Within-Firm Human Capital Externalities in Tunisia

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Abstract

This case study exploits matched firm-employee Tunisian data in order to underline the role played by within-firm human capital in worker remuneration. The estimated returns to human capital in wage equations remain unchanged when the dummies representing firm heterogeneity are replaced in the list of regressors with three firm variables: a textile industry dummy, within-firm mean education, and firm age. We find that part of what is usually considered as return to education may be due to within-firm externalities.

Keywords: Education returns, human capital, wage differentials, within-firm knowledge externalities, Tunisia.

JEL Codes: J24, J31, O12.

1. Introduction

While many factors affect wages, including firm characteristics, labour compensation is expected to predominantly reflect returns to human capital and skills. These returns have been incorporated into individual wage equations by including variables for schooling and worker experience (and perhaps training), usually years of schooling and years of work experience. There is considerable evidence that returns to education are high in developing countries (Sahn and Alderman, 1988; Behrman, 1999).[1] However, Al-Samarrai and Reilly (2008) find that the private rates of return to education in the wage employment sector are rather low in Tanzania, suggesting that human capital returns may be lower in Africa than in other developing countries. This paper offers further evidence for the case of Tunisia; although perhaps not representative of sub-Saharan Africa, it is Africa rather than other developing country regions.

It has been recognized that certain worker skills are firm-specific; experience accumulated within the firm may be different from experience previously obtained outside the firm. Thus, part of the return to human capital in worker remuneration can be viewed as originating within the firm, implying the desirability of having matched worker and firm data. Moreover, the endogenous growth literature emphasizes the presence of technological or social externalities that generate higher returns to traditional factors, notably labour. It is likely that some of these externalities occur in the form of general knowledge diffused in the economy. In particular, externalities may take place within the firm where the worker operates, since that is where technological processes are frequently exhibited. Some work processes require team work, with skills diffused throughout the workplace (Battu, Belfield and Sloane, 2003). For instance, some workers may learn through imitation, that is, through observing skilled workers performing tasks. Since interaction among workers may enhance skills, knowledge diffusion may be higher in firms well endowed in human capital. As a

consequence, a worker may be more productive and therefore better paid in a firm that is human capital intensive.

Thus, the wage function return to human capital may be a combination of personal skills, firm knowledge and organization characteristics. Neglecting to account for knowledge externalities within firms may lead to a biased estimate of the benefits of education and training policies. Although these considerations may have particular importance in developing countries, where workers may often have more to learn in order to reach the international efficiency frontier, they are relevant for any economy. For example, Serrano (2003) estimates wage equations including within-firm and within-region education to capture such externalities in Spain. Similar investigations for the US (Rees, Zax and Herries, 2003; Moretti, 2004; Mas and Moretti, 2006) have been extended to externalities estimated directly through firm productivity using matched firm-employee data. They find evidence of productivity spillovers suggesting that social pressure and mutual monitoring may also induce effort, beyond the human capital gain of learning from co-workers.

Identifying within-firm human capital externalities is a complex task, requiring rich and accurate data. Such data are beyond the reach of most investigators and typically not available for developing countries. It is therefore necessary to use a simplified empirical strategy. Namely, we consider as a working hypothesis that, when workers' characteristics are held constant, the correlation of firm human capital density with worker wages primarily reflects within-firm human capital externalities. This approach excludes other interpretations: selectivity or matching effects; economic rents correlated with human capital and other firm characteristics, as in Teal (1996); or unemployment shocks to the different human capital categories specifically affecting certain industries, as in Hoddinott (1996). The data available do not allow us to address these possibilities.

One widespread means of accounting for firm characteristics is to base the econometric investigation on matched worker-firm data.[2] We exploit such data, for the first time in the Tunisian case.[3] The interest of this investigation, however, goes beyond Tunisia, since it also provides valuable insight on the issues of earnings and returns to skills in Africa, adding to the emerging literature. Schultz (2004) examines wage differentials across schooling levels using several recent household surveys from six African countries (Ghana, Côte d'Ivoire, Burkina Faso, South Africa, Kenya and Nigeria). He finds that private schooling returns are highest at the secondary and post-secondary levels. These results contrast with usual findings in industrialized countries, that returns are higher at primary school levels, but are consistent with Kristensen and Verner (2005) on Côte d'Ivoire, Söderbom et al (2006) for Kenya and Tanzania, Fox and Oviedo (2008) in twenty Sub-Saharan African countries, and Kuépié et al (2009) in seven African capitals. These studies find that returns are higher for secondary than for primary education, i.e. a convex, or at least non-concave, earnings curve for returns to education. We test for such non-concavities in Tunisia.

This paper sets out to investigate the hypothesis that the presence of human capital externalities within firms contributes to convex education returns. If these externalities exist, increasing worker education may benefit them directly, and may also benefit their co-workers. In this situation, since (1) human capital levels are often correlated across co-workers and (2) tasks corresponding to higher education levels may be more subject to human capital externalities, what is observed as convex education returns may arise from within-firm human capital externalities. Beyond our work in Tunisia, these externalities have attracted little attention in other African countries.[4] Using non-matched data from 1980 and 1999 employment surveys, Zouari-Bouattour et al. (2004) also find that returns to education increase with education levels in Tunisia.

The Tunisian data provide information on employees and their firms, allowing us to investigate a number of questions. Do human capital marginal returns vary with human capital levels in Tunisia? Do human capital within-firm externalities affect Tunisian workers' wages? Can these externalities shed light on increasing human capital returns in wage equations? Section 2 presents our data. Section 3 contains a discussion of the estimation results for wage equations. Finally, Section 4 presents our conclusions.

2. Matched firm-employee data for Tunisia

The matched worker-firm data used were collected directly within the workplace in 1999.[5] Eight formal sector firms were selected based on criteria of size (no fewer than 50 employees), activity, export vocation and capital ownership.[6] As the observed characteristics refer only to wage workers in the formal exporting sector they are not representative of all workers in Tunisia. The occupational structure, obtained from employer interviews within each firm, was used to constitute representative sub-samples of their workers. Workers were randomly selected within each occupational strata and no less than 10 percent of workforce was interviewed in each firm. Because it cannot be claimed that these data represent complete sectors, we treat them as an interesting case study. Accordingly, we leave standard errors uncorrected for clustering and stratification.[7]

The questionnaire provides accurate information about each worker: individual characteristics, wages, educational investment, post-school training, total experience on the labour market and occupation. These data also include characteristics of the firms to which the workers belong.

The 231 workers in the final sample were interviewed in February 1999. Appendix Table A1 reports descriptive statistics for these workers, which are matched with a sample of eight firms (four firms in the Textile-clothing sector and four firms in the Mechanics,

Metallurgical, Electrical and Electronics Industries, IMMEE). The worker sample is well distributed across industries with 54.1 percent of employees working in the textile sector and 45.9 percent in IMMEE. The proportion of women in the overall sample amounts to almost half, 49.8 percent; however, female workers predominate in textile firms, while male workers do so in IMMEE firms.

Mean education amounts to 9.6 years when calculated from the worker questionnaires, using information on the highest education level reached. Mean education years is higher for men (10.6 years versus 8.7 years for women). By contrast, when calculated using school leaving age (from which we deduct 6 years), mean schooling years is close to 13. We thus thought it preferable to use an education variable net of repeated classes in order to account for unsuccessful years of education.[8] Only 0.8 percent of the observed workers have never attended school, 9.9 percent have only completed a primary level of education (1 to 5 years), 71.8 percent have reached secondary school level (6 to 12 years) and 17.3 percent have completed studies in higher education. The proportion of employees with a vocational diploma related to their current job amounts to 31.6 percent.

Mean tenure in the current firm is 5.9 years (5 years for women, 6.75 years for men). Total professional experience is 9.1 years (10 years for men; 8 years for women) on average. In addition, previous experience, apart from the current job, is on average 3.3 years. The experience variable is an actual measure, as opposed to a potential one based on age. It excludes current job experience (TENURE) and possible periods of unemployment or inactivity.

The ratio of tenure to overall work experience is 64 percent due to a sizeable percentage of young, first-time workers. The sample mean age is rather low, amounting to 29.5 years. Tenure may be important for human capital accumulation in these firms, since on-the-job training has been observed for about one fifth of workers. Using these data, Muller

and Nordman (2005) find in estimated wage equations that on-the-job training substantially affects wages across all quantiles.

Certain wage characteristics are worth noting. The average monthly wage is 303 Tunisian Dinars (213 US dollars),[9] while the average monthly wage for male workers is 1.7 times that for female workers. Beyond differences in human capital endowment between genders, the large female proportion of the sample employed in Textiles, where wages are low, contributes to the wage differential: 94 percent of the observed female workers belong to the Textiles sector, while male workers from this sector represent only 14 percent of all male workers. Indeed, the average monthly wage in the IMMEE sector is 1.6 times higher than in Textiles. This can be explained partially by educational differences: on average, the IMMEE workers have 10.6 compared to 8.9 years for those working in Textiles.

Figure A1 in the Appendix shows the kernel density estimate of observed monthly wages. The two minimum wages are indicated separately by vertical lines. They correspond to 40 hours per week and 48 hours per week respectively. Wage observations are concentrated around values slightly above the minimum wage, while heavy right tails account for a small number of very skilled workers. Indeed, individuals earning more than 500 Dinars per month only represent 12.5 percent of the sample. Also, 80 percent of these workers have achieved higher education versus only 7.4 percent of the workers with monthly wages below 500 Dinars.

The four firms from each sector are located in the Tunis area with an average size of 130 employees (they are therefore likely to have been affected by the labour market shocks discussed in the Appendix). Information about the firm's characteristics was directly collected from the employers: workforce composition, work organization, training and communication policies, organizational or technical innovations and competitive position (Appendix Table A2 provides descriptive statistics).

3. Estimation Results

3.1 Model and estimation method

The matched worker-firm data enables us to estimate the returns to human capital using information from both workers and their firms. For this purpose, the average and marginal returns to human capital are given by the coefficients for years of schooling and labour market experience in a Mincer-type wage equation. In non-linear specifications of human capital effects, the returns must be calculated for given values of the wage correlates, for example, at the mean for the whole population of workers.

As mentioned previously, 'convex' earnings functions, that is, those with education marginal returns increasing with education levels, or earnings functions where human capital returns vary with human capital levels, have been found in the literature. Specific returns should therefore be assessed for each skill and human capital population. Consequently, quadratic and more flexible polynomial specifications of both education and experience variables are estimated.

Since we are interested in within-firm human capital externalities, we distinguish off-firm experience from tenure. Dividing the tenure variable by the firm's age to account for the vast heterogeneity in firm age does not change the qualitative results obtained.

We account for firm heterogeneity by introducing firm dummy variables. However, since this study uses cross-section data, it is not possible to model the unobserved individual heterogeneity as in Abowd et al. (1999). To temper the effects of unobserved individual heterogeneity and measurement errors which might bias the estimated coefficients, we include control variables in the OLS regressions and attempt instrumented regressions using two stage least squares (2SLS).

Of course, using firm dummies is only a rudimentary way of accounting for within-firm human capital externalities. In particular, part of what could be interpreted as human

capital externalities in the estimates may result from worker selection by firms and vice versa. For example, alternative interpretations could be based on matching. Assuming that highly skilled workers are relatively more productive at the most productive firms, then sorting of the most productive workers into the more productive firms may occur. In this case, one cannot separately identify the contributions of workers and job characteristics based on a simple wage equation with job and firm characteristics. Although such or other selectivity effects may take place, it is presently impossible to control for this with these data. However, due to the rigidity and inefficiency of the Tunisian formal labour market (with sluggish administrative procedures, and little public information on jobs and workers) it is plausible that selection effects are less intensive than in industrialized countries.

We thus have no choice but to assume that selectivity and matching effects may be neglected. Although this is not a completely satisfactory hypothesis, we are currently limited to this method for the purposes of investigating these issues in the Tunisian case. This approach does not imply that we *always* interpret the effects of firm dummies or characteristics as human capital externalities. As a matter of fact, we also incorporate other aspects related to 'job differences' across firms.

In the wage equations, we include formal training received in the current firm in the list of independent variables. In our sample, more educated workers generally receive more formal training: on average 12.2 years of schooling for workers having received formal training versus 9.1 for others. Two other dummy variables are retained. One dummy variable indicates the worker's gender, while the other describes his or her hierarchical position in the firm (executive or supervisor).

Finally, the estimated model is:

$$\text{Log}(w_i) = X'_i \beta + T'_i \gamma + F_{ij} \delta_j + u_i \,, \qquad (1)$$

where w_i is the hourly wage rate of worker i. T_i describes the human capital variables, in particular education, tenure and experience with their squared terms, and also human capital firm characteristics. X_i describes the other wage determinants, F_{ij} is the dummy variable of worker i in firm j and u_i is an error term. We estimate (1) using OLS and 2SLS regressions.

[Table 1 about here]

3.2 Wage equation estimates

The first estimated equations of the logarithm of individual hourly wage are reported in Table 1. The first two columns and columns (4) and (5) correspond to OLS estimates while columns (3) and (6) report the 2SLS regression results. Table 3 summarizes the main effects of human capital variables for the entire set of estimates.

Incorporating firm dummies into the wage equation raises goodness-of-fit only moderately (columns 1 and 2).[10] Return to schooling decreases after controlling for firm heterogeneity with firm dummies. In OLS regressions of the extended Mincer model, the marginal return to education at the mean sample shifts from 7.9 percent down to about 6.9 percent when including firm effects instead (Table 5). Such a drop is consistent with the literature (Abowd and Kramarz, 1999). Firm characteristics are therefore important. To our knowledge, no comparable estimates exist for Tunisia.[11] Note that some of the education effect may be caused by selection. Firm dummies may help us to control for certain selection effects, but other individual and household characteristics are missing, preventing us from fully avoiding a possible selectivity bias.

We attempt to control for the possible endogeneity of the education variable by using a two-stage least square regression (2SLS), the estimates for which are shown in columns (3) and (6). Endogeneity corrections are extended to all independent variables. These are composed of worker education, experience and tenure variables, i.e. by gathering information

on individual human capital. As the set of instruments is limited (see discussion in online Appendix) we place more emphasis on the OLS results than on IV estimates.

Despite the limitations of the instrument set the main qualitative results remain unchanged for the 2SLS estimates, although some specific estimated coefficients vary. However, the returns to human capital are refined: the marginal return to education at the mean sample in the basic firm dummies models (FDM) drops from 6.9 percent (column 2 of Table 1 and OLS FDM in Table 3) to 4.17 percent and becomes insignificant (2SLS, column 3 in Table 1; see also 2SLS FDM in Table 3). Under unobserved ability bias, a reduction is expected, which may contribute to explaining the statistically non-significant education effects with 2SLS. However, what we are estimating here is slightly different from the typical literature since we are measuring the *within-firm* returns to human capital.

Regarding the experience variables, findings differ. The average return to tenure (calculated at the sample mean) increases from 3.7 percent in the OLS FDM model to 4.7 percent in its 2SLS version. By contrast, the IV return to off-firm experience is insignificant, while the OLS estimate is significantly positive, amounting to 3.5 percent.

We also investigate how marginal human capital returns vary with human capital variables, that is, with education, tenure and off-firm experience. Almost all our estimates, except imprecisely estimated IV estimates, show definitive non-linearities in returns, corresponding to a convex earnings function in years of education. In this sense, our results echo recent findings in the literature on wages in Africa. By contrast, the earnings function is concave in experience, whether within or outside the firm. These results are confirmed in Table 2 with the introduction of firm human capital characteristics. A caveat is the imprecise IV estimators, preventing us from fully controlling for endogeneity issues. The inaccuracy of IV estimators stems from the small sample size combined with insufficient instruments. The IV estimators are too weak in this case to capture the returns to education and off-firm

experience, and we shall not discuss them in detail. Finally, an alternative possibility is that the apparent nonlinearity in the returns could be partly attributed to the selection of workers according to their human capital level.

[Table 2 about here]

Let us look at the other estimated coefficients. Completed on-the-job training (OJT) often plays an important role in explaining wage differentials. Its positive coefficient is always significant at the 5 percent level. A dummy for the few observations corresponding to ongoing OJT has been introduced as a control, while omitting it changes the other estimated coefficients slightly. Overall, we find that workers benefit from OJT through a positive wage premium when training is completed (from about a 20 to 35 percent increase depending on the regression).

The gender coefficient is significantly negative in all specifications. This suggests the presence of a gender wage gap to the detriment of female workers as found in most countries. However, the modest size of this gap may also reflect some degree of selectivity effect for female workers. By contrast, the supervisor dummy coefficient is always significantly positive, and typically larger in absolute value than the female dummy coefficient.

Finally, we note that the firm dummy coefficient estimates are large and significant at the 1 percent level (except with the introduction of interaction terms for Firm 6; see discussion on these interaction terms in Appendix). These results are aligned with those usually found for wage differentials across individuals working in different sectors with identical productive characteristics.[12] Such wage differentials have been found in Tunisia in non-matched data (Abdennadher et al., 1994). Here, we can see that workers with comparable observed characteristics earn different wages partly because they belong to different firms. In the following sub-section, firm effects are interpreted in terms of the features of each company.

3.3 Introducing firm variables

We now replace the firm dummies in the regressions with several firm characteristics: a dummy for the textile sector, firm age, and three variables proxying the firms' human capital stocks (mean education level in the firm, mean off-firm experience, and mean tenure). We eliminate the contribution of the considered individual in these means, which allows us to recover within-firm variability in these regressors, and thus to identify all the firm variable coefficients. Moreover, excluding individual contribution from these mean human capital variables conforms to the idea of estimating "pure" human capital externalities. Finally, it should be straightforward to collect information on these firm characteristics from workers in any labour force or household survey. We denote such regressions as the first "extended" model, EM1 (columns 1 and 2 of Table 2).

For a second extended model, EM2 (columns 3 and 4 of Table 2), two interacted variables were substituted for firm mean experience. These were (1) individual tenure interacted with the firm mean education and (2) individual education interacted with the firm mean tenure. EM2 thus allows for cross-effects between individual and aggregate firm human capital characteristics. As mentioned previously, we also attempted to introduce the Firm 6 dummy interacted with individual human capital characteristics. However, introducing these terms removes the most interesting significant effects, which cannot be well identified in our small sample. We therefore restrain our analysis for models EM1 and EM2, while still providing OLS and 2SLS estimates.[13]

Table 3 summarizes the returns to both individual and firm human capital for each of the eight firms. Most significant effects seen with the previous specifications are confirmed when including the firm variables in OLS estimates (column 1). However, new effects emerge. The dummy for Textiles has a systematic negative impact on wages. This is

consistent with the generally low remuneration in this industry, often associated with labour intensive processes. Firm mean education positively affects wages. Individual education interacted with firm mean tenure has no significant effect (column 2). Mean tenure and individual tenure interacted with mean education both have negative influences on wages.

[Table 3 about here]

Introducing firm aggregate characteristics substantially reduces the estimated marginal returns of the education variable compared to the OLS estimates without firm dummies. This suggests that part of what is usually considered as return to education may be due to within-firm externalities.

One of our working hypotheses was that the non-concavity of the earnings function in education, or perhaps in other human capital variables, could be due to the omission of the effects of human capital firm characteristics. Such a hypothesis is clearly undermined by our results in Table 2. For the OLS results, we cannot reject the presence of the significant quadratic effects of both education and tenure. Thus, while the earnings function is shown to be concave in tenure, it appears to be quite convex in education, with a low point at 3.65 years. This is all quite apparent when one examines the sign and standard errors of the first six estimated coefficients of the variables in the first column. Moreover, possible non-concavities and non-linearities of the earnings function are hidden amid the interaction effects of the individual human capital variables with firm human capital variables. If we denote X = education years, the corresponding functional form of the earnings function can be described by a polynomial ($a_1 + a_{15}$ (firm mean tenure)) $X + a_2 X^2$, if we only consider the individual effects of education, where a_i denotes the coefficient of the i^{th} variable in the first column of Table 2. By contrast, if we consider the effect on the other firm workers of a given worker education, we obtain the polynomial ($a_{11} + a_{14}$ tenure) X / N, where N is the number of workers in the considered firm. The total education effect on earnings in the firm can be

represented by the sum of these two polynomials, which correspond to a private and a partial social component. It is thus easy to see that the only origin of quadratic education effects in the basic specification (without interaction effects) is that associated with the coefficient a_2 of squared education. The same type of analysis could be carried out for the tenure and off-firm experience variables.

Incorporating the interaction effects into the model generates more possibilities for *multi-dimensional* curvature, for example, by crossing education with mean firm tenure. However, these terms only generate slight curvature in wage equations since, first, they are interacted terms instead of squares; and, second, the effects of the mean firm variables are attenuated by dividing individual human capital by the number of firm workers; third, they correspond rather to a form of social return, which is not captured by typical wage equations.

Delving further into the interpretation of the effects of the interacted variables (individual human capital interacted with firm human capital) is difficult because we cannot observe and ascertain what is happening within firms. However, a few suggestions do naturally emerge. The systematic positive impact of firm mean education is consistent with positive within-firm human capital externalities, for example, through learning by imitation or advice from colleagues. When firm mean education is then interacted with tenure and the corresponding coefficient is significantly negative in OLS estimates, it is tempting to assume that these learning externalities are stronger for recently employed workers, who have more to learn about firm procedures and technologies than 'old hands'. The negative effect of firm mean tenure on wages is more difficult to interpret. One possible explanation is the existence of depreciation effects on wages for recent workers. For instance, recent workers may be locked into an internal 'secondary market' by tenured insiders monopolising higher remuneration. Also, many tenured older workers may weigh towards archaic procedures in

these firms, which would generate negative externalities that may not be well captured by a firm's age or sector affiliation.

In a nutshell, our results confirm, in alignment with current literature, a convex earnings function in education years and a concave one for tenure. Second, we find that accounting for firm human capital is not sufficient to eliminate these convexities, although individual human capital returns are affected. It is interesting to note that the firm age coefficient becomes insignificant when two interacted variables are added: individual tenure by firm mean education and individual education by firm mean tenure. As individual tenure and mean tenure within the firm should generally increase with the firm's age, allowing for longer tenure accumulation, this result indicates that the impact of firm age on wages may only correspond to tenure effects, whether own tenure or tenure externalities from other workers.[14]

The returns to human capital obtained from the EM1 (columns 1 and 2 in Table 2) are closer to those of the firm dummies model (FDM, columns 2 and 3 in Table 1) than to the corresponding returns from the Mincerian Model (MM, column 1 in Table 1). More specifically, the EM1 model yields estimated marginal returns to education similar to that obtained with the FDM (in OLS, 6.98 percent compared to 6.94 percent with the FDM, while it amounts to 7.8 percent with the MM; see summary results in Table 3). Thus, if the main interest is to estimate returns to education, the firm dummies effects can be accounted for by introducing within-firm mean human capital characteristics. Such results suggest that human capital externalities are at work. A similar observation can be made for tenure and, to a lesser extent, for off-firm experience. In the case of tenure, the OLS EM1 return stands at 3.70 percent, whereas it amounts to 3.69 and 3.24 for the OLS FDM and OLS MM respectively.

Comparing the estimation results based on firm dummies with the EM1 estimation results is instructive. In these data, three of the firm's observable characteristics (firm age,

mean education, Textiles dummy) suffice to account for most of the impact of the firm dummies on wages.

4. Conclusion

In this case study, we use matched Tunisian worker-firm data from 1999 to bring out the roles of different forms of within-firm human capital in worker remuneration. We capture these roles by introducing mean human capital characteristics into the wage equations, interacted, in certain cases, with individual human capital variables. Their effects appear to be pervasive in all estimated wage equations. Our key finding is that within-firm externalities are important for individual wages and are thus implicitly so for individual productivity. We confirm the presence of convexities for worker earnings functions with respect to education levels, accompanied by concavities in tenure. However, we test and reject the hypothesis that the earnings function convexities are solely due to within-firm human capital externalities in these data. Our results suggest that other forces are at work. The most obvious suspects are the interplay of supply and demand for skills and various aspects of human capital content.

We also find that the estimated return to education in wage equations is not affected when firm dummies representing firm heterogeneity are replaced in the list of regressors, with a list of easy to observe aggregate firm characteristics. The most important aggregate characteristics are the textile industry dummy, within-firm mean education and firm age. These characteristics all have implications for knowledge transmission within the firm. Thus, many of the within-firm effects in these data can be interpreted as potentially related to within-firm human capital externalities.

An alternative interpretation of the results could be that the estimated within-firm wage externality partially captures the role of unobserved physical capital. Indeed, it may be that high human capital and training are correlated with high capital intensity across firms. If

this is the case, the impacts of firm human capital and firm physical capital on wages should be analysed jointly. This calls for accurate measurement of physical capital, which is often a difficult task. Also, some of the within-firm human capital effects may originate from selectivity or matching effects. For example, because of specific technologies requiring a high level of skills, some firms may hire workers with high human capital and pay this specific human capital well. Finally, limitations stem from the small size of the sample of firms and workers used in this case study.

Given these conditions, the policy implications are potentially multiple, although caution should be taken not to extrapolate results for a few firms to Tunisian manufacturing or more generally. First, since we find that within-firm externalities matter, government policies should consider them seriously. In the Tunisian context, emerging tensions in the labour market will need to be closely monitored across skill composition. The role of human capital accumulation is central in dealing efficiently with these tensions. One outcome of our work is the discovery of the likelihood that human capital investment proceeds partly through within-firm externalities, rather than stemming from public education policies alone.

While it should be verified by further studies, if this conjecture is true, public subsidies to OJT may be a channel for fostering specific firm human capital and therefore potential within-firm externalities. These could be implemented through the Tunisian programme ‘remise à niveau’, which currently assists firms in adjusting to the competitive global industrial market. Promoting the development of business-government relations in this direction could contribute to industrial upgrading. As emphasized by Cammet (2007), Tunisia has been particularly proactive in creating vocational and technical training institutes. These initiatives could easily extend to diverse aspects of within-firm human capital externalities, by stimulating better practices through demonstration and supervision carried out by a few selected outstanding workers within firms.

Imbalances in the labour markets for given skills and education levels may result not only in convex earnings functions but also in the unemployment of relatively skilled workers. This is consistent with findings by Salah Redjeb and Ghobentini (2005), who report gaps between labour supply and demand, and between the profiles of job searchers and those sought out by firms, thereby leading to lay-offs and job precariousness. About one third of one percent of GDP is already spent by the government on training programmes within 'active employment policies' targeted at young workers. Clearly, better monitoring of skill production within and outside firms could save a great deal of resources. These programmes could be improved by a better understanding of how newly employed workers might benefit from within-firm human capital. The programmes proposing initial and continuing OJT could also be better designed thanks to a better understanding of human capital externalities. There is significant room for development in these areas in Tunisia, where only 4.5 percent of the programme's spending is devoted to within-firm training.

Finally, one avenue for future research might involve ascertaining whether the type of findings of our study extends to a more representative and larger sample of firms or workers within Tunisia and in other parts of Africa. If within-firm human capital externalities are as important in other contexts as we found they were in our case study, then taking them into account when designing education, training and labour market policies could substantially improve the efficiency of these policies.

[1] Using Indian data, Chamarbagwala (2008) finds that high returns to education may increase the likelihood of children attending school.

[2] Abowd et al (1999), Goux and Maurin (1999), Abowd et al (2001). Abowd and Kramarz (1999) provide a survey.

[3] Matched worker-firm data are collected, for example, as part of the World Bank's Regional Program for Enterprise Development (RPED) surveys in Africa. Each of these surveys constitutes a sample of about 200

firms with about 10 interviewed workers in each firm. Using such surveys, Frazer (2006) studies apprenticeship in Ghanaian manufacturing firms, while Nordman and Wolff (2009a, 2009b) analyse firm effects on the gender wage gap in Madagascar, Mauritius and Morocco. However, such data are not available for Tunisia.

[4] One exception, however, is the study on information technology knowledge transfers in Kenya and Ghana by Nyaki Adeya (2003).

[5] The methodology for the Tunisian survey appears in Nordman (2002) and Destré and Nordman (2003). The definitions and descriptive statistics of the variables are in online Appendix Tables A1 and A2, see also Muller and Nordman (2005).

[6] The observed firms were selected among firms exporting their production and having capital which is not fully foreign.

[7] Accounting for these features of the sampling scheme does not change the significance of the main results (details available from the authors on request).

[8] By comparison, Angrist and Lavy (1997) estimate the number of repeated classes at 2 to 3 years in Morocco. In addition, the UNDP (1994) shows that in the 1980s Tunisia had a higher rate than Morocco of repeated classes in primary school.

[9] The average monthly wage corresponds to 1.8 times the monthly SMIG of 1997 for 48 hours per week (177.8 Tunisian Dinars, that is, 125 US dollars in 2001). The stated monthly wages are those of January and February 1999.

[10] Our F-test results for the constrained model (without the firm's dummies) against the unconstrained one show that we fail to reject the unconstrained model at the 1 percent level. The null hypothesis is that of no effects of firm dummies. Note, however, that, probably due to the small sample size, high R^2 are obtained even with the standard Mincerian equation. Care should thus be taken when interpreting goodness-of-fit statistics in this case.

[11] Psacharopoulos and Patrinos (2004) report the returns to education in many countries.

[12] See, for example, Krueger and Summers (1988), Abowd et al. (1999) and Goux and Maurin (1999).

[13] Sargan tests still validate the instruments, while the results of Hausman exogeneity tests reject exogeneity.

[14] Unfortunately, the 2SLS estimates are less interesting when firm aggregate characteristics are added. This is to be expected, as there are not enough instruments for the newly introduced potentially endogenous variables related to workers' human capital. Many of the coefficients describing human capital effects are insignificant. As a result, we shall not discuss these estimates, since they do not provide satisfactory information.

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APPENDIX

Figure A1. Kernel density estimate of workers' monthly wages

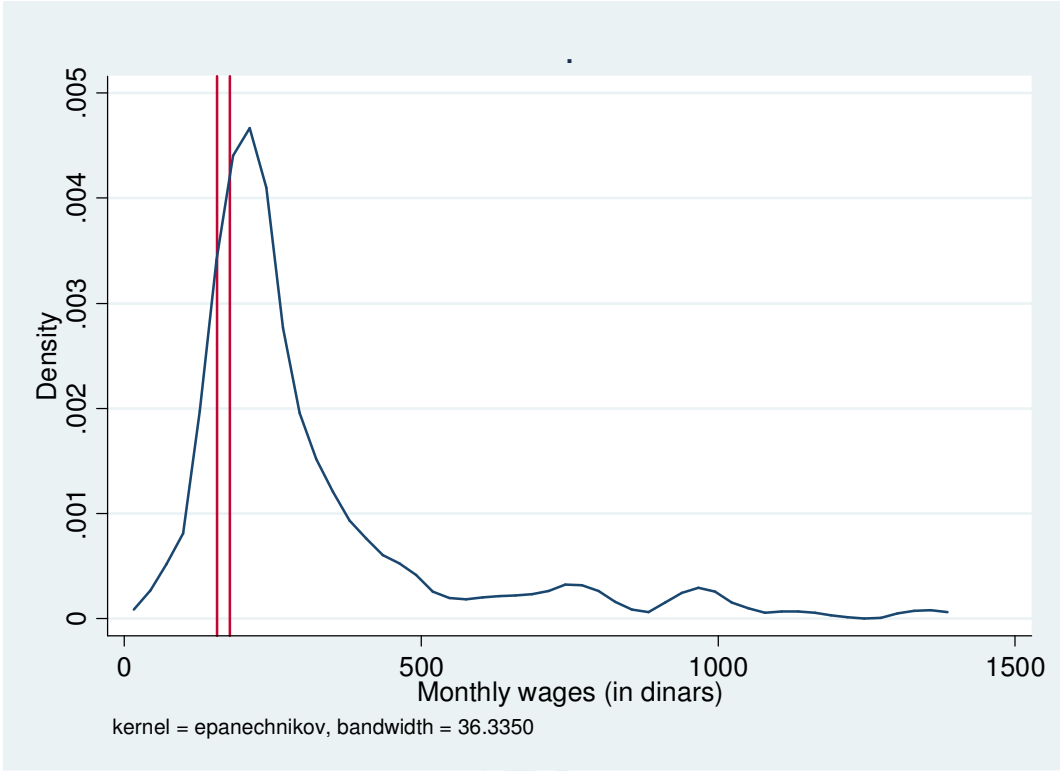

Table A1. Descriptive worker characteristics statistics

Variables	*Mean*	*Standard deviation*	*min*	*max*
Age of individuals (AGE)	29.532	7.774	15	52
Sex (FEMALE, 1: woman; 0 man; conversely for MALE)	0.498	0.501	0	1
Geographical origin (PROVE, 1: rural area; 0 otherwise)	0.147	0.355	0	1
Marital status (MARI, 1: if married; 0 if divorced, widowed or single)	0.368	0.483	0	1
Single male (CELIBAH, 1: yes; 0 otherwise)	0.303	0.460	0	1
Number of dependent children (ENFT)	0.580	1.060	0	5
Father has some level of Primary school (PPRIM, 1: yes; 0 otherwise)	0.173	0.379	0	1
Father has some level of Secondary school (PSECON, 1: yes; 0 otherwise)	0.164	0.371	0	1
Father has some level of Higher education (PSUP, 1: yes; 0 otherwise)	0.125	0.332	0	1
Father is illiterate (PANAL, 1: yes; 0 otherwise)	0.194	0.396	0	1
Years of schooling (EDUCATION)	9.676	3.880	0	18
Previous apprenticeship in a firm (APPRENTI, 1: yes; 0 otherwise)	0.363	0.482	0	1
Periods of internship related to current job (STAGA, in years)	1.468	3.617	0.00	24.0
Periods of internship not related to current job (STAGAN, in years)	0.121	0.759	0.00	6.00
Previous years of unemployment (CHOMA)	1.385	2.825	0.00	18.0
Previous relevant experience (EMSIM, 1: yes; 0 otherwise)	0.554	0.498	0	1
Previous (off-firm) professional experience (EXPERIENCE*, in years)	3.261	4.689	0	22
Start date in current firm (ENTREE)	1992.1	5.901	1968	1997
Tenure in current firm (TENURE, in years)	5.898	5.902	0.17	30.08
Formal training received in current firm (FORMAD, 1: yes; 0 otherwise)	0.182	0.387	0	1
Formal training period in current firm in years (FORMAA)	0.091	0.323	0	3
Ongoing formal training in current firm (FORSTIL, 1: yes; 0 otherwise)	0.017	0.130	0	1
Member of a union (SYNDIC, 1: yes; 0 otherwise)	0.203	0.403	0	1
Work on team (EQUIPE, 1: yes; 0 otherwise)	0.367	0.483	0	1
Work on production line (CHAINE, 1: yes; 0 otherwise)	0.320	0.467	0	1
Executive or supervisor (ENCADR, 1: yes; 0 otherwise)	0.190	0.394	0	1
Hourly wage (salh, in dinars)	1.893	1.347	0.29	7.57
Log of hourly wage (lnsalh)	0.197	0.251	-0.54	0.88
Monthly wage (sal, in dinars)	315.131	231.382	52	1350
*Firm dummies***				
Firm 1 (IMMEE sector)	0.134			
Firm 2 (IMMEE sector)	0.160			
Firm 3 (Textile sector)	0.143			
Firm 4 (Textile sector)	0.130			
Firm 5 (Textile sector)	0.130			
Firm 6 (IMMEE sector)	0.087			
Firm 7 (IMMEE sector)	0.078			
Firm 8 (Textile sector)	0.139			

*: This experience variable is an actual measure, as opposed to a potential one based on age. It excludes experience in the current job (TENURE) and possible periods of unemployment or inactivity. **: The means of the firm dummies indicate the sample distribution of workers across firms and sectors.

Table A2. Descriptive firm statistics

Variables	*Mean*	*Standard deviation*	*min*	*max*
Mean education in firm	10.07	2.546	7.7	15.4
Mean tenure in firm	5.818	3.631	1.43	13.60
Mean off-firm experience in firm	9.002	3.869	3.61	16.9
Average age of employees in firm	29.717	2.880	26.19	34.55
Work autonomy stimulated (1: yes; 0: no)	0.250	0.463	0	1
Level of stimulated internal communication (1 to 3)	0.900	1.039	0	3
Level of competition (1 to 5)	3.125	1.642	1	5
Regular work control (1: yes; 0: no)	0.500	0.535	0	1
Firm age	10.438	5.766	3.5	20
Number of intermediary levels of management	5.000	0.535	4	7
Size (number of employees)	131.250	100.954	70	371
Existing system of formal training (1: yes; 0: no)	0.250	0.463	0	1
Task definition (1: globally defined; 0: precisely defined)	0.250	0.463	0	1
Organizational innovation in the last four years (1: yes; 0: no)	0.5	0.534	0	1
Technological innovation in the last four years (1: yes; 0: no)	0.625	0.517	0	1
Percentage of exported production	0.603	0.462	0	1
Firm is export oriented (1: yes; 0: no)	0.75	0.462	0	1
System of versatility (job rotation) implemented (1: yes; 0: no)	0.625	0.518	0	1
Percentage of employees working on production line	0.358	0.409	0.00	0.91
Sector (1: textiles; 0: IMMEE)	0.500	0.535	0	1
Rate of supervision	0.103	0.069	0.05	0.25
Rate of management	0.146	0.278	0.02	0.83

Table 1. Wage equations

Dependent variable: Log hourly wage (lnsalh)

	OLS	OLS	IV (2SLS)	OLS	OLS	IV (2SLS)
	Mincerian Model (MM)	Firm Dummies Model (FDM)	Firm Dummies Model (FDM)	Firm Dummies Model (FDM)	Firm Dummies Model (FDM)	Firm Dummies Model (FDM)
	(1)	(2)	(3)	(4)	(5)	(6)
Education	-0.0700***	-0.0370	-0.0705	-0.0285	-0.0281	-0.0765
	(0.0258)	(0.0246)	(0.0735)	(0.0250)	(0.0250)	(0.0775)
Education^2	0.0077***	0.0055***	0.0058	0.0049***	0.0049***	0.0062
	(0.0013)	(0.0012)	(0.0037)	(0.0013)	(0.0013)	(0.0039)
Tenure	0.0442***	0.0522***	0.0994***	0.0501***	0.0517***	0.1013**
	(0.0098)	(0.0095)	(0.0368)	(0.0095)	(0.0094)	(0.0396)
Tenure^2	-0.0010**	-0.0013***	-0.0044**	-0.0013***	-0.0013***	-0.0045**
	(0.0004)	(0.0004)	(0.0019)	(0.0004)	(0.0004)	(0.0020)
Experience	0.0337***	0.0417***	0.0187	0.0341***	0.0378***	0.0201
	(0.0111)	(0.0109)	(0.0256)	(0.0112)	(0.0110)	(0.0279)
Experience^2	-0.0005	-0.0010	0.0005	-0.0004	-0.0006	0.0003
	(0.0006)	(0.0006)	(0.0016)	(0.0006)	(0.0006)	(0.0017)
Ongoing formal training	-0.4228***	-0.3549**	-0.3319*	-0.4704***	-0.3710**	-0.3230*
	(0.1589)	(0.1498)	(0.1893)	(0.1724)	(0.1488)	(0.1950)
Completed formal training	0.3218***	0.2066***	0.1992**	0.2035**	0.2185***	0.1792
	(0.0621)	(0.0708)	(0.0859)	(0.0813)	(0.0718)	(0.1094)
Female	-0.2322***	-0.1614**	-0.1996**	-0.1725***	-0.1570**	-0.1954**
	(0.0453)	(0.0629)	(0.0783)	(0.0658)	(0.0630)	(0.0939)
Executive or supervisor	0.1369**	0.1930***	0.3681***	0.2038***	0.1847***	0.3632***
	(0.0617)	(0.0594)	(0.0979)	(0.0636)	(0.0597)	(0.1249)
Education*Firm 6				1.9204	0.3228	-0.3158
				(2.0569)	(0.2792)	(0.9318)
Education^2*Firm 6				-0.0573	-0.0097	0.0114
				(0.0668)	(0.0107)	(0.0370)
Tenure*Firm 6				0.2124		
				(0.7198)		
Tenure^2*Firm 6				-0.0389		
				(0.2677)		
Experience*Firm 6				0.0723		
				(0.0733)		
Experience^2*Firm 6				0.0043		
				(0.0100)		
Ongoing formal training*Firm 6				0.0425		
				(0.6225)		
Completed formal training*Firm 6				0.1215		
				(0.2366)		
Female*Firm 6				0.4844		
				(0.4165)		
Executive or supervisor*Firm 6				-0.1782		
				(0.2590)		
Firm dummies (reference : Firm 6)						
Firm 1		-0.4618***	-0.4194**	15.8823	2.1634	-2.5183
		(0.1016)	(0.1873)	(15.9535)	(1.7684)	(5.4487)
Firm 2		-0.4496***	-0.5997***	15.8681	2.1771	-2.7146
		(0.0986)	(0.1499)	(15.9532)	(1.7742)	(5.4907)
Firm 3		-0.6074***	-0.7673***	15.7222	2.0184	-2.8871
		(0.1057)	(0.1541)	(15.9534)	(1.7800)	(5.5206)
Firm 4		-0.5417***	-0.7788***	15.7840	2.0801	-2.8983
		(0.1109)	(0.1973)	(15.9534)	(1.7792)	(5.5050)

Firm 5		-0.5543***	-0.7253***	15.7755	2.0684	-2.8452
		(0.1064)	(0.1627)	(15.9534)	(1.7789)	(5.5201)
Firm 7		-0.5521***	-0.6232***	15.7899	2.0821	-2.7420
		(0.1015)	(0.1611)	(15.9535)	(1.7751)	(5.4985)
Firm 8		-0.5880***	-0.7341***	15.7412	2.0422	-2.8573
		(0.1032)	(0.1650)	(15.9534)	(1.7792)	(5.5138)
Constant	0.0513	0.3968***	0.7602**	-15.9315	-2.2612	2.8905
	(0.1289)	(0.1437)	(0.3283)	(15.9527)	(1.7718)	(5.4596)
Observations	231	231		231	231	231
R-squared	0.75	0.79		0.81	0.80	
Pseudo Squared			0.71			0.70
Hansen J Statistic			17.41			16.82
Hansen p-value			0.43			0.33
Durbin-Wu-Hausman						
Statistic test			17.20			16.77
P-value			0.00			0.03

Standard errors are given in parentheses. ***, ** and * mean significant at the 1%, 5% and 10% levels respectively.

The instrumented variables in the IV regressions are: education, tenure, experience, their squared values and their interactions in model 6. The excluded instruments used in the IV regressions include: PPRIM, PSECON, PANAL, ENFT, ENFT^2, ENFT*AGE, PROVE, MARI*FEMALE, MARI*MALE, CHOMA, CHOMA^2, EMSIM, APPRENTI, STAGAN, PPRIM*AGE, PSECON*AGE, PANAL*AGE, PPRIM*ENFT, PSECON*ENFT, PSUP*ENFT, PANAL*ENFT, PPRIM*CHOMA, PSECON*CHOMA, PANAL*CHOMA.

The definitions of the variables and instruments appear in Table A1.

Table 2. Wage equations with human capital externalities

Dependent variable: Log hourly wage (lnsalh)

	OLS Extended Model 1 (EM1)	IV (2SLS) Extended Model 1 (EM1)	OLS Extended Model 2 (EM2)	IV (2SLS) Extended Model 2 (EM2)
	(1)	(2)	(3)	(4)
Education	-0.0424*	-0.0683	-0.0535**	-0.1198
	(0.0249)	(0.0758)	(0.0252)	(0.0937)
Education^2	0.0058***	0.0056	0.0055***	0.0098**
	(0.0013)	(0.0038)	(0.0012)	(0.0049)
Tenure	0.0535***	0.1004**	0.1561***	0.2577*
	(0.0095)	(0.0394)	(0.0300)	(0.1398)
Tenure^2	-0.0014***	-0.0045**	-0.0014***	-0.0039*
	(0.0004)	(0.0020)	(0.0004)	(0.0020)
Experience	0.0370***	0.0106	0.0454***	0.0352
	(0.0108)	(0.0262)	(0.0106)	(0.0309)
Experience^2	-0.0007	0.0009	-0.0012*	0.0000
	(0.0006)	(0.0017)	(0.0006)	(0.0018)
Ongoing formal training	-0.3680**	-0.3494*	-0.3852**	-0.4984**
	(0.1525)	(0.1964)	(0.1493)	(0.2298)
Completed formal training	0.2036***	0.2124**	0.2407***	0.2371***
	(0.0716)	(0.0880)	(0.0704)	(0.0889)
Female	-0.1481**	-0.1929**	-0.1524**	-0.1124
	(0.0638)	(0.0819)	(0.0633)	(0.1092)
Executive or supervisor	0.1976***	0.3933***	0.2145***	0.3363***
	(0.0604)	(0.0997)	(0.0587)	(0.1063)
Firm human capital variables				
Firm mean education	0.0425***	0.0694***	0.0816***	0.0928**
	(0.0154)	(0.0217)	(0.0167)	(0.0427)
Firm mean tenure	-0.0108	0.0028	-0.0385**	0.0431
	(0.0086)	(0.0137)	(0.0194)	(0.0725)
Firm mean experience	-0.0071	-0.0016		
	(0.0174)	(0.0206)		
Firm mean education*Tenure			-0.0107***	-0.0183
			(0.0030)	(0.0148)
Firm mean tenure*Education			0.0028	-0.0031
			(0.0017)	(0.0068)
Firm heterogeneity controls				
Sector (textiles: 1; IMMEE: 0)	-0.1335*	-0.1755**	-0.1216*	-0.1976**
	(0.0709)	(0.0851)	(0.0679)	(0.0892)
Firm age	-0.0142***	-0.0199***	-0.0063	0.0019
	(0.0046)	(0.0065)	(0.0051)	(0.0175)
Constant	-0.1869	-0.2344	-0.5541***	-0.7345
	(0.2466)	(0.4108)	(0.2095)	(0.5054)
Observations	231	231	231	231
R-squared	0.78		0.80	
Pseudo Squared		0.69		0.70
Hansen J Statistic		15.08		14.59
Hansen p-value		0.59		0.48
Durbin-Wu-Hausman test		19.91		19.78
P-value		0.00		0.01

Standard errors are given in parentheses. ***, ** and * mean significant at the 1%, 5% and 10% levels respectively. The instrumented variables in the IV regressions are: education, tenure, experience, their squared values and their interactions in model 4. The excluded instruments used in the IV regressions include: PPRIM, PSECON, PANAL, ENFT, ENFT^2, ENFT*AGE, PROVE, MARI*FEMALE, MARI*MALE, CHOMA, CHOMA^2, EMSIM, APPRENTI, STAGAN, PPRIM*AGE, PSECON*AGE, PANAL*AGE, PPRIM*ENFT, PSECON*ENFT, PSUP*ENFT, PANAL*ENFT, PPRIM*CHOMA, PSECON*CHOMA, PANAL*CHOMA.

Definitions of the variables and instruments appear in Table A1.

Table 3. Marginal returns to individual human capital[#]

Alternative wage specifications	**Education**	**Tenure**	**Experience**
OLS MM	0.0790	0.0324	0.0304
OLS FDM	0.0694	0.0369	0.0352
2SLS FDM	0.0417 [ns]	0.0475	0.0220 [ns]
OLS EM1	0.0698	0.0370	0.0324
2SLS EM1	0.0401 [ns]	0.0473	0.0165 [ns]

[#]: The human capital returns stem from the Mincerian Models (MM), Firm Dummies Models (FDM) and Extended Models (EM1) reported in Tables 1 and 2. The returns are calculated at the mean point of the sub-sample.

[ns]: not significantly different from zero at 10% level.

Within-Firm Human Capital Externalities in Tunisia[†]

April 2010

Online Appendix

1. Labour market in Tunisia

Several changes have recently occurred in Tunisia's labour market framework. First, the Labour Code was revised in 1994 and 1996 to clarify the conditions under which workers could be laid off and to establish guidelines for financial compensation. Second, Tunisian producers are facing stronger competition in their export markets following the disappearance of the Multi-Fibre Arrangements (MFA) in 2005. Third, competition has become even fiercer on the local market since the full implementation in 2007 of the Association Agreement signed with the EU in 1995, which allows free trade provisions. It is expected that better jobs will be generated for more highly-skilled workers and that less skilled workers will encounter greater difficulties in finding and retaining jobs.[1] Indeed, the opening of international markets implies that Tunisian industries will be up against not only European firms, but also firms from countries with very low labour costs, such as China and India. Low-wage workers are thus facing a worrying context of increasing liberalization, economic openness and privatization. A response to policy and structural shocks may be found in improving productivity, especially by raising skill levels.[2]

In response to these economic changes, Tunisia undertook massive modernization of its productive sector in 1996 through a programme assisting industrial and service-based firms in adjusting to the free market. Human capital investment will be crucial for this modernization process.

Tunisian authorities are placing increasing emphasis on vocational training, which fulfils the dual objective of educating and preparing workers for the modern job market. In 1995, the government implemented a programme to stimulate vocational training and employment (MANFORME, *Mise à Niveau de la Formation Professionnelle et de l'Emploi*).

[1] The measurement of unemployment in Tunisia is a contentious issue (Rama, 1998). However, unemployment is a growing concern for the population and government.
[2] Belhareth and Hergli (2000).

Assessing the role of within-firm human capital externalities in Tunisian firms may help us to appraise the spillover effects that vocational education policies may foster.

2. Discussion on instruments

On-the-job training variables are left untreated for lack of suitable instruments. Endogeneity may arise from several sources: simultaneous determination of education and wages, ability bias, measurement error and even uncontrolled selectivity. The decrease in the estimated effect after instrumentation suggests that the ability bias is the most likely contribution to the endogeneity problem.

The instrumented variables in the IV regressions are: education, tenure, experience, their squared values and their interactions. The excluded instruments used in the IV regressions include: PPRIM, PSECON, PANAL, ENFT, ENFT^2, ENFT*AGE, PROVE, MARI*FEMALE, MARI*MALE, CHOMA, CHOMA^2, EMSIM, APPRENTI, STAGAN, PPRIM*AGE, PSECON*AGE, PANAL*AGE, PPRIM*ENFT, PSECON*ENFT, PSUP*ENFT, PANAL*ENFT, PPRIM*CHOMA, PSECON*CHOMA, PANAL*CHOMA. The definitions of the variables and instruments appear in Table A1.

The instrumentation is largely based on family demographics, former father's characteristics and on the workers' former spells of vocational training and unemployment before they joined the current firm. An important instrument for the worker education variable is the schooling level of the worker's father. This instrument, often used for developing country data, may capture various genetic and environmental influences (Sahn and Alderman, 1988). Its validity relies on the hypothesis that the former schooling of the worker's father bears heavily on the worker's education, while having only a negligible correlation with the worker's wage determination. The plausibility of this hypothesis is reinforced by the fact that we are dealing with formal firms with well-established recruitment processes rather than with

the informal sector where the father's connections could play a bigger role. First, the presence of firm dummies in the wage equations should strengthen the quality of the instruments, since these dummies could capture the role of parental characteristics in influencing the segment of the labour market a worker is in.

Second, statistical tests can be used to guarantee that the chosen IV have proper statistical characteristics and perform well. The values of the F-statistics and partial R^2 in instrumental equations ensure that this is not a weak instrument case (Abadie et al., 2002). This is confirmed by robust p-values of the Cragg-Donald F-statistics, which indicate that we can safely reject the null of the excluded instruments in the first stage regressions at the 1 percent level.

Moreover, Hansen J tests, which are robust under heteroscedasticity, with estimated p-values well beyond 0.3, confirm the validity of the set of instrumental variables used in all our specifications. These results are confirmed by the results of Sargan tests.

Finally, Hausman-type exogeneity test results, with estimated p-values of 0.03 at most, systematically reject the exogeneity of the treated set of the possible endogenous variables. They are confirmed by heteroscedasticity-robust tests. On the whole, although we would have liked to exploit a more extended set of instruments, it is still worthwhile to consider 2SLS estimates, despite the probable imprecision of certain estimated coefficients. To be on the safe side, we use the robust heteroscedasticity-consistent standard error estimates for 2SLS.

3. Discussion on interaction terms for Firm 6 (Table 2)

Firm 6's characteristics appear quite distinct from those of other firms and this firm generally remunerates its employees better. It operates in the ITC branch of the IMMEE. Firm 6 is the most technology-intensive among the observed sample firms. The average education of observed employees in this firm amounts to 15.4 years of completed schooling, whereas the

firm sample average is 10 years. It is also a young company, in which average employee tenure is 1.4 years (the firm sample average is 5.8 years). Moreover, it enjoys a quasi-monopoly status on its products in the country (for electronics components). It is thus able to offer workers higher wages, all else equal.

This explains the estimated negative and significant coefficients of the other firm dummies in most specifications. It may thus seem pertinent to introduce several interaction terms for the Firm 6 dummy, for instance, with the various human capital variables. Unfortunately, the small sample prevents us from doing so systematically. However, we maintain education interacted with the Firm 6 dummy in columns (5) and (6), where its coefficient is positive without being significant. We also attempt a more general specification with interaction effects of Firm 6 with individual human capital variables, gender and a supervisor dummy, which is shown in column (4). As expected, perhaps because of the limited information, this version shows insignificant interacted effects. These results suggest that the high returns to these components of human capital in Firm 6 are relatively well taken into account by the level of human capital variables in this firm, and the non-linearities in returns. As a matter of fact, removing the observations corresponding to this firm from the sample has little influence on the OLS estimates of the marginal returns once firm dummies are introduced. The other estimated non-interacted effect coefficients are quite similar in levels and significance to what is found when excluding the Firm 6 interacted effects.

4. Additional discussion on firm wage differentials

In an additional analysis, we normalized the estimated firm wage differentials as deviations from the (employment weighted) mean differential following Krueger and Summers (1988). The resulting statistics express the proportionate difference in wages between an employee in a given firm and the average employee. From this computation, we can see in the

table below that the average employee in Firm 6 earns a wage 6.3 percent higher than that of the average employee in all firms, after controlling for human capital characteristics. By contrast, the average employee in Firm 3 earns a wage 54.4 percent lower than that of the average worker in all firms. These differentials are all significantly different from the average at the 1 percent level.

Estimated Firm Wage Differentials

Firms	Deviations from the (weighted) mean differential
Firm 1	-0.3987
	(0.1335)
Firm 2	-0.3865
	(0.0970)
Firm 3	-0.5443
	(0.1070)
Firm 4	-0.4786
	(0.1097)
Firm 5	-0.4912
	(0.1297)
Firm 6	0.0630
	(0.0115)
Firm 7	-0.4890
	(0.1034)
Firm 8	-0.5249
	(0.0988)

Adjusted standard errors are in parentheses.