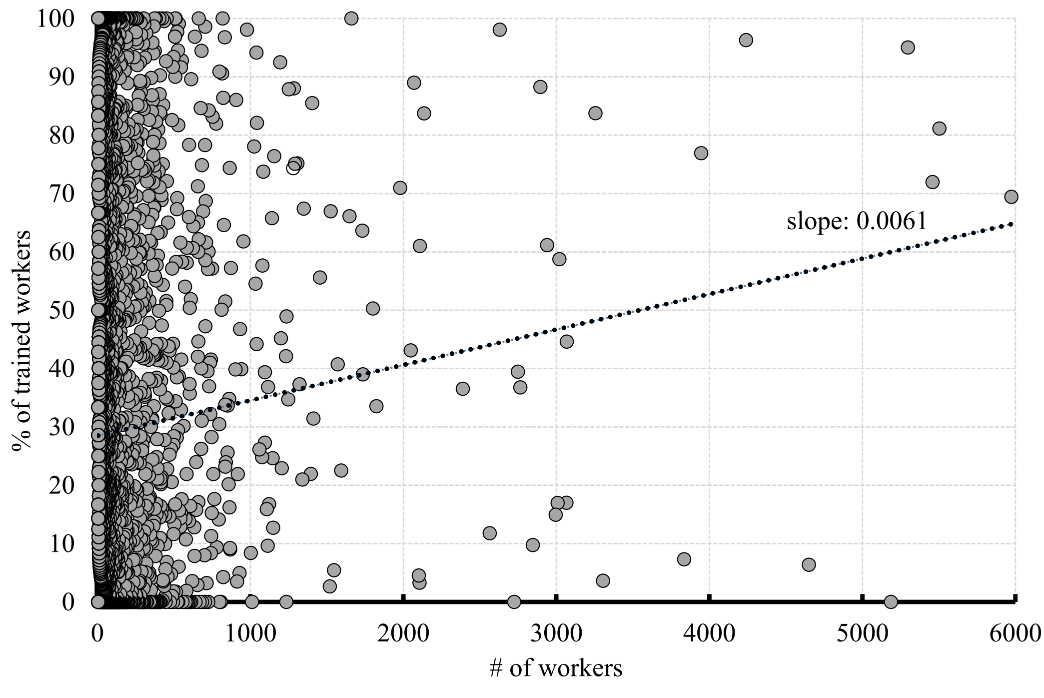

Figure B1: Firms' size and training provision

The slope of the line in figure B1 as well as the results in table B1 reveal that the marginal effect of firms' size on the percentage of trained workers is quite small. However, this finding does not belittle the importance of corporate dimension in explaining the extensive margin of training provision; indeed, it is well known that point OLS estimates provide the marginal effect of each covariate taken into consideration under the hypothesis that all the other regressors remain fixed (*ceteris paribus*). By contrast, table 1 shows that large firms are usually more capitalized than small businesses. Consequently, as the size of firms grows, the impact of the number of employees on the percentage of trained workers should be augmented by the more considerable effect driven by the higher capitalization.[17]

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