Returns to specific skills in industrial districts

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Abstract

By extending the standard returns to seniority wage regression, this paper tries to evaluate whether workers receive on-the-job compensations for skills that are neither completely general nor fully firm-specific. Our framework allows to assess whether the returns to firm tenure estimated in the literature are in fact capturing (part of) the remuneration of skills that are common to a broader set of firms. The issue has relevant implications, particularly as far as the wage losses associated to exogenous job displacement are considered. Crucial identification information is provided by the data that allow to obtain unbiased estimation of the returns to district tenure. We do not find evidence that workers in industrial districts (IDs) receive compensation for skills that are valued at district level. We rather estimate high returns to firm-specific skills, inferring high wage drops in case of exogenous workers' displacement.
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1. Introduction

There is wide evidence that wages tend to rise within a firm, so that job market history helps explaining wage differences between individuals. On-the-job learning, either induced through purposeful investment in human capital accumulation (as in Becker, 1994) or obtained as exogenous by-product of workers' activity (as in Dustmann and Meghir, 2001), has been addressed as one possible explanation of the evidence. Skills accumulated on-the-job can affect each individual's wage profile in two ways. On one

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hand, labor market experience provides general skills, increasing workers' productivity in any possible job. On the other hand, workers acquire specific skills that affect productivity only as long as they remain in the same firm.[1]

Evaluating to what extent the labor market history represents a source of wage growth for different individuals, and determining whether part of the skills accumulated by the worker is firm-specific, are important issues. When inferring the cost of job destructions, for instance, higher returns to tenure would mean higher losses in case of exogenous job displacement. Also, two individuals with the same accumulated general skills will have different wage level according to the accumulated firm-specific skills in the current job.

The empirical literature has so far concentrated on the appropriate econometrics to be used to correctly identify the structural parameters, returns to general experience and firm tenure (Abraham and Farber, 1987; Altonji and Shakotko, 1987; Topel, 1991; Williams, 1991; Altonji and Williams, 1997; Dustmann and Meghir, 1997, 2001). Neal (1995) first raised the question whether the standard two regressors specification is the appropriate labor market history decomposition, suggesting that the estimated returns to firm-specific tenure could in fact capture the remuneration of skills that are rather specific to the industry or sector the firm belongs to. Under this hypothesis, not directly tested by Neal, both the estimation and inference based on the parameter of interest might change. For example, in case that only sector-specific skills mattered within sector movers will not experience any drop in wage. Consequently, a labor force characterized by low mobility will expect a lower variance in the wage profile offered by geographical areas where similar firms concentrate and are easily accessible.

In this paper, we will identify and estimate the returns to skills that are neither completely general nor fully specific, but rather common to firms operating in relatively homogeneous economic activities. The data used here refer to Italian provinces with high concentration of industrial districts (henceforth IDs), that is, groups of specialized firms characterized by *geographical proximity* and *productive similarity* (Guiso and Schivardi, 1999). This framework is relevant both for identification purposes and for the economic implications of our exercise. Our identification strategy allows to obtain unbiased estimation of the returns to district tenure (i.e., work experience accumulated in firms belonging to the industrial districts), thus obtaining evidence of their economic importance in determining wage profiles for district workers. We will be able, then, to test whether the hypothesis that the labor market in industrial districts can be compared to the internal market of a large firm, where movers are reallocated in the production process without experiencing losses in competencies and wage.

The paper is organized as follows. Section 2 presents the empirical literature and discusses why we think that industrial districts represent a plausible framework to evaluate the relevance of returns that are neither completely general nor firm-specific. In Section 3, we discuss the estimation problems and present our identification strategy. Section 4 presents the data and describes the methodology used to identify the sample of district workers. The results are proposed and discussed in Section 5. Finally, Section 6 concludes.

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[1] Underlying the relation between firm-specific productivity increases and wage growth is the assumption that turnover induces workers and firms to split the quasi-rent generated by specific skills accumulation. The setting is not a Walrasian one in this sense. See Hutchens (1989).

2. The literature

2.1. Wages and the accumulation of specific skills

Most empirical works dealing with the relationship between individual earnings and the composition of labor market history have focussed on the following regression specification

$$\ln w_{ijt} = \gamma_1 X_{it} + \gamma_2 T_{ijt} + u_{ijt} \tag{1}$$

where T_{ijt} indicates job tenure (i.e., years spent working in the same firm), X_{it} is the overall accumulated labor market experience and u_{ijt} represents unobserved characteristics of individual i working in firm j at period t. The coefficients capturing the effect on wage of an additional year of experience or tenure (γ_1 and γ_2) have been interpreted as the average returns to general and firm-specific human capital, respectively, and mainly used to infer the implied wage loss experienced by exogenously displaced workers. For instance, according to Topel's (1991) estimates on US data (PSID), the wage drop experienced by a worker displaced after 10 years spent in the same firm would amount to nearly one-fourth of the entry wage.[2]

Neal (1995) first suggested that returns to tenure measured through Eq. (1) are capturing the remuneration of *industry*, rather than *firm*-specific skills, and tested the implication that the individual wage loss in case of exogenous displacement should vary according to whether the worker is able to reallocate in the same industry or not. Using data on US displaced workers, Neal compares industry switchers and stayers finding that the experienced wage difference between current and pre-displacement jobs is negative and higher for switchers than stayers. He also finds a positive correlation between the wage drop and the levels of pre-displacement experience X_{it} and (firm-specific) tenure T_{ijt}, again higher for industry switchers. For instance, a displaced worker having accumulated 10 years of tenure in the same firm would experience a wage fall of 23% in case he switches industry, but only 11% if she is able to reallocate in the same industry. These differences, the author argues, must be capturing some industry-specific skills losses.

The purpose of this paper is to look for direct evidence of returns to sector-specific tenure, starting from the alternative decomposition of workers labor market history

$$\ln w_{ijt} = \beta_1 X_{it} + \beta_2 T_{it}^{S} + \beta_3 T_{ijt}^{F} + \varepsilon_{ijt} \tag{2}$$

where the accumulation of sector-specific skills is captured by the sum of years spent working in the same sector. If T_{it}^{S} is an omitted variable in the original specification, both parameters considered in the standard regression will be affected due to the existing correlation between the three regressors. In particular, estimating consistently the parameters in Eq. (2) allows to determine to what extent the returns to job seniority as obtained through in the standard regression are in fact returns to the accumulation of knowledge that is valuable within a broader group of firms.

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[2] Using a different estimation approach, Altonji and Shakotko (1987) found that the cumulated 10-year returns to tenure are only 6.7%.

The same issue has been addressed in two very recent papers. Parent (2000) finds that returns to sector tenure are more important than firm-specific returns in two samples of US workers (namely, the National Longitudinal Survey of Youth and the PSID). Dustmann and Meghir (2001) focussed on skilled and unskilled young workers in Germany finding that returns to sector tenure are positive but rather small and not significantly different from zero in the case of the unskilled. Our work will be compared to theirs in Section 3.

2.2. Industrial districts

Most of the more competitive and dynamic Italian manufacturing industries display a high degree of geographical concentration. A large body of literature has described the main features of such agglomerations, mainly based on the concept of Marshallian externalities, and such clusters are commonly referred to as IDs. The definition of IDs involves both geographical and economic characteristics. One crucial feature is the presence of a large number of (mostly small-sized) specialized firms producing at various stages or in various ways something that is homogeneous in one way or another (Brusco, 1982; Pyke et al., 1990). Such firms must also be characterized by a high degree of geographical proximity, favoring technological and information spillovers through personal and informal communication. Often a socioeconomic flavor is added to simple agglomeration (Becattini, 1990): for example, it is claimed that the local community in IDs has certain underlying characteristics (shared values, willingness to co-operate, mutual trust, positive relationships with the local administration, etc.) strengthening the effect of externalities.

More important, for our purposes are the features of the labor market as described by the IDs literature. Since the early works, it has been stressed that intensive firm-specific knowledge accumulation within industrial districts contributes to the higher degree of labor supply segmentation observed in district firms. Younger individuals (also called carrier workers), in particular, accept low starting wages in exchange for implicit or explicit training on-the-job, inducing substantial increases in productivity and wages after some years of tenure (Brusco and Paba, 1997; Solinas, 1982). Other authors indicate, however, that knowledge accumulated on-the-job as well as improvements and innovations introduced by the workforce are common to the entire network of specialized producers rather than firm-specific (Pyke et al., 1990). This could be either a consequence of the accumulation of socially codified "tacit knowledge" concerning technology, skills, products and processes (Sweeney, 1987; Lundvall, 1992) that are specific to district activities rather than to a single firm and/or to the acquisition of a broader knowledge-base spurred by the need to accomplish a great variety of tasks within small IDs firms than elsewhere. As a consequence, the districts labor market has been compared to the internal market of a large firm, in that workers can reallocate in specialized firms without experiencing large losses in competencies (Becattini, 2001).

We argue, therefore, that the identification and estimation of returns to skills accumulation should be particularly appropriate in such context. In particular, IDs should provide the ideal environment for the accumulation of skills that are neither completely general nor firm-specific, allowing within-district movers to reduce wage losses associated

to exogenous displacement. We will estimate the extended regression (2) using matched data referred to two Italian provinces characterized by high density of IDs. We will account for the accumulation of tenure in the district as possible determinants of individuals' earning capacity.[3] As we will discuss in Section 3, the geographical dimension in the definition of the IDs provides crucial information to identify the main parameter of interest.

3. Identification and estimation issues

The sources of possible biases in average returns estimation, induced by match and individual heterogeneity or endogenous selection, have been widely discussed in the literature. The error term in Eq. (1) can be decomposed as $u_{ijt} = \mu_i + \phi_{ij} + v_{ijt}$ where μ_i is an individual fixed effect, ϕ_{ij} is a match-specific effect capturing the quality of the match and v_{ijt} is the normally distributed random component. The regression specification (1) becomes

$$\ln w_{ijt} = \gamma_1 X_{it} + \gamma_2 T_{ijt} + \mu_i + \phi_{ij} + v_{ijt} \tag{3}$$

As discussed in Altonji and Williams (1997) and Topel (1991), the match-specific effect ϕ_{ij} is likely to be correlated with both regressors. In particular, the correlation with general experience X_{it} would be positive due to job shopping over a workers' career. The sign of the correlation between the match-specific effect ϕ_{ij} and job seniority T_{ijt} is uncertain.[4] As far as individual heterogeneity μ_i is concerned, the correlation is shown to be positive with tenure and negative with experience (see Altonji and Williams, 1997). As a result, the overall bias direction is indeterminate for both parameters of interests.

As introduced above, our approach moves from a simple modification of the standard wage regression (1) and is therefore subject to similar identification problems. We start considering the sub-sample of district workers, regressing wage at time t on the accumulated level of district-specific tenure (labeled T_{it}^D), general labor market experience (X_{it}) and firm tenure (T_{ijt}^{DF}). Grouping all workers employed in the various districts, that is focussing on average returns independently of the specialization sector, we will have:

$$\ln w_{ijt}^D = \beta_1 X_{it} + \beta_2 (X_{it}^D + T_{ijt}^{DF}) + \beta_3 T_{ijt}^{DF} + \mu_i + \eta_{id} + \phi_{ij} + v_{ijt} \tag{4}$$

where district tenure is written as the sum of the entry level of experience in district firm (X_{it}^D) and current tenure in the district firm she is observed (i.e., $T_{it}^D = X_{it}^D + T_{ijt}^{DF}$).

In the new specification, unobserved heterogeneity allows for a term (η_{id}) capturing the quality of the match between the individual and the district she is employed in.

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[3] Appendix A briefly describes the main sources of wage differences within the Italian wage setting mechanism and argues that individual earnings are not fully subject to centralised determination, justifying our empirical analysis of the relationship between skills, productivity and wages.

[4] In particular, if firms' share in the returns to a good match is positive, ϕ_{ij} will be negatively correlated with layoff probability and positively with tenure. On the other hand, Topel (1991) notes that the selection induced by voluntary job changes implies that low tenure is associated with high ϕ_{ij}, because longer tenure means worst matches in his setting.

Unobserved correlation between the entry level of district experience (X_{it}^D) and the residuals exacerbates the identification problems. Such correlation is likely to be positive because those workers who are more productive in district activities (high η_{id}) will tend to allocate in the district, then having comparatively higher entry levels of district experience.[5] Also, if higher past experience in district firms helps locating better matches within the district, we will have positive correlation with the unobserved match-specific effect ϕ_{ij}. This reasoning induces to expect an upward bias in the OLS estimation of $\hat{\beta}_2$.

Parent (2000) and Dustmann and Meghir (2001) are the only papers we know of that tackle the issue of estimating unbiasedly the returns to sector tenure. Parent (2000) instruments sector tenure with its mean-deviation $(T_{id}^D - \bar{T}_i^D$, in our framework). He finds that returns to sector tenure are more important than firm-specific returns. Although his instrument is by construction uncorrelated with the sector-specific match component $(\eta_{id}$ in the specification above), it will be positively correlated with the unobserved match-specific effect ϕ_{ij}, if higher experience in the same sector implied on average better matches with firms in that sector (as in Neal, 1999). The estimate of β_2 will therefore be biased upwards, and, given the strong correlation between sector and firm tenure, the returns to job seniority will experience an offsetting downward bias. Dustmann and Meghir (2001) estimate a random coefficient model allowing for heterogeneous returns to experience and sector tenure. As in the present paper, the authors adopt a control function estimation approach, but they need to assume that the same instrument (age) controls for both the endogeneity of general experience and sector tenure. Our strategy follows closely Dustmann and Meghir's, but we will identify district returns using alternative sets of instruments.

3.1. Discussion of the instruments

In particular, we will use two instruments to identify the returns to entry level of experience in district specialization before the current job (X_{it}^D). First, we observe that at any date t in our window and in any of the districts considered the average entry experience of people in specialized industries (X_{it}^D) would be higher, the greater the importance of those industries in the district where they work. A specialization indicator as the share of workers employed in district activities (L^D) with respect to overall manufactures (L^M) would therefore be correlated to workers' past experience in such activities. Provided it varies sufficiently across districts, the variable SHARE $= L_d^D/L_d^M$ is eligible as instrument if the main sources of geographical concentration at the origin of the districts are not related to the residuals in our equation. We do not exclude that the underlying workers' unobservables in a given area might be at the basis of districts formations, or that growing concentration of specific activities might have attracted workers particularly productive in those branches. The identification hypothesis is rather that the early patterns of district formation did not reflect factors that significantly contribute to today's factors productivity.[6] Clearly, if past sources of endogeneity had been transmitting through time and across

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[5] A matching model in which wages are determined by idiosyncratic matches between workers attributes and the tasks specific to district activities could generate such problems.

[6] Our identification approach relies implicitly on assumptions of low workers mobility.

different generations of district workers, the IV estimation would be biased and we would estimate an upper bound of the returns to district tenure.

An alternative identification strategy exploits information on distances between workers and firms. Under the assumption that individual unobservables are equally distributed across different geographical areas, and that daily commuting is costly, so that people tend to find works within the area where they live, the distance between the place of residence (RESID) and the district area will be a variable correlated with past spells in firms belonging to the district.[7] Then for workers living in an industrial district, we will observe on average a higher level of past district tenure (X_{it}^{D}). One possible problem that might arise using RESID as instrument could be unobserved, district-specific education, for instance due to the existence of technical school providing training specific to the activity of that area. Again the instrument would provide an upper bound for the returns to district tenure.

Other two instruments used to estimate consistently the average returns in Eq. (4) have been first used by Dustmann and Meghir (1997). "Firm closure" (CLOS) is a dummy variable accounting for whether a worker comes from a firm that closed down in the previous period, and is clearly correlated with mobility. The fact that it does not affect wage directly (or that it identifies a class of new spells for which the match-specific effect is drawn randomly) derives from the assumption that an exogenous interruption of current job induces workers to take up the first job they are offered.[8] Finally, worker's age (AGE) is correlated with overall labor market experience, because older individuals have on average higher experience. The identification assumption in this case is that, conditional on observed experience, age does not affect wage determination.

4. The data

The available data sources are three National Social Security Service (INPS) archives with full coverage of employees and firms operating in two industrialized provinces in northern Italy characterized by a tight labour market. The underlying economy of the two provinces (Treviso and Vicenza) is briefly described in Table 1. The archives provide data on workers for any work episode for whom contributions were paid during two decades (from 1975 to 1997): in particular the three data sets provide information on the worker, the firm and the characteristics of the match, respectively. The *workers file* contains data on more than one million individuals, including gender, date of birth, place (or foreign country) of birth, place of residence and an identifier for the firm they are employed in. The information is anonymous and workers are identified by a progressive code. No information on education, marital status or family size is available. The *contributive file* contains information on the worker–firm match, including qualification (available with a

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[7] We also hypothesize that, when choosing their residence, workers act considering mainly variables that are exogenous to unobserved productivity opportunities in firms located in the different areas: such elements can include the location of their family, imperfections of the housing market, the quality of life, etc.

[8] This assumption, however, leads to further estimation problems. If post-closure employments are on average worst and shorter matches compared to those of workers that were not forced to leave their job, then the instrument proposed by Dustmann and Meghir (1997) will lead to positive bias in the estimation of returns to tenure.

Table 1
Provinces of Treviso and Vicenza. Economic indicators in the 1990s

Variable	Provinces	Italy
(a) Population (thousands)	1,410	53,481
(b) Growth in value added	6.2%	4.7%
(c) Growth in manufacturing value added	5.7%	4.3%
(d) Employment share of manufactures	54.9%	33.1%
(e) Unemployment rate	2.7%	10.9%

(a) Population census data (1991); (b, c) ISTAT regional accounts, average nominal growth per year in 1991–1997; (d) ISTAT regional accounts (1995); (e) Labour Force Statistics (1991–1997).

breakdown in apprentices, blue-collar workers, white-collar workers and managerial workers) and type of contract (whether full or part-time). Gross nominal wages are recorded with a breakdown in periodic current earnings ("competenze correnti") and other non-periodic payments ("altre competenze") and include overtime. The wage information always relates to a single firm, and never covers more than one calendar year: it reports the total pay received for the year or fraction of year worked, together with the number of months/weeks paid. If the worker changes jobs, a new record is opened including the total pay for the period from the start of the new spell to the end of the calendar year (or the date of termination of employment at the new firm, whichever is more recent). The third archives (_firms file_) contains information concerning location (at municipality level), the industry affiliation with a three-digit level breakdown and the average employment size of all firms existing in the two provinces from 1975 to 1997, whether they are still trading or not. The exact dates at which they started and ceased trading (if occurred within the period spanned) are also provided.[9]

4.1. The sample and districts' identification

Left censoring and the absence of information on education imply that potential experience (commonly obtained as age less years of schooling less 6) cannot be calculated for workers entering before 1975, the opening date of our window. On the other hand, the data allow to construct very accurate work and earnings histories for the working life of individuals born after 1961, who were not left censored in 1975 because they were not of working age yet by that year. For those individuals, we can compute job market experience and firm tenure, with minimal, if any, measurement error. The time worked is calculated in weeks and allows to account for job switching, entrance or leaving the job market occurring within the year; it thus provide a noticeable source of variation when computing individual experience and tenure. An additional advantage of being able to track the full working history of individuals is that, based on the tightness of the labor market in these areas, one can infer the educational level from the labor market entry date.[10] Also,

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[9] Previous works on the same data allowed to control for "spurious" closures deriving from changes in ownership, denomination or legal status, which are recorded as changes in INPS firm identifier (see Occari and Pitingaro, 1998).

[10] We attributed primary education level to workers entering the labour market at age below 18, secondary schooling if age < 25 and university degree otherwise.

matching information on firms with those available for individuals allowed to identify workers who suffered an exogenous break in their tenure accumulation due to firm closure, needed to implement the estimation.

As a consequence, the sample used in this exercise concerns *young workers* in the manufacturing sector, the potentially oldest individual being aged 37. Our selection rule rises several issues worth mentioning. On one hand, it seems unlikely that the returns we estimate here can be extended to the entire population, which we expect to be characterized, on average, by a flatter wage profile. On the other hand, given that most of on-the-job learning occurs early in workers' carrier, we expect that, if district-returns are actually positive, our sample is an appropriate one to find evidence that the acquired skills are transferable across firms to different extents depending on their productive specialization.[11] Finally, higher mobility of young workers across occupations should provide large source of variations for the tenure variables (and exacerbates endogeneity problems due to search and unobserved match quality, thus strengthening the case for using an IV approach).

To identify the existing industrial districts in the two provinces, we started from the classifications provided by the Italian National Statistical Institute (ISTAT, 1997). The procedure consists of, first, dividing the national territory into local labor systems (LLS), that is, territorial groupings of municipalities marked by a certain degree of commuting to work. Second, defining as industrial districts those LLS having a proportion of employment in manufacturing greater than the national average and a significant share of employment in at least one subsector in which the LLS is specialized. To avoid the inclusion of "marginal" communities that reached the minimum share of employment in district activities after the opening of our observation window (in 1975), we require that a significant share (>25%) of the population in the communities had been working in the leading sectors throughout the whole 1975–1997 period (see Pitingaro et al., 2000).

As a result, we have identified 10 districts, located in a smaller fraction of the territory with respect to ISTAT's classification (the geographical *core* of the district), and specialized in the production of leather, sport shoes, wool products, electromechanical, pottery, machinery, clothing, wood products, inox-plastic and furniture.

In the following pages, we will refer to district workers as those individuals employed in any of the firms that fulfill both the geographical and productive specialization requirements that identify industrial districts. The main regressor (district tenure) is obtained as the sum of spells accumulated in different firms belonging to the same district. Non-district workers are employed at time *t* in firms that fulfill the sectoral requirement (i.e., produce one of the district-specialized goods), but are located outside of the corresponding district area. This grouping allows for a high degree of homogeneity among the two sub-samples as far as firms' characteristics are concerned.

Our final sample accounts for more than 12,000 worker–firm matched observations, regarding 1,320 individuals in the two provinces.

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[11] Notice that focussing on *young workers* does not imply restricting the analysis to *young firms* in our data. According to INPS archives, in 1986, the average age of manufacturing firms in the two provinces was 7.3 years as opposed to 7.4 obtained for firms that employed young workers. I thank an anonymous referee for raising this issue that, in principle, could restrict our analysis to new firms that do not fully benefit from the ID environment.

5. Estimation and results

We follow a two-step instrumental variable estimation approach developed by Smith and Blundell (1986) in a simultaneous equation framework and applied by Dustmann and Meghir (1997) in the estimation of returns to tenure. In brief, the idea is to estimate the regression model

$$\ln w_{ijt} = \mathbf{x}'_{ijt}\beta + \hat{\mathbf{u}}'_{ijt}\delta + v_{ijt} \tag{5}$$

where the endogenous variables have been grouped in a $(k \times 1)$ vector $\mathbf{x}_{ijt}$ and each element $\hat{u}^k_{ijt}$ in the $(k \times 1)$ vector $\hat{\mathbf{u}}'_{ijt}$ is obtained as residual from the auxiliary regression of the corresponding endogenous variable x^k_{ijt} on the set of instruments $\mathbf{z}_{ijt}$, that is,

$$\hat{u}^k_{ijt} = x^k_{ijt} - \mathbf{z}'_{ijt}\hat{\alpha}_k \tag{6}$$

If the adopted instruments represents truly exogenous sources of variation for the regressors, then the relevant parameters in (5) can be consistently estimated: intuitively, the endogenous component of each regressor would be controlled by the introduced residuals. Moreover, as shown by Smith and Blundell (1986), a simple test of exclusion of the residuals ($\hat{\delta}_k = 0$) will be a test of the (weak) exogeneity of the corresponding variable (firm/sector tenure and experience). A positive/negative coefficient will indicate that workers with high unobserved productivity (wages) have higher/lower levels of the corresponding explanatory variable.

The analysis has been developed in two steps. We first tried to determine whether the standard determinants of wages (experience and firm tenure) differ when we compare district versus non-district workers. In a second exercise, we addressed the main question raised in this work and estimate the remuneration of skills that are specific to district activities, focussing on a sample of district workers only.

5.1. Wage determinants: district and non-district workers

In the first step, we will focus on the following specification

$$\ln w_{ijt} = \gamma_1 X_{it} + \gamma_2 T_{ijt} + \delta_1 \widehat{ex}_{it} + \delta_2 \widehat{fte}_{ijt} + \xi_{ijt} \tag{7}$$

where $\widehat{ex}_{it}$ and $\widehat{fte}_{ijt}$ are the residuals obtained from two auxiliary regressions of experience and firm tenure, respectively, on the set of instruments Z, including AGE and CLOS, and a set of time and educational controls. Apart from the regressors shown in Eq. (7), we controlled for individuals' observables (education, gender, qualification, type of contract and a dummy for the first year of tenure), characteristics of the firm (size and a group of dummies capturing possible fixed district effects on wages) and for the year of observation. Quadratic terms in experience and tenure are also considered to capture concavity in the relation with the wage.

Table 2
Standard earnings function estimates. District and non-district workers

	Non-district workers		District workers	
	IV (1)	OLS (2)	IV (3)	OLS (4)
exp	0.0631 (0.0165)	0.0904 (0.009)	0.0726 (0.0213)	0.1108 (0.0153)
exp^2	− 0.0020 (0.0004)	− 0.0022 (0.0004)	− 0.0033 (0.0008)	− 0.0035 (0.0007)
ten	0.0812 (0.0273)	0.0828 (0.008)	0.0771 (0.0351)	0.0462 (0.0126)
ten^2	− 0.0041 (0.0005)	− 0.0046 (0.0005)	− 0.0026 (0.0009)	− 0.0026 (0.0009)
$\hat{ex}$	0.0262 (0.0148)		0.0441 (0.0184)	
$\widehat{fte}$	− 0.0059 (0.0263)		− 0.0317 (0.0340)	
cons	8.1946 (0.0924)	7.9539 (0.0604)	8.2859 (0.1507)	8.0806 (0.1069)
R^2	0.5990	0.5978	0.6140	0.6132

Standard errors in parentheses. Sample sizes: non-districts = 8622, districts = 3733.

The results are reported in detail in Table 2.[12] Our IV estimations (columns 1 and 3) indicate that there are only minor differences among the two groups of workers as long as the returns to general and firm-specific skills are concerned. Moreover, both regressors contribute to the determination of district and non-district wages roughly with the same weight in the two samples. In fact, we could neither reject a test that the two coefficients (β_1 and β_2) are the same, nor that the two variables play the same role when considering the effects on wage of the first year spent in the same firm. Within the districts, the latter effect amounts to 13.7%, with firm-specific tenure contributing to 7.1% of the wage increase. The numbers for non-district workers are 13.9% and 6.74%, respectively.

The controls have the expected sign and are mostly significant in both sub-samples: other things equal, male, higher educated, white-collar workers with a full-time contract earn higher wages. Wages seem not to differ significantly across most of the districts we are considering. Also, the comparison with OLS (columns 2 and 4) suggests that, for both groups of workers, endogeneity is a concern for the returns to general experience: the positive coefficient on the residuals of the auxiliary regression indicates that higher experience in the labor market is associated to higher unobserved productivity in the current job, leading to an upward bias in the estimation of $\hat{\beta}_1^{OLS}$.

Because the estimated linear and quadratic parameters are quite similar in the two sub-samples considered, we only find slight differences in the implied wage growth due to increases in the two variables of interest (Table 3). Also, the implied wage loss in case of exogenous displacement, calculated as the difference between the wages imputed to a worker with τ versus 0 year of tenure is in general quite large but nonlinear in job seniority, and it is only slightly lower for non-district workers (Table 4).

This result is clearly driven by the large importance of the returns to job seniority as estimated in the two groups: both are much larger than those obtained in the empirical analyses on US data (Topel, 1991; Altonji and Shakotko, 1987; Altonji and Williams, 1997), but smaller than those obtained by Dustmann and Meghir (1997) for Germany. One

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[12] The results of the auxiliary regressions (not shown) indicate that the set of instruments explains large part of the variability of each of the endogenous regressors. For instance, the adjusted R^2 in the experience regression is greater than 80% and falls to less than 40% if Z is dropped.

Table 3
Wage growth effects: districts vs. non-districts

	Non-district	District
Average per annum wage growth	12.05%	12.70%
Tenure contribution	6.25%	6.61%

Based on Table 2, columns 1 and 3. Averages over 5 years.

possible cause is the fact that, as in the German case, the sample used here refers to young workers, whose productivity in the first years of work is subject to large increases. This implies that the estimated parameters do not allow for projections of the results to a long time horizon.

5.2. The returns to district tenure

Our identification approach allows to investigate the possibility that the large returns to firm-specific tenure estimated in the district sample are in fact capturing district-specific skills' remuneration. Accordingly, regression (5) has been estimated in the sample of district workers:

$$\ln w_{ijt}^{D} = \beta_1 X_{it} + \beta_2 (X_{it}^{D} + T_{ijt}^{DF}) + \beta_3 T_{ijt}^{DF} + \delta_1 \widehat{ex}_{it} + \delta_1 \widehat{dte}_{it} + \delta_3 \widehat{fte}_{ijt} + \zeta_{ijt} \qquad (8)$$

Here, the added residuals are derived from the auxiliary regression of three endogenous variables (X_{it}, X_{it}^{D} and T_{ijt}^{DF}) on the set of instruments Z. We first consider the set Z^{share} including AGE, CLOS and SHARE (the districts specialization index). In a second exercise, we use Z^{res} where workers' place of residence (RESID) substitutes the specialization index. The same controls for observable workers and firm characteristics, as in Section 5.1, are added to the regression. The results are reported in Table 5.

It is interesting to start discussing the results obtained estimating the extended regression with least squares. As shown in column 3, OLS estimates would suggest that district workers are compensated for district-specific skills. Comparing these results with those obtained previously (Table 2, column 4), we could also conclude that district tenure is an omitted variable in the standard regression and is subsumed to both experience and firm tenure. As a consequence, the implied wage drop for displaced district workers finding a new job in a specialized firm would be lower than we estimated previously: for example,

Table 4
Wage drops at different levels of job seniority

Firm tenure (months)	Wage drops	
	Non-district	District
24	13.5%	13.4%
36	18.6%	18.7%
48	22.8%	23.4%
60	26.1%	27.4%

Based on Table 2, columns 1 and 3.

Table 5
Extended earnings functions estimates. District workers

District workers	IV (SHARE) (1)	IV (RESID) (2)	OLS (3)
exp	0.1286 (0.0370)	0.1261 (0.0356)	0.0921 (0.0194)
$\exp^2$	− 0.0036 (0.0010)	− 0.0037 (0.0010)	− 0.0033 (0.0010)
dist_ten	− 0.0891 (0.0640)	− 0.0936 (0.0640)	0.0429 (0.018)
dist_ten^2	− 0.0010 (0.0010)	− 0.0009 (0.0010)	− 0.0012 (0.0010)
ten	0.1088 (0.0535)	0.1230 (0.0538)	0.0290 (0.0140)
ten^2	− 0.0022 (0.0009)	− 0.0021 (0.0009)	− 0.0021 (0.0010)
$\widehat{ex}$	− 0.0234 (0.0322)	− 0.0213 (0.0306)	
$\widehat{dte}$	0.1289 (0.0611)	0.1329 (0.0609)	
$\widehat{fte}$	− 0.0789 (0.0517)	− 0.0937 (0.0521)	
cons	8.2429 (0.1355)	8.2591 (0.1316)	8.0566 (0.1026)
R^2	0.6153	0.6154	0.6143

Standard errors in parentheses. Sample size = 3373.

the wage loss after 3 years of tenure would amount to 6.5% (as opposed to the previous loss of 18.7%). The implied drop for district movers would be of around 17%, however.

The picture changes dramatically when we consider the IV results (Table 5, columns 1 and 2). Notice, in fact, that the two sets of instruments used here (Z^{share} and Z^{res}) provide fairly similar results in two respects. First, both show that the returns to experience and firm tenure do not change significantly, indicating in particular that firm-specific skills are an important determinant of earnings in industrial districts and that these are not completely embedded in the broader concept of sector-specific skills (as suggested by Neal, 1995). Second, the estimates for both the linear and quadratic terms of average returns to district tenure are not significant at 10% significance level under either set of instruments considered. The fact that, as argued in Section 3, our IV approach might be establishing an upper bound to the estimated returns to district tenure strengthens this finding.[13]

Also, our estimates indicate that a larger working experience in specialized firms is associated to higher unobserved productivity in district activities rather than to the accumulation of district-specific skills. To see this, notice that the coefficient on the residuals of the auxiliary regression for district tenure $\widehat{dte}_{it}$ is, under both sets of instruments, positive and significant. The implied upward bias (possibly due to a kind of "line of work" shopping process) could explain the positive and significant returns obtained in the benchmark OLS estimation (β_2^{OLS}).

All in all, our analysis does not seem to provide evidence for the fact that previous years spent in district firms are valuable within IDs, productive similarity notwithstanding. Our results indicate that most learning rather occurs at the firm level, possibly due to a high degree of specialization reached by firms involved at the different stages of production of the district goods. Hence, we might conclude that the correct specification to evaluate the determinants of earnings is the standard two regressors wage equation estimated in Section 5.1.

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[13] A specification including, simultaneously, both SHARE and RESID also yielded the same results.

6. Conclusions

Using data from the Italian National Social Security Service Institute (INPS), this work looks for direct evidence that workers in industrial districts are rewarded for the accumulation of skills that are neither completely general nor fully firm-specific, but rather common to the network of district-specialized firms. Such skills would be lost by displaced workers only in case they have to reallocate outside of the network. Moreover, this exercise provides a quantitative description of labor markets in some Italian industrial districts, to complement the existing (mainly) qualitative analyses on the subject.

The possibility to instrument for the variable added to the standard wage regression (tenure in the district) relies on the characteristics of district firms, namely, *geographical proximity* and *productive similarity*, and on assumptions on individuals' mobility. We used two alternative sets of instruments obtaining nearly the same results.

First, we do not find evidence that skills that are specific to the district are an important determinant of workers' earning capacity. Explicitly introducing district tenure as a regressor does not affect the importance of firm-specific returns either, which remains a crucial source of wage growth for district workers. This suggests that district firms have high degree of specialization notwithstanding their productive similarity. A consequence of the previous findings is that the implied wage drops associated to exogenous displacement remain substantial even for within-district movers. Therefore, the idea that the labor market in industrial districts allows workers to reallocate within the network of specialized firms without experiencing large losses in competencies and wage is not confirmed by our results.

More importantly, because the additional regressors are not significant, the determinants of earnings can be estimated with the standard model, that is, accounting for returns to general and firm-specific skills only. The standard wage regression provided high estimated returns to tenure, both for district and non-district workers, possibly as a consequence of having a sample of young workers who experience high rates of growth of productivity in their first years of labor market experience. The point estimates of the structural parameters are very similar in the two groups, though suggesting that firm-specific learning is not higher within the network of district specialized firms than it is outside.

Acknowledgements

Appendix A. The wage setting

Though collective bargaining is usually addressed to as the main force driving wage determination, the Italian industrial relations system allows for several potential sources of wage differences both across and within firms belonging to the same industry (see Erickson and Ichino, 1993). Bargaining takes place on national, industry and firm level. National agreements focus on specific issues of general relevance, as employment regulation, safety rules, etc., while contracts signed at the industry and firm level are most linked with wage determination. In particular, contracts signed at the industry level specify the levels of *minimum* wages that are subsequently used as floor for contracts signed at the firm level (which are not compulsory, however) or for individual level bargaining (more common in small-sized firms).

As far as industry-level bargaining is considered, most of its outcomes are differentiated across workers because minimum wages vary according to a skill ranking system based not only on the industry affiliation but also to the nature of occupation of the worker. To identify different occupations, dependent workers are first divided into four qualifications (blue-collar, white-collar, "quadri" and managerial workers), and the first three categories are further divided into several quasi-skill levels (called *inquadramento* levels) that may vary across industries. In the metal manufacturing sector, for instance, it is possible to identify 15 different skill ranks (of which 5 relate to blue-collar, 7 to white-collar workers) for which contracts signed at the industry level determine the minimum wage.

Moving to agreements signed within firms, data available on wage composition in the metal manufacturing sector indicate that the share of total pay determined at this level was nearly 20% over the period considered in our exercise. Within these determinants (including the collective and individual superminima, production premia and variable compensation), the main source of wage dispersion is the individual superminimum, a wage premium determined by the employer on individual basis. It accounts for more than 10% of workers' compensation. Both the individual and collective superminima displayed large variation across firms, according to Erickson and Ichino (1993).

Hence, there are several complementary ways firms can generate individual wage differences. First, through the determination of across-ranks wage differences, established with firm-level bargaining on top of minimum wages. Second, through preferences accorded to workers in climbing the skill-rank ladder and, finally, by means of employer–worker bargaining, setting individual wage premia. In small firms, where collective agreements at the firm level are rare, the share of the wage bill exceeding the contractual minimum that is established on individual basis turns out to be higher than in larger establishments. In our archives, the ratio between the upper and lower deciles in the within-sector wage distribution for blue-collar workers ranged from 2.1 (wood and furniture) to 3.6 (pulp and paper).

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