Human Capital, Exports, and Earnings*

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Abstract

This paper tests whether manufacturing exporters pay more to educated workers in an effort to ascertain whether the productivity of human capital is raised by exports. Using a panel of matched employer-employee data from Morocco, we find no evidence that the education wage premium is higher in exporting sectors and firms. Although exporters pay more on average, much of the wage differential can be explained by the fact that exporters have a larger workforce and more capital. Educated workers who start working for an exporter do not experience a larger wage increase relative to their previous job. We find a mild positive association between exports, technology, and product quality, part of which is due differences in firm size. We discuss why our results differ from those obtained using different countries and methodologies.

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1. Introduction

Much attention has been devoted to human capital and its role in development (e.g. Lucas 1993, Mankiw, Romer and Weil 1992, Barro and i Martin 1992). There has also been considerable interest in the role of international trade in fostering rapid growth and productivity gains (e.g. Young 1991, Coe and Helpman 1995, Tybout and Westbrook 1995, Baldwin 2003, Wagner 2007).[1] Several explanations have been proposed for the observed relationship between trade and growth. One of them is that international trade facilitates the transfers of technological and market knowledge, thereby leading to an increase in firm productivity (e.g. Grossman and Helpman 1991, Das, Roberts and Tybout 2001, Cameron, Proudman and Redding 2005, Topalova 2004).[2] It is natural to expect educated workers and managers to play a crucial role in this transfers because they are in the position to translate knowledge into new products and procedures (e.g. Tybout 2000, Liu and Tybout 1996). Human capital and exports thus appear to go hand in hand in the growth process (e.g. Johnson and Stafford 1999, Acemoglu 2003, Aw, Roberts and Winston 2001, Feenstra 2000, Epifani and Gancia 2004, Denny, Harmon and Lydon 2002, Batista 2005).

These observations are the starting point for this paper. We examine the link between exports and human capital using survey data on manufacturing firms in Morocco. At the root of our testing strategy is the simple idea that, if educated workers are more productive in exporting firms, exporters should pay them more. Comparing the earnings education premium between exporting and non-exporting firms therefore provides an indirect test that human capital is essential for trade-related productivity grains. The maintained hypothesis behind our

[1] See also Keller (1998) for evidence undermining the evidence presented by Coe and Helpman (1995), and Rodriguez and Rodrik (2001) for evidence that trade openness and growth are statistically unrelated.

[2] Some studies, however, have found that, while exporting firms were more productive before exporting, the fact of exporting need not increase firm productivity (e.g. Clerides, Lach and Tybout 1998, Fafchamps, El Hamine and Zeufack 2007, Soderbom and Teal 2000).

approach is that firms share some of their productivity rents with workers, an idea that has gained widespread acceptance (e.g. Oi and Idson 1999, Bigsten, Collier, Dercon, Fafchamps, Gauthier, Gunning, Isaksson, Oduro, Oostendorp, Patillo, Soderbom, Teal and Zeufack 2003). The details of the process that leads to rent sharing does not matter for our analysis. What matters is that firm-specific worker productivity is partly reflected in individual wages.

Using matched employer-employee data from Morocco, we examine the earnings education differential in the manufacturing labor market. Morocco is a useful study case because it is fairly representative of other moderately open, middle income economy with manufacturing exports concentrated in labor intensive industries – i.e., textile, garment, and leather products. Its proximity to Europe and trade agreement with the European Union also provides a useful comparison to Mexico, where the earnings skill gap has been shown to increase with trade openness to the US (e.g. Hanson and Harrison 1999, Verhoogen 2007, Kaplan and Verhoogen 2006).

Using a Mincerian earnings regression, we first show a strong positive association between the export status of a firm and the average wage it pays to its workers. Since Clerides et al. (1998) and, more recently, Fafchamps et al. (2007) have shown that Moroccan exporters are on average more productive than non-exporters, this is consistent with the idea that firms share productivity rents with their workers. The exporter wage premium remains if we control for individual worker characteristics such as occupation within the firm, gender, education, experience, length of tenure, and vocational training. But the estimated premium gets smaller or disappears, depending on functional form, once we control for firm capital and labor (e.g. Oi and Idson 1999, Fafchamps and Soderbom 2006).

Next we investigate whether there is a larger education wage premium in exporting firms. We estimate firm fixed effect regressions in which the export status of the firm is interacted with

worker education. We find no evidence that exporters pay a higher premium to educated workers. Although exporting firms employ slightly more educated people in middle management positions, they do not pay them more than other firms. We do find that, controlling for education, exporters pay more to skilled production workers relative to unskilled ones, but the occupational definition of skill has little to do with education.

To check the robustness of our findings, we investigate several alternative specifications. First we examine whether firms that start exporting or increase their export share increase wages as well. We find that they do not. Next we investigate whether workers who switch job enjoy a larger pay increase if they start working for an exporter. We find no such evidence.

These findings stand in contrast with much of the empirical literature. Focused on the Americas, the literature has tended to find a positive relationship between trade and the earnings skill differential (e.g. Bernard and Jensen 1997, Hanson and Harrison 1999, Verhoogen 2007). This difference with our findings may be due to the nature of Moroccan manufacturing exports, which remain concentrated in light industries such as textile and garments where wages are low compared to those paid in Morocco's main export markets. Sutton (2007) has hypothesized that the higher a country's labor cost is, the more it has to move up the quality ladder to remain internationally competitive. Better quality products in general require quality control procedures and a better technology, two features that probably call for better educated workers. We investigate whether the data displays features that are consistent with these two ideas. We find that technology and product quality are significantly better in exporting firms and industries, but the difference is not large. We also check whether firms that use a more modern technology and emphasize quality control also employ better educated workers. We find that they do. Exporters, in contrast, do not. We also find that firms that emphasize quality and modern technology pay higher wages on average. They do not, however, pay a higher education

premium.

Our favorite interpretation of the findings is that Sutton's conjecture applies reasonably well to Morocco: cheap and disciplined labor appears to be what brings exporters to the country, a finding consistent with the work of Fafchamps and Soderbom (2006) on labor management. Standard comparative advantage seems to account better for the Moroccan experience to date than trade models emphasizing human capital and technology transfer. While this provides some hope for countries with low levels of human capital wishing to initiate manufacturing exports, it may also explain why Moroccan manufacturing exports have not climbed the quality ladder and have failed to grow over time. Another possible interpretation is that rents shared with workers are shared equally, irrespective of the educational status of workers. This does not, however, explain why exporters do not employ better educated workers even though we find a strong association between technology, quality, and the average education level of the workforce.

The paper is organized as follows. In section 2 we outline our estimation strategy. The data is presented in Section 3. In Section 4 we examine the data for evidence of wage differences between exporters and non-exporters. Technology and quality control are discussed in Section 5 while in Section 6 we interpret our results in the light of the existing literature and speculate as to why our approach yields results that seem at odds with those found using a different methodology.

2. Estimation strategy

The starting point of our analysis is a standard Mincerian earnings function of the form:

$$\log w_{ijt} = \alpha H_{ijt} + \eta D_{ijt} + \theta X_j + \beta Z_{jt} + \varepsilon_{ijt} \tag{2.1}$$

where w_{ijt} denotes the earnings of worker i in firm j at time t, H_{ijt} denote a vector of human capital variables specific to worker i, Z_{jt} is a vector of firm characteristics (including industry dummies), D_{ijt} is a vector of occupational dummies, and ε_{ijt} is a residual. The export status of the firm is written as X_{jt}. A positive coefficient θ means that exporting firms pay more to workers in general.

To test whether exporting firms pay more to workers with more human capital, we add regressors of the form $H_{ijt}X_{jt}$:

$$\log w_{ijt} = \alpha H_{ijt} + \eta D_{ijt} + \theta X_{jt} + \gamma H_{ijt} X_{jt} + \beta Z_{jt} + \varepsilon_{ijt} \tag{2.2}$$

If γ is significantly larger than 0, this constitute evidence of a larger earnings skill gap within exporting firms – a sign that human capital is more productive in exporting firms. This is the approach applied to German data by Schank, Schnabel and Wagner (2007) and Munch and Skaksen (2006).

It is traditional to include occupation dummies in Mincerian wage regressions. The reason is that the wage workers receive is affected by the tasks they undertake and their position in the firm's hierarchy. To the extent that exporting firms have a systematically different mix of occupations, omitting D_{ijt} may result in omitted variable bias. The bias, however, may also go the other way. The occupational classification of workers within the firm is to some extent at the firm's discretion. Exporting firms may decide to reclassify educated workers in higher categories without changing their job description simply in order to pay them more. For this reason we estimate the model with and without occupation dummies.

Regression model (2.2) does not control for firm-specific unobserved heterogeneity (e.g. Schank et al. 2007, Munch and Skaksen 2006). Given that we have matched employer-employee data, we can control for this by adding a firm-level fixed effect u_j to the model. The regression

then takes the form:

$$\log w_{ijt} = \alpha H_{ijt} + \eta D_{ijt} + \theta X_{jt} + \beta Z_{jt} + \gamma H_{ijt} X_{jt} + u_j + \varepsilon_{ijt} \tag{2.3}$$

Equation (2.3) does not permit the inclusion of time-invariant firm-specific variables in the regression. In our data, the export status X_{jt} of firms hardly changes over time. Consequently, it is not possible to estimate θ precisely from (2.3). To obtain an estimate of θ, we follow Wooldridge (2002), p.324, and regress fixed effects on time-invariant firm-characteristics. For this procedure to yield a consistent estimate of θ, X_{jt} can be correlated with u_j but must not be correlated with ε_{ijt}. We have no compelling reason to suspect that it is.

It is also possible that results are affected by worker unobserved heterogeneity correlated with the regressors. This would arise, for instance, if more able workers are hired by exporting firms. To control for this possibility, we use wage information which we have for two time periods for each worker and we reestimate the model with worker fixed effects:

$$\log w_{ijt} = \alpha H_{ijt} + \eta D_{ijt} + \theta X_{jt} + \beta Z_{jt} + \gamma H_{ijt} X_{jt} + u_j + v_{ij} + \varepsilon_{ijt} \tag{2.4}$$

It goes without saying that once we control for worker fixed effects, time-invariant worker-specific regressors have to be dropped. This is true, for instance, of education and gender in H_{ijt}. Since we do not have observations on the same workers working in different firms over time, firm-level fixed effects u_j drop out once we include worker fixed effects. We use regression model (2.4) to examine whether better educated workers enjoy faster growing wages than uneducated ones, and whether the growth rate of wages vary between exporters and non-exporters.

Going from model (2.2) to models (2.3) and (2.4) enables us to control for a growing range of unobserved confounding factors. But it also puts increasing demands on the data, making

identification more difficult. Put differently, while the less restrictive model (2.2) may yield a false positive – i.e., a significant coefficient when the true effect is zero, more restrictive models (2.3) and (2.4) may yield a false negative – i.e., a non-significant coefficient when the true effect is not zero. What we hope for is that results are similar across models.

3. The data

With a GDP per head of approximately 4300 US$ in 2005 and an annual growth rate of 2% in the 1990's, Morocco is a good example of intermediate economy. Its geographical proximity to Spain, stable regime, and decent infrastructure make it a good candidate for serving the European market with cheap manufactured goods. Furthermore, Morocco is engaged in a far-reaching program of trade integration with the European Union. The question is whether its relatively uneducated workforce is sufficient for the country to take advantage of expanded export opportunities with Europe. The country already experimented with trade liberalization in the late 1980's and early 1990's (e.g. de Melo, Haddad and Horton 2001, Clerides et al. 1998). Currie and Harrison (1997) have shown that this liberalization tended to reduce employment in exporting firms.

The data used in this paper comes from the Firm Analysis and Competitiveness Survey (FACS) conducted from September to December 2000 by the Moroccan Ministry of Commerce, Industry and Telecommunications (MCIT) and the World Bank (e.g. MCI et Banque Mondiale 2001, Fafchamps and El Hamine 2005). The author was directly involved in designing and pre-testing the questionnaire, selecting the sample, and training the enumerators. The sampling frame from which FACS is drawn is the annual census of manufacturers conducted every year by MCIT. Since responding to the census questionnaire is a legal obligation, census coverage is virtually universal, except for small informal firms. The FACS data can be obtained directly

from the World Bank.

Firms with fewer than 10 employees are excluded from the FACS sampling frame. This suits our purpose well because small firms are extremely unlikely to export and they often have different wage setting practices such as unpaid family labor and apprentices. Seven manufacturing sectors are covered by the FACS survey: food processing, textiles, garments, leather, electrical machinery, chemicals, and plastics. This list includes all the most important manufacturing sectors in Morocco, and all the dominant export industries.

To minimize survey costs, the FACS survey focused on manufacturing firms located in the six regions: Casablanca, Rabat, Tangiers, Nador, Fes, and Settat. The first four are located on the coast; Fes and Settat are inland.[3] Census data shows that these six regions account for over 90% of the country's manufacturing firms. More than half of the country's manufacturers are located in and around the town of Casablanca alone. The resulting sampling frame includes around 1400 firms from which 859 firms were drawn at random, without any stratification, to constitute the FACS sample. This ensures that the sample is self-weighting for the sampled population.

A lengthy questionnaire was administered through face-to-face interviews with the firm's manager, accountant, and head of human resources. The questionnaire gathered data about many aspects of the firm's operation, including detailed information about exports and manpower over the two years preceding the survey. In addition to the firm questionnaire, ten workers were individually interviewed in each firm. These workers were selected at random by the enumerator assisted by the firm's human resource manager. Enumerators were instructed to select at least one worker in each of the main occupational categories of the firm. As a result upper management employees tend to be overrepresented (see Table 2 below). Although enumerators

[3] To facilitate interpretation, we refer to regions by the name of their main city rather than using the Moroccan names for the region itself, with which the reader is less likely to be familiar.

probably did not rely on formal random sampling, we have no reason to suspect any systematic sample selection bias. In particular, enumerators were not aware that the data would be used to examine the relationship between exports and wages.

For each worker, information is available on a variety of worker characteristics as well as on current earnings, earnings one year prior to the survey, earnings at the time of hiring, and last earnings from the previous employer, if any. The matched employer-employee data have been used, together with similar data from other countries, to study the earnings education gap (Fafchamps, Soderbom and Benhassine 2006) and to investigate labor management and supervision issues (Fafchamps and Soderbom 2006).

The main characteristics of the surveyed firms are summarized in Table 1, together with a breakdown by exporting status. Average employment is 125 permanent workers. Sixty percent of the FACS sampled firms are in two industries, textile and garment, and sixty percent are located in and around Casablanca. One fifth of surveyed firms also employ casual workers. Firms have been in existence for 16 years on average. See Fafchamps and El Hamine (2005) and MCI et Banque Mondiale (2001) for more details.

The sample is more or less equally divided between exporters and non-exporters. Using the FACS data, Fafchamps et al. (2007) have shown that exporting manufacturers in Morocco are primarily young firms geared towards export markets from their inception. Specialization in exports or domestic sales is indeed the norm: 47% of all firms do not export any of their output while 34% export all their production. Only 17% of manufacturers serve both the domestic and export markets. 83% of all exports go to Europe, 46% to France alone; 6% of exports go to neighboring Maghreb countries, 5% to other destinations - primarily sub-Saharan Africa.

From Table 1 we see that exporters differ from non-exporters in a number of important respects. They tend to be larger, having on average twice as much equipment and more than

three times as many workers. Juding by a simple t-test, these differences are highly significant. Exporters employ slightly more casual workers, but the different is only borderline significant. The average education level of the workforce is basically identical across the two sets of firms, which in itself already suggests that Moroccan exporters do not rely on a more educated workforce. Exporters do, however, employ significantly more women who, on average, are paid less – see Fafchamps et al. (2006).

Moroccan exporters are concentrated in light industries – primarily garment, textile, and leather products. Of all 7 industrial sectors studied, the garment sector is the most oriented towards exports: on average, garment firms export 80% of their output. Textile and leather manufacturers export, on average, 37-40% of their output. Food processors export a third. The remaining three industries export less than 10% of their output on average. Given these differences across industries, all regression analysis controls for industry dummies.

For each worker we have information on earnings at the time of the survey and one year prior to the survey. This results in observations on earnings for 7850 workers in two consecutive years – approximately 15,700 observations in total.[4] Given the way the sample of workers is constructed, workers in small firms and in less common occupations are over-represented. To correct this bias, all regression results presented here are weighted by the size of the firm's employment in each occupational category. This information is available from the firm questionnaire. We also correct standard errors for clustering by firm and stratification by occupation.[5]

Descriptive statistics for the worker sample are presented in Table 2, for the two years combined. To illustrate the importance of proper weighting, we report weighted and unweighted

[4] This is slightly less than the theoretical maximum of $10 \times 859 = 17180$ because some of the interviewed workers have not been employed for a year or more.

[5] Given the large number of individual effects in some regressions, fixed effects are not controlled for by introducing dummies in the survey regressions but by differencing the data with respect to the weighted mean and applying the survey regression to the differenced data. Experimentation shows that coefficient estimates and standard errors are identical to those obtained by including individual dummies.

averages. Weighted monthly earnings are USD 293. The average age of workers is 33 years. Education refers to completed years of schooling. Tenure is the number of years of employment with the current employer. Experience is the number of years elapsed since finishing school, minus the time spent out of the labor force or in unemployment. Workers have on average 8 years of education and 7 years of tenure.

About a 51% of the weighted sample of workers are women, many of whom are illiterate. Using regression analysis controlling for worker characteristics, Fafchamps et al. (2006) have shown that in Moroccan manufacturing the wage received by women is on average 19% lower than that of men. Yet the share of women in labor force is higher in exporting industries. This is at prima facie inconsistent with the idea that exporting manufacturers rely on better skilled, highly paid workers.

The breakdown of the sample by occupational category shows that production workers – skilled and unskilled – represent the bulk of manufacturing employment. We see that, because of stratification, management and administrative workers are overrepresented in the worker sample. For this reason, throughout the analysis we weigh observations by occupational category within each firm.

As emphasized in the modeling section, some variables of interest – such as education and gender – vary across workers but not over time. Others such as age, experience, and length of tenure vary by the same increment each year. Other variables in contrast vary over time but not across workers, such as the capital, employment, or the share of exports in the firm's sales. These variables also vary more across firms than over time for a given firm. These features must be kept in mind in the analysis.

4. Do exporters pay higher wages?

We begin by estimating model (2.1) controlling for sectoral fixed effects. This is equivalent to comparing wages across workers and firms in the same industry. We wish to investigate whether exporters pay higher wages. Given the existence of threshold effects in exporting (Roberts and Tybout 1997), the main variable of interest is a dummy variable that takes value 1 if the firm exports: we expect exporting firms to differ from non-exporting firms. We also include as additional regressor the proportion of exports in total sales to investigate whether wages vary systematically with export intensity. A large number of worker characteristics are included as control variables. Following current best practice, worker age, experience, and length of tenure enter the regression in quadratic form. A gender-education interaction term is included to capture the idea that returns to education differ by gender, a point emphasized by Fafchamps et al. (2006). The number of previous employers is included as additional regressor to control for job search effects. We also include a dummy variable that takes value 1 if the worker reported his or her earnings net of taxes, 0 otherwise. Since earnings enter the regression in log form, the coefficient of the dummy represents the average percentage gap between net and gross earnings. A year dummy is included as well.

The results from this regression are shown in the first column of Table 3. Reported coefficients come from weighted regressions in which the weights are the number of workers in a given occupation present in the firm in the relevant year. Weighting has a large effect in estimated coefficients. This is because unweighted earnings regressions fail to correct for the fact that most workers are employed by large firms. Reported t-statistics are based on standard errors corrected for clustering at the firm-occupation level. Correcting for clustering dramatically reduces t-values, indicating that earnings residuals are strongly correlated within firms – a feature consistent with rent sharing.

Turning to the estimated coefficients themselves, we find that exporting firms pay more on average to otherwise observationally equivalent workers. Since exporting firms are more productive than non-exporters (e.g. Fafchamps et al. 2007, Soderbom and Teal 2000), this provides indirect evidence that exporting firms share productivity rents with workers (see also Bigsten et al. (2003)). The effect nevertheless falls with the proportion of exports in total sales – albeit it remains positive.

Other estimated coefficients are by and large in line with the literature, suggesting that our data are not remarkable. Worker characteristics have the expected sign, and many are significant. Education, for instance, is highly significant. Results indicate decreasing returns to experience and non-linear age effects. Wages are also found to increase significantly with the number of previous employers, suggesting that workers who switch employer raise their wage over time. This is probably because of selection effects. All these results are in line with much of the available evidence. The education and gender wage gaps in these data are examined in detail by Fafchamps et al. (2006), so we need not discuss them further here.

A spurious correlation between exports and wages may arise because, as we have seen in Table 1, exporters tend to be larger firms and, as been documented in the literature, larger firms pay more on average. To examine this possibility, in the second column we add regressors for firm size by including the logarithms of firm capital and total employment as additional regressors. As in most of the literature (Wagner 2007), we find that firms with more capital pay higher wages on average. The coefficient of the export dummy remains significant once we control for firm size but the export share variable is no longer significant.

Following Tsou, Liu and Huang (2006) and Munch and Skaksen (2006), we also reestimate column 2 with the share of exports and its square – but without the export dummy. Results are summarized at the bottom of Table 3 where we report two F-statistics. The first one tests

whether earnings are higher among firms that export 50%; the second one tests whether earnings are higher in firms that export all their output. The choice of a 50% share is driven by the fact that the quadratic relationship between exports and earnings peaks at around 50% of exports. Test results show that the relationship is only significantly positive for firms that export half of their output, not for those that export all. Taken together, these results confirm that there is a weak albeit non-linear empirical association between earnings and export share in our data. A closer look at the data reveals that small firms tend to fully specialized in either exports or domestic sales. Only large firms sell to both markets. It therefore not surprising that the export share variable is negatively significant in column since it (inversely) proxies for firm size among exporting firms.

Next we test whether earnings vary when firms change their exports.[6] To do this, we reestimate model (2.1) controlling for firm-level fixed effects.[7] In this case, identification of the export coefficient is achieved from firms that changed their exports between the two consecutive years for which we have individual worker earnings. Some 60 firms changed their export share in our data, representing 7% of the sample.[8] This may be too small to find a significant effect, especially if the change in export structure takes time to affect earnings.

Results are reported in the third column of Table 3. Coefficients of worker specific regressors are similar to those reported in columns 2 and 3, except that standard errors are somewhat larger. But the coefficients of the export variables are not significant. As shown at the bottom on column 3, the same finding obtains if we include a quadratic term in export share: both

[6] We also investigated what happens when the firm switches in and out of exports. But the number of observations is too small: between the two years for which we have earnings data, only 8 firms switched into exporting and 2 switched out.

[7] To this effect we difference the data with respect to the firm-specific mean and apply the Stata survey regression command to the differenced data. This method yields the same result as including firm-specific dummies but is much faster.

[8] 47% export nothing in both years, 34% export all their production in both years, and 12% export the same share of output in both years.

F-statistics are non-significant. Such finding is not unusual: other authors have found that switching in or out of exporting does not have an immediate wage effect. Bernard and Jensen (1997) even find a negative relationship between the two. Taken together, our results suggest that the positive association between earnings and export arises largely from differences across firms.[9]

The last column of Table 3 reports results from a worker fixed effect regression. This regression compares identical workers between the two consecutive years for which we have earnings data. Its purpose is to test whether individual workers get paid more when their employer begins exporting or exports more. Most worker characteristics drop out of the regression as they either do not change over time or are collinear with the year dummy. From the coefficient of the year dummy we see that nominal wages increased on average by 8.1% between the two survey years. The capital and manpower variables are positive and significant, suggesting that firms that grow raise wages to already employed workers – and vice versa. The coefficient of the export share variable is again not significant while that of the export dummy is significant but negative. This latter result is based on a very small number of firms that switched exporter status between the two years, and thus should be taken with caution.

We repeat the above analysis separately for each of the six industrial sectors in our sample. If human capital is essential for exports, the education wage gap should be higher in industries that export more. We find the opposite. In the three leading export industries (garments, textile, and leather), the education wage premium ranges from 1.2% per year of schooling (leather)

[9] To investigate this issue further, we regress log earnings on worker characteristics and time-specific firm-level fixed effects u_{it} (i.e., 859×2 fixed effects). These fixed effects measure the firm-specific wage premium in year t, correcting for workers' observable characteristics. We then recover the $\widehat{u}_{it}$'s and regress them on sector fixed effects, export share, capital, and labor. The logic of this procedure was touched upon in Section 2 and is discussed in detail in Wooldridge (2002), p.324. Results, not presented here to save space, show that exporting firms have, on average, a higher firm-specific wage premium. But the export variable is no longer significant once we control for labor and capital. This is true whether we include a quadratic export share term or not.

to 2.2% (textile) and 3.9% (garment).[10] In contrast, the education wage premium is 5.2% in food processing, 5.4% in electrical machinery, 5% in chemicals, and 3.6% in rubber and plastics. Leading export industries thus tend to have a lower education wage premium. In no case is the coefficient of exports significant in the firm fixed-effect regression. We also reestimate all the regressions separately for men and women. The results are similar to those reported in Table 3, albeit generally less significant given the smaller sample size.

5. Is there an education premium among exporters?

Taken together, results so far suggest that there is a positive relationship between wage earnings and exporting status. But this relationship disappears once we control for the fact that exporting firms are, on average, larger. As we explained in Section 2, these results may nevertheless be misleading because the estimated export coefficient fails to account for differences in the education level of workers. Our hypothesis is that the return to human capital is higher among exporters, and hence that exporters pay educated workers more. To test this conjecture, we proceed as outlined in equation (2.2) and reestimate the last three regressions presented in Table 3 with cross terms between years of schooling and the export dummy. Because exporters employ many women, we also include an interaction term between gender and exports.

Results are shown in Table 4. Contrary to expectations, we find in column 1 that the interaction term is not significant, which indicates that the education wage premium does not depend on whether the firm exports or not. The schooling-export interaction remains non significant when we control for firm fixed effects (column 2) or worker fixed effects (column 3). If we replace the export dummy by the export share in the interaction term, the coefficient becomes negative and significant (in columns 1 and 2), which also rejects the idea that exporters

[10] Report estimates are for male workers, based on sector-specific firm-fixed regressions including the same regressors as column 3 of Table 3. Regression results are not shown here to save space.

pay educated workers more. Broadly similar conclusions obtain if we replace the export dummy with the square of the export share – and its interaction with education and gender (see bottom of the Table). We also find that the wage premium for women is smaller among exporters. As we have pointed out in Table 1, exporters employ a larger proportion of women than non-exporters. Many of these women are illiterate.

We repeat the same analysis by industry. Again we find no consistent pattern. In the industry fixed-effect regressions, the schooling-export interaction term is significantly negative in food processing and garment manufacturing, significantly positive in textile and electrical machinery, and non-significant in the other two. When we control for firm or worker fixed-effects, several of these results are reversed, making sectoral regressions results largely inconclusive.

The results presented in Tables 3 and 4 do not control for the occupation status of the worker within the firm. Conceivably, this may lead to a bias if exporters have a different hierarchical structure and hence a different mix of occupations than non-exporters. This may even explain our lack of evidence of higher returns to human capital among exporters if exporters employ more low education workers in better paid middle management jobs.

To investigate this possibility, we begin by regressing the share of a firm's workforce in each occupational status on an export dummy, the log of capital, the log of employment, and industry dummies. Results confirm that exporters have more middle management than non-exporters. To test whether differences in workforce composition can account for our results so far, we reestimate the models presented in Table 4 with occupational dummies. Controlling for the occupational status of the worker does not change earlier findings. Results are not shown here to save space.

Comparing the wage that workers receive from their current employer to the wage paid by their previous employer also provides a way of testing the relationship between exporting and

wages. If workers receive more when their new employer is an exporter, especially if they are well educated, this would suggest that identical workers are paid more by exporters compared to non-exporters. We do not have panel data following workers across firms and thus do not know the exporter status of the previous employer. But we know the last wage paid by the previous employer, if any, and the first wage paid by the current employer. This information alone enables us to identify an exporter wage effect as long as the export status of the employer is not perfectly correlated across employers of the same worker – something we unfortunately cannot test.

We proceed as follows. We estimate three worker fixed effect regressions comparing the earnings of individual workers between the current employer and the previous one. The dependent variable is difference between the (log of the) last wage paid by the previous employer and the (log of the) wage paid to the worker when he or she began working for the current employer. In the first regression we only include a new job dummy and interaction terms between this dummy and education. The coefficient of the new job dummy yields the percentage increase in earnings resulting from the change of employer. The interaction terms measure whether this percentage increase is larger for educated and trained workers, respectively. Regression results are presented in the first column of Table 6. We see that workers who shift employer enjoy on average an 11.1% wage increase. The education interaction term is positive but not significant.

We then test whether the rise in earnings between jobs is higher when the current employer is an exporter. To this effect we introduce an interaction term between the new job dummy and the export share. The results, presented in the second column of Table 5, indicate that, if anything, workers receive a smaller wage increase when they begin working for an exporter. The effect, however, is not significant.

We also investigate whether the wage change is higher for educated workers working in ex-

porting firms, as would be expected if human capital has a higher productivity among exporters. To this effect, we interact the exporter status variable with education and the new job dummy. Results, shown in the third column of Table 6, are not significant: being educated does not lead to a higher wage increase when starting to work for an exporter.

It is conceivable that human capital is only useful in certain tasks, such as worker supervision. In that case, it is possible that educated workers gain by switching jobs only in certain occupations. To test this, we estimate the model reported in Table 5 for each occupation separately. Results, not shown here, show that the new job dummy is strongly significant for all workers except top and middle managers. We obtain a significantly negative export-new job interaction coefficient for middle management and skilled workers; the effect is not significant for other occupations. We also find a positive and significant education-export-new job coefficient for middle management; in other occupations, the coefficient is not significant. Because the export-new job dummy is negative, however, this only means that the smaller wage gain for middle managers resulting from joining an exporting firm is attenuated for those with higher education.

Finally, we hypothesize that the lack of earnings education differential between exporters and non-exporters may be because of job reclassification, i.e., because exporters promote workers more readily. We investigate whether this is the case but find no significant evidence that exporters and non-exporters differ in their propensity to promote workers across occupations.

6. Quality and technology

We have found no evidence that exporters pay a higher premium to educated workers. The question is why. Could it be that our testing strategy is flawed? We would like to know whether we found no evidence of a higher education premium in exporting firms because returns to

human capital are not higher in exporting firms, or because workers do not share these returns. To this we now turn.

There are several reasons why we expect returns to human capital to be higher in exporting firms. One is technology: exporters get to know about other methods of production through their foreign contacts; to integrate these new methods of production into their own firm, they need better trained workers and managers. Since exporters are on average more productive than non-exporters (Fafchamps et al. 2007), they are also in a better position to use retained earnings to invest in better technology (e.g. Yeaple 2005, Bustos 2005).

Another channel is product quality: to be successful, exporters must compete not only on price but also on quality (Sutton 2007). This is especially true if they export to developed countries where consumers are more demanding (Trofimenko 2007). Raising quality requires a stricter organization of the production process, involving quality control procedures, closer supervision of workers, and better tracking of products through the chain. This typically calls for more educated workers (better able to follow rigid procedures and written instructions) – and managers (better able to supervise the production process). In practice, technology and quality control often are intertwined since a better, more up-to-date technology is typically required to achieve high quality standards. But they need not – think of hand-made crafts and other 'boutique' consumer products.

The FACS dataset contains information on technology and quality control. This information is summarized in Table 6 and broken down by exporter status. The first variable is the average age of the machinery used in the firm.[11] The second is an index of technological sophistication that takes value 2 if the firm uses machines that are controlled electronically (e.g., by computer),

[11] This measure is noisy, however. Not only is the measure subject to recall and rounding error, we also suspect that some respondents understood the question to be about the year in which they bought the equipment, not the year in which the equipment was built. Many Moroccan firms use second or third-hand machinery and may not know when the equipment was manufactured.

value 1 if the firm uses automated machinery that is not electronically controlled, and 0 otherwise. We see that, for both variables, exporters on average have a more up-to-date technology. The difference is not large, however, and the average technology level is rather low.

The next reported variable takes value 1 if the firm aims its products primarily at the low end of the market, 3 if it targets the high-end of the market, and 2 otherwise. We also have information about quality control, i.e.: whether the firm has an ISO certification; whether it provides warranty on its products; and whether it has a customer services department (*service apres-vente*). Combining these, we construct an index of quality control that is the sum of the three. We see in Table 6 that exporters are more likely to aim for the top-end of the market and to undertake some form quality control. The difference is significant but not large.

Table 6 shows a significant although weak association between technology, quality control, and exports. This may simply be due to firm size: exporters tend to be larger. To investigate this possibility, we regress each of the four variables shown in Table 6 on the export dummy, the logs of capital and manpower, and sectoral fixed effects. Results shown that, even after controlling for size and industry, exporting remains significantly associated with a lower age of machinery and a higher propensity to aim for the top-end of the market.

We can now ask whether there is any evidence that returns to human capital are higher in firms that use more modern technology or put more emphasis on quality. Our idea is simple: if educated workers are more productive in these firms, the firms should either hire more of them or pay them more (or both) – depending on the conditions prevailing on the labor market.

Table 7 investigates the first possibility. The dependent variable is the average education level of the firm's workforce, as reported by each firm. The information is available by occupational category. This enables us to investigate whether the importance of human capital varies by occupation. We also control for export dummy, firm size, and industry. We expect the education

level of production workers to be particularly critical for technology: automated machines, especially those controlled electronically, are probably best operated by literate workers. In contrast, we expect the education level of managers to be particularly critical for setting up rigorous quality control.

Results confirm that better quality and technology are associated with a better educated workforce: three of the four variables are significant with respect to the total workforce of the firm (column 1). Although not significant in column 1, the quality control index is significant in the management regressions. Technology is associated with better educated production workers while quality control is associated with better educated managers. In contrast, the export dummy is never significant.

This shows that firms with better technology and quality control hire more educated workers. This confirms that the assumed link between quality and human capital is present in our data. We now investigate whether this is also reflected in higher wages. To this effect, we reestimate the first regression of Table 4 with technology and quality regressors. Interaction terms between them and schooling are introduced sequentially.[12] Other regressors are as in Table 4 (column 1). Industry dummies as well as firm and worker characteristics are included in the estimation but not shown. Firm fixed effects are not included since quality and technology variables are time-invariant in our data.

Results are presented in Table 8. We find that three of the four technology and quality variables are systematically associated with higher wages. The only exception is, as in Table 7, the quality control index, which is not significant in any of the regressions. Interaction terms with schooling have the expected sign, except for the age of machinery which has the wrong sign. As in Table 4, the interaction term between schooling and the export dummy is never

[12] Multicollinearity among these variables makes it difficult to include firm fixed effects. The absence of time variation precludes the use of worker fixed effects.

significant.

Taken together, the evidence presented here suggests that returns to human capital are higher in firms using a more up-to-date technology and aiming at the top-end of the market. This is most visible in the education regressions presented in Table 7. Although better technology and quality are associated with higher wages in general, we do not find strong evidence of an excess education premium. This may be because rents are shared among all the workers of a firm, irrespective of their education level.

7. Discussion

These results presented in this paper contribute to the existing literature in several ways. Many authors have found a positive relationship between the earnings skill differential and trade liberalization (e.g. Atanasio, Goldberg and Pavcnik 2004, Epifani and Gancia 2004, Denny et al. 2002, Bernard and Jensen 1997, Robbins and Gindling 1999, Gindling and Robbins 2001, Hanson and Harrison 1999, Verhoogen 2007, Kaplan and Verhoogen 2006). There are some exceptions, however. Gonzaga, Filho and Terra (2006), for instance, find that, in Brazil, the earnings skill gap fell with trade liberalization. Pavcnik, Blom, Schady and Schady (2004) also find no relationship between the skill premium and the level of trade openness in Brazil. Soderbom and Teal (2000) come to a similar conclusion in their study of manufacturing export patterns in sub-Saharan Africa. Robbins, cited in Hanson and Harrison (1999), reportedly finds that the relative wages of skilled workers rose following trade liberalization in Chile, Colombia, Costa Rica, and the Philippines, but was stable or fell in Argentina and Malaysia.

Most of these findings are obtained by examining how the earnings skill differential evolves over time during episodes of trade liberalization. Tariff reduction is seen as a 'quasi-natural experiment'. Identification is achieved through a before-after comparison that implicitly assumes

that the technological and institutional factors driving earnings differentials change less rapidly over time than trade openness. This approach is appealing because it takes care of general equilibrium effects. But it is susceptible to omitted variable bias since the researcher does not observe what would happen in the absence of trade liberalization.

We followed Bernard and Jensen (1997) and focused instead on differences across firms around a given point in time. Identification is predicated on the assumption that, if the productivity of individual workers is at least partly reflected in their wages and if skilled workers are more productive than unskilled workers in exporting firms, then we should observe a different earnings gap for educated workers among exporting and non-exporting firms.

With some exceptions (e.g. Bernard and Jensen 1997, Kaplan and Verhoogen 2006, Schank et al. 2007, Munch and Skaksen 2006), research on this issue has focused on data aggregated at the sectoral level, perhaps because of the dearth of matched employer-employee data in developing countries. The works of Kaplan and Verhoogen (2006) and Schank et al. (2007) are exceptions but, for confidentiality reasons, Kaplan and Verhoogen (2006) only have limited firm-level data. We rely here on matched employer-employee data using a dataset that we collected and that contains detailed information about both firms and workers. We reach conclusions that are different from those obtained by most of the existing literature.

This raises the question of why the two approaches yield different results. One possible explanation is that returns to human capital vary across industries and thus across countries, depending on what they export. In the traditional trade literature, the emphasis was put not on human capital but on cheap labor as a driving force behind export success (e.g. Baldwin 1992, Feenstra 2004). This view finds some support in our data: much of the export wage premium can be attributed to a firm size effect, and exporting firms in Morocco rely heavily on female workers who are paid less than men and who have very low levels of education.

It is possible that exporting industries in Morocco differ from those of countries such as Mexico where the earnings skill gap is positive. Verhoogen (2007), for instance, describes in great detail the effect of trade liberalization on Mexican car manufacturing. Morocco does not export cars, however – only labor intensive garment, textile, and leather products, and it does so using a largely illiterate female workforce. This may explain why human capital does not play as important a role in Morocco compared to Mexico.

This interpretation is consistent with the idea that countries' comparative advantage differ depending on their level of human capital: countries with a comparative advantage in human capital are expected to export products that require human capital, such as high-quality products (Sutton 2007). Countries with little human capital are expected to export labor-intensive products instead. This fits our findings, except that the evidence presented here adds an important caveat. While a labor-abundant country may export low quality products in the aggregate, within a given industry exports to developed countries must meet minimum quality standards to be acceptable to demanding consumers and delivery chains (Trofimenko 2007). Although Morocco exports labor-intensive products that may be of lower quality than what is produced in destination countries, these exports tend to be, on average, of higher quality than what is sold on the domestic Moroccan market.

Another possible explanation for the difference between our results and results obtained by examining trade liberalization episodes is suggested by the work of Bernard and Jensen on US exporters. Comparing the wages paid by US exporters and non-exporters, Bernard and Jensen (1995) find that exporters pay 8% more to production workers and 7.3% more to non-production workers (who, on average, are more skilled). This means that the skilled to unskilled wage gap is slightly smaller among US exporters, a result similar to ours. Yet, applying a time series approach to the same US exporters, Bernard and Jensen (1997) find an increase in US

manufacturing exports in the 1980's associated with an increase in the wage gap between high- and low-skilled workers. The authors note that much of the increased wage gap is driven by increases in employment at exporting plants.

The apparent contradiction between the two results can be explained by compositional effects: a rise in exports may increase (decrease) the proportion of skilled (unskilled) workers in exporting firms that pay more to all workers.[13] It follows that, even if the skilled-unskilled wage gap is the same for exporters and non-exporters, it is possible to observe a rise in the average earnings skill differential – as in Mexico – or a fall – as in Brazil – depending on the relative shares of skilled workers in the workforce of exporters and non-exporters, respectively. This interpretation is consistent with what Gonzaga et al. (2006) report regarding the relative skill intensity of export and non-export industries. In Morocco we similarly find that exporters are on average no more likely to employ educated workers than non-exporters.

8. Conclusion

We have sought to test whether returns to human capital are higher in exporting firms. To this effect, we have tested whether manufacturing exporters pay educated workers more. Using a panel of matched employer-employee data from Morocco, we have found no evidence that educated workers receive a higher education premium relative to uneducated workers when

[13] To see why, imagine a simple situation in which manufacturing is small so that general equilibrium effects on wages can be ignored. Let $d > 1$ be the *within-firm* earnings skill differential, meaning that if an uneducated workers earns w in firm i, an educated worker in the same firm earns on average wd. Assume that d is constant across firms and let $x > 1$ be the wage premium paid by exporters to all their workers, skilled and unskilled. Further let $\eta < 0.5$ be the proportion of workers employed by exporters. Finally, let $0 < S_x < 1$ and $0 < S_n < 1$ be the share of skilled workers in the workforce of exporters and non-exporters, respectively. The average earnings skill differential D in the economy is:

$$D = d\frac{S_n(1-\eta) + xS_x\eta}{(1-S_n)(1-\eta) + x(1-S_x)\eta}\frac{1-S}{S}$$

where $S \equiv S_n(1-\eta) + S_x\eta$. It can be shown that, for most values of $\eta < 0.5$, the average earnings skill differential D increases with employment in the export industry η whenever $S_x > S_n$. This is because, when $S_x > (<) S_n$, a rise in exports increases (decreases) the proportion of skilled (unskilled) workers working in exporting firms that pay more to all workers.

working for exporters. We also found that, although exporters pay more on average, much of the difference can be explained by the fact that they have a larger workforce and more capital. These findings differ from the literature which has often found a positive relationship between trade liberalization and the skill earnings gap.

The question is how to reconcile these contrasted findings. One possibility, discussed above, is that the relationship between trade liberalization and skill earnings differential is driven by composition effects: exporters pay more on average to all workers and trade liberalization raises employment in exporting firms. Another possibility is that rent sharing operates at the level of the firm, not of the individual worker: firms that redistribute average productivity rents to their workforce may do so across the board, without differentiating between high and low productivity workers. This would break the link between earnings and the firm-specific productivity of individual workers. This could explain the absence of relationship between exports, human capital, and earnings.

This leaves us with two sharply contrasted views of export success, the first emphasizing the role of human capital and the second the role of cheap labor. To a country trying to break into export markets, which of these two views is correct has profound implications for policy regarding education, vocational training, wage control, and labor regulation. These two views need not be incompatible, however. The work presented here suggests that returns to human capital are not particularly high in labor intensive export industries such as the ones found in Morocco. Instead we find circumstantial evidence that export success is linked to an abundant supply of cheap uneducated female labor.

The low level of human capital present in Moroccan firms may nevertheless explain why manufacturing exports from that country have remained focused on a few labor intensive industries – and why they have failed to grow over time. Human capital may not be necessary to

begin exporting manufactures, but it may be essential to climb the quality ladder and remain competitive when the cheap labor advantage starts to erode.

References

Acemoglu, D. (2003). "Patterns of Skill Premia.", *Review of Economic Studies*, 70(2):199–230.

Atanasio, O., Goldberg, P. and Pavcnik, N. (2004). "Trade Reforms and Wage Inequality in Colombia.", *Journal of Development Economics*, 74(2):331–66.

Aw, B. Y., Roberts, M. J. and Winston, T. (2001), Export Market Participation, Investments in R and D and Worker Training, and the Evolution of Firm Productivity. (mimeograph).

Baldwin, R. E. (1992). "Are Economists' Traditional Trade Policy Views Still Valid?", *Journal of Economic Literature*, 30(2):804–29.

Baldwin, R. E. (2003), *Openness and Growth: What's the Empirical Relationship?*, NBER Working Papers, 9578.

Barro, R. J. and i Martin, X. S. (1992). "Convergence.", *J. Polit. Econ.*, 100:223–251.

Batista, C. (2005), Joining the EU: Capital Flows, Migration and Wages. (unpublished PhD thesis).

Bernard, A. B. and Jensen, B. J. (1995). "Exporters, Jobs and Wages in U.S. Manufacturing 1976-87.", *Brookings Papers on Economic Activity, Microeconomics*, pp. 67–119.

Bernard, A. B. and Jensen, J. B. (1997). "Exporters, Skill Upgrading, and the Wage Gap.", *Journal of International Economics*, 42(1-2):3–31.

Bigsten, A., Collier, P., Dercon, S., Fafchamps, M., Gauthier, B., Gunning, J. W., Isaksson, A., Oduro, A., Oostendorp, R., Patillo, C., Soderbom, M., Teal, F. and Zeufack, A. (2003). "Risk Sharing in Labour Markets.", *World Bank Economic Review,*, 17(3):349–66.

Bustos, P. (2005), The Impact of Trade on Technology and Skill Upgrading: Evidence from Argentina. (mimeograph).

Cameron, G., Proudman, J. and Redding, S. (2005). "Technological Convergence, R and D, Trade and Productivity Growth.", *European Economic Review*, 49(3):775–807.

Clerides, S., Lach, S. and Tybout, J. (1998). "Is Learning-by-Exporting Important? Micro-Dynamic Evidence from Colombia, Mexico, and Morocco.", *Quarterly Journal of Economics*, 113(3):903–947.

Coe, D. T. and Helpman, E. (1995). "International R and D Spillovers.", *European Economic Review*, 39(5):859–87.

Currie, J. and Harrison, A. E. (1997). "Sharing the Costs: The Impact of Trade Reform on Capital and Labor in Morocco.", *Journal of Labor Economics*, 15(3):S44–71.

Das, S., Roberts, M. J. and Tybout, J. R. (2001), Market Entry Costs, Producer Heterogeneity, and Export Dynamics., *Technical report*, National Bureau of Economic Research, Working Paper 8269, Cambridge, Mass.

de Melo, J., Haddad, M. and Horton, B. (2001), Exports and Industrial Performance During the Moroccan Trade Liberalization., *Producer Heterogeneity and Performance in the Semi-Industrialized Countries*, James Tybout and Mark Roberts (eds.), Oxford University Press, Oxford.

Denny, K., Harmon, C. and Lydon, R. (2002), Cross Country Evidence on the Returns to Education: Patterns and Explanations. (mimeograph).

Epifani, P. and Gancia, G. (2004), The Skill Bias of World Trade. (mimeograph).

Fafchamps, M. and El Hamine, S. (2005), The Manufacturing Sector in Morocco. (unpublished report).

Fafchamps, M., El Hamine, S. and Zeufack, A. (2007). "Learning to Export: Evidence from Moroccan Manufacturing.", *Journal of African Economies*, . (forthcoming).

Fafchamps, M. and Soderbom, M. (2006). "Wages and Labor Management in African Manufacturing.", *Journal of Human Resources*, 41(2):346–79.

Fafchamps, M., Soderbom, M. and Benhassine, N. (2006), Job Sorting in African Labor Markets. (mimeograph).

Feenstra, R. C. (2000), *The Impact of International Trade on Wages*, NBER Conference Report Series, University of Chicago Press, Chicago and London.

Feenstra, R. C. (2004), *Advanced International Trade: Theory and Evidence*, Princeton University Press, Princeton and Oxford.

Gindling, T. and Robbins, D. (2001). "Patterns and Sources of Changing Wage Inequality in Chile and Costa Rica during Structural Adjustment.", *World Development*, 29(4):725–45.

Gonzaga, G., Filho, N. M. and Terra, C. (2006). "Trade Liberalization and the Evolution of Skill Earnings Differentials in Brazil.", *Journal of International Economics*, 68(2):345–67.

Grossman, G. M. and Helpman, E. (1991). "Trade, Knowledge Spillovers, and Growth.", *Europ. Econ. Rev.*, 35(2-3):517–26.

Hanson, G. H. and Harrison, A. (1999). "Trade Liberalization and Wage Inequality in Mexico.", *Industrial and Labor Relations Review*, 52(2):271–88.

Johnson, G. and Stafford, F. (1999), The Labor Market Implications of International Trade., *Handbook of Labor Economics, Volume 3*, O. Ashenfelter and D. Card (edsd.), Elsevier, New York, pp. 2629–710.

Kaplan, D. S. and Verhoogen, E. A. (2006), Exporting and Individual Wage Premia: Evidence from Mexican Employer-Employee Data. (mimeograph).

Keller, W. (1998). "Are International R and D Spillovers Trade-Related? Analyzing Spillovers Among Randomly Matched Trade Partners.", *European Economic Review*, 42:1469–1481.

Liu, L. and Tybout, J. R. (1996), Productivity Growth in Chile and Colombia: The Role of Entry, Exit, and Learning., *Industrial Evolution in Developing Countries: Micro Pattern of Turnover, Productivity, and Market Structure*, Mark J. Roberts and James R. Tybout (eds), Oxford University Press for the World Bank, Oxford and New York, pp. 73–103.

Lucas, R. E. (1993). "Making a Miracle.", *Econometrica*, 61(2):251–272.

Mankiw, N. G., Romer, D. and Weil, D. N. (1992). "A Contribution to the Empirics of Economic Growth.", *Quarterly J. Econ.*, CVII:407–437.

MCI (2000), Les Entreprises Industrielles Exportatrices., *MCI - Conjoncture*, Vol. 40, Ministere de l'Industrie, du Commerce et de l'Artisanat, Rabat, Morocco.

MCI et Banque Mondiale (2001), *Le Secteur Manufacturier Marocain à l'Aube du 21ème Siècle - Résultats de l'enquête pour l'analyse et la compétitivité des entreprises (FACS-Maroc)*, Ministère du Commerce et de l'Industrie, Rabat, Maroc.

Munch, J. R. and Skaksen, J. R. (2006), *Human Capital and Wages in Exporting Firms*, IZA DP No. 2409.

Oi, W. Y. and Idson, T. L. (1999), Firm Size and Wages., *Handbook of Labor Economics, Volume 3B*, O. Ashenfelter and D. Card (edsd.), Elsevier Science, Amsterdam, New York and Oxford, pp. 2165–214.

Pavcnik, N., Blom, A., Schady, P. and Schady, N. (2004). "Trade Liberalization and Industry Wage Structure: Evidence from Brazil.", *World Bank Economic Review*, 18(3):319–44.

Robbins, D. and Gindling, T. (1999). "Trade Liberalization and the Relative Wages for More-Skilled Workers in Costa Rica.", *Review of Development Economics*, 3(2):140–54.

Roberts, M. J. and Tybout, J. R. (1997). "The Decision to Export in Colombia: An Empirical Model of Entry with Sunk Costs.", *American Economic Review*, 87(4):545–564.

Rodriguez, F. and Rodrik, D. (2001), Trade Policy and Economic Growth: A Skeptic's Guide to the Cross-National Evidence., *NBER Macroeconomics Annual 2000*, Vol. 15, MIT Press, Cambridge and London, pp. 261–325.

Schank, T., Schnabel, C. and Wagner, J. (2007). "Do exporters really pay higher wages? First evidence from German linked employer-employee data.", *Journal of International Economics*, 72(1):52–74.

Soderbom, M. and Teal, F. (2000). "Skills, Investment, and Exports from Manufacturing Firms in Africa.", *Journal of Development Studies*, 37(2):13–43.

Sutton, J. (2007), Quality, Trade and the Moving Window: The Globalisation Process. (mimeograph).

Topalova, P. (2004), *Trade Liberalization and Firm Productivity: The Case of India*, International Monetary Fund Working Papers, Washington DC.

Trofimenko, N. (2007), Learning by Exporting: Does It Matter Where One Learns (Evidence from Colombian Manufacturing Plants, 1981 - 1991). (mimeograph).

Tsou, M. W., Liu, J. T. and Huang, C. J. (2006). "Export Activity, Firm Size and Wage Structure: Evidence from Taiwanese Manufacturing Firms.", *Asian Economic Journal*, 20(4):333–54.

Tybout, J. R. (2000). "Manufacturing Firms in Developing Countries: How Well Do They Do and Why?", *Journal of Economic Literature*, 38(1):11–44.

Tybout, J. R. and Westbrook, D. M. (1995). "Trade Liberalization and the Dimensions of Efficiency Changes in Mexican Manufacturing Industries.", *Journal of International Economics*, 39(1-2):53–78.

Verhoogen, E. A. (2007), Trade, Quality Upgrading and Wage Inequality in the Mexican Manufacturing Sector. (mimeograph).

Wagner, J. (2007). "Exports and Productivity: A Survey of the Evidence from Firm-Level Data.", *World Economy*, 30(1):60–82.

Wood, A. and Mayer, J. (2001). "Africa's Export Structure in a Comparative Perspective.", *Cambridge Journal of Economics*, 25(3):369–94.

Wooldridge, J. M. (2002), *Econometric Analysis of Cross Section and Panel Data*, MIT Press, Cambridge, Mass.

Yeaple, S. (2005). "A Simple Model of Firm Heterogeneity, International Trade and Wages.", *Journal of International Economics*, 65:1–20.

Young, A. (1991). "Learning by Doing and the Dynamic Effects of International Trade.", *Quat. J. Econ.*, 106(2):369–405.

Table 1. Characteristics of firms

	Mean	St. dev.	Non-export.	Exporters	p-value (**)
% of exports in sales	43.4%	47.1%	0.0%	82.3%	0.000
Machinery and equipment (US$)	1283.4	3660.1	858.2	1669.9	0.002
Number of permanent workers	123.2	210.4	55.1	185.5	0.000
% of firms employing casual workers	21.2%		18.5%	23.0%	0.101
Average schooling of workers	6.9	4.2	6.9	6.9	0.875
% of women among permanent workers	44.5%	33.9%	31.2%	56.9%	0.000
% of women among casual workers	52.8%	41.0%	35.3%	65.3%	0.000
Industry					
Food processing	9.4%		12.0%	7.2%	
Textile	23.2%		23.7%	22.8%	
Garment	37.0%		22.2%	50.3%	
Leather	8.0%		5.0%	10.7%	
Electrical and electronic products	4.4%		5.7%	3.1%	
Chemicals	8.8%		15.2%	3.1%	
Plastics and rubber products	9.1%		16.2%	2.7%	0.000
Number of observations (*)	859		401	447	

(*) with some small variation across variables because of missing values

(**) p-value from a test of equality between exporters and non-exporters

Table 2. Characteristics of workers

Worker characteristics	Sample mean	Weighted mean	Standard deviation
Earnings	328.3	292.9	373.0
Female	39.3%	50.2%	
Years of schooling	8.7	8.1	5.4
Age	34.7	33.5	8.8
Years of tenure in current job	7.2	7.2	6.4
Years of work experience	18.7	17.9	11.1
Wage reported net of taxes	34.8%	27.2%	
Number of employers, past and current	2.3	2.3	1.7
Occupation			
Upper management	4.5%	0.9%	
Middle management	9.3%	3.1%	
Skilled workers	39.6%	42.2%	
Unskilled worker	30.4%	46.6%	
Support and administrative staff	16.2%	7.2%	
Firm characteristics			
Number of permanent workers	120.0	439.9	
Machinery and equipment (US$)	1264.5	4358.1	
Share of exports in sales	43.0%	66.9%	
Industry			
Food processing	10.1%	5.3%	
Textile	23.5%	25.4%	
Garment	36.3%	51.7%	
Leather	7.9%	6.1%	
Electrical and electronic products	4.3%	3.4%	
Chemicals	9.1%	4.5%	
Plastics and rubber products	8.8%	3.6%	
Number of observations (*)	15700		

(*) with some small variation across variables because of missing values

Current year observation	52.5%	51.8%

Table 3. Earnings regressions

Firm characteristics	**Coef.**	**Coef.**	**Coef.**	**Coef.**
Export dummy	**0.195*** **	**0.116*** **	-0.044	**-0.036** **
	(4.759)	(2.916)	(-0.613)	(-2.419)
Share of exports	**-0.109** **	-0.055	-0.134	0.033
	(-2.304)	(-1.116)	(-0.868)	(1.285)
Capital (log)		**0.035*** **	0.013	**0.025** **
		(3.490)	(0.516)	(2.214)
Manpower (log)		0.017	0.099	**0.047** **
		(1.057)	(1.205)	(2.372)
Worker characteristics				
Female dummy	**0.088*** **	**0.082*** **	0.018	
	(2.878)	(2.611)	(0.536)	
Years of schooling	**0.049*** **	**0.048*** **	**0.039*** **	
	(11.315)	(10.745)	(6.594)	
Schooling x female	**-0.025*** **	**-0.023*** **	**-0.015*** **	
	(-7.424)	(-6.634)	(-4.909)	
Age of worker	-0.014	**-0.021***	-0.008	
	(-1.264)	(-1.938)	(-0.742)	
Age squared	**0.000** **	**0.000*** **	**0.000** **	-0.001
	(2.107)	(2.671)	(2.334)	(-1.623)
Years of tenure	0.007*	0.005	**0.015*** **	
	(1.870)	(1.350)	(4.737)	
Tenure squared	**0.000** **	**0.000*** **	-0.000	0.000
	(2.532)	(2.697)	(-1.257)	(1.080)
Years of work experience	**0.015*** **	**0.020*** **	**0.015*** **	
	(3.393)	(4.226)	(2.600)	
Experience squared	**-0.000*** **	**-0.000*** **	**-0.000*** **	-0.000
	(-3.768)	(-4.539)	(-5.061)	(-1.232)
Number of employers	**0.093*** **	**0.099*** **	**0.071*** **	
	(5.351)	(6.095)	(5.234)	
Wage reported net of tax	**-0.097*** **	**-0.065*** **	**-0.094** **	**-0.073***
	(-4.709)	(-3.167)	(-2.409)	(-1.865)
Year dummy	0.017	0.018	0.012	**0.081*** **
	(0.865)	(0.934)	(1.289)	(4.717)
Industry fixed effects	Yes	Yes		
Firm fixed effects	No	No	Yes	
Worker fixed effects	No	No	No	Yes
Number of observations	13,555	12,748	12,748	14,068
R2	0.380	0.361	0.273	0.088
Summary of regressions with exports and exports squared:				
F-test that export is significant when exports 50% of outpu				
residual degrees of freedom	4835	4551	4551	4889
F-statistic	**32.50**	**13.60**	0.96	1.46
p-value	0.000	0.000	0.327	0.227
F-test that export is significant when exports 100% of outpu				
residual degrees of freedom	4835	4551	4551	4889
F-statistic	**5.17**	2.12	0.69	0.72
p-value	0.023	0.145	0.408	0.397

Estimated using weighted OLS with robust SE corrected for stratification and clustering at the firm-occupation level. The corresponding t-statistics are reported below the estimated coefficients. Significance level: 1% ***; 5% **; 10% *

Table 4. Earnings regressions with export cross terms

Worker characteristics x export status	**Coef.**	**Coef.**	**Coef.**
Schooling x exports	0.002	0.001	-0.004
	(0.620)	(0.378)	(-1.419)
Female x exports	**-0.115*** **	**-0.039***	0.006
	(-4.074)	(-1.741)	(0.204)
Firm characteristics			
	0.131* **	-0.039	-0.013
	(2.947)	(-0.522)	(-0.496)
Share of exports	-0.037	-0.129	0.031
	(-0.752)	(-0.851)	(1.188)
Capital (log)	**0.036*** **	0.013	**0.025** **
	(3.717)	(0.512)	(2.210)
Manpower (log)	0.015	0.099	**0.047** **
	(0.944)	(1.211)	(2.373)
Worker characteristics			
Female dummy	**0.177*** **	0.051	
	(5.202)	(1.569)	
Years of schooling	**0.046*** **	**0.038*** **	
	(10.519)	(7.686)	
Schooling x female	**-0.023*** **	**-0.016*** **	
	(-6.600)	(-4.824)	
Age of worker	**-0.022** **	-0.008	
	(-1.994)	(-0.762)	
Age squared	**0.000*** **	**0.000** **	-0.001
	(2.737)	(2.361)	(-1.623)
Years of tenure	**0.005**	**0.015*** **	
	(1.315)	(4.723)	
Tenure squared	**0.000*** **	-0.000	0.000
	(2.776)	(-1.236)	(1.100)
Years of work experience	**0.020*** **	**0.015*** **	
	(4.283)	(2.617)	
Experience squared	**-0.000*** **	**-0.000*** **	-0.000
	(-4.645)	(-5.074)	(-1.238)
Number of employers	**0.097*** **	**0.070*** **	
	(6.006)	(5.242)	
Wage reported net of tax	**-0.065*** **	**-0.096** **	**-0.073***
	(-3.189)	(-2.471)	(-1.869)
Year dummy	0.018	0.012	**0.081*** **
	(0.917)	(1.282)	(4.718)
Industry fixed effects	Yes		
Firm fixed effects	No	Yes	
Worker fixed effects	No	No	Yes
Number of observations	12,748	12,748	14,068
R2	0.363	0.273	0.088
Summary of regressions with exports and exports squared:			
Interacted schooling x exports term:			
F-test that interacted term is significant at 50% exports			
residual degrees of freedom	4551	4551	4889
F-statistic	**10.16**	1.20	1.39
p-value	0.001	0.273	0.238
F-test that interacted term is significant at 100% exports			
residual degrees of freedom	4551	4551	4889
F-statistic	**4.53**	**9.11**	0.46
p-value	0.033	0.003	0.499
Interacted gender x exports term:			
F-test that interacted term is significant at 50% exports			
residual degrees of freedom	4551	4551	4889
F-statistic	2.54	**3.70**	1.96
p-value	0.111	0.055	0.162
F-test that interacted term is significant at 100% exports			
residual degrees of freedom	4551	4551	4889
F-statistic	**19.20**	**2.74**	0.00
p-value	0.000	0.098	0.995

Estimated using weighted OLS with robust SE corrected for stratification and clustering at the firm-occupation level. The corresponding t-statistics are reported below the estimated coefficients. Significance level: 1% ***; 5% **; 10% *

Table 5. Earnings differential with previous job

	Coef.	Coef.	Coef.
New job dummy	**0.111*** **	**0.148*** **	**0.149*** **
	(4.303)	(4.152)	(5.113)
Education x new job dummy	0.002	0.001	0.001
	(0.522)	(0.409)	(0.290)
Export x new job dummy		-0.041	-0.042
		(-1.254)	(-0.966)
Education x export x new job			0.000
			(0.017)
Wage reported net of tax	-0.034	**-0.048***	**-0.048***
	(-1.115)	(-1.684)	(-1.667)
Worker fixed effect	Yes	Yes	Yes
Number of observations	7,850	7,795	7,795
R2	0.140	0.145	0.145

Estimator is weighted OLS with worker fixed effects.
t-statistics reported below estimated coefficients.
Significance level: 1% ***; 5% **; 10% *

Table 6. Technology and quality

Indicators of technological sophistication:	**All firms**	**Non-export.**	**Exporters**	**p-value (***)**
Average age of machinery (years)	8.6	9.8	7.5	0.000
Firms with machinery that is:				
All operated by hand	47%	50%	44%	
Automated (all or some)	32%	33%	30%	
Electronically controlled (all or some)	21%	16%	25%	0.005
Indicators of product quality:				
Firm sells product for:				
low end of the market	11%	14%	8%	
middle of the market	56%	58%	55%	
high end of the market	33%	29%	37%	0.001
Quality control index (*):				
none	20%	23%	17%	
one	56%	53%	59%	
two	18%	16%	19%	
all three	7%	8%	6%	0.046
Number of observations (**)	859			

(*) sum of following: (1) ISO certification; (2) customer warranty; (3) client services

(**) with some small variation across variables because of missing values

(***) p-value from a test of equality (t-test for age of machinery, Pearson Chi-square for the other three

Table 7. Average education level of firm's labor force

Quality variables	All coef/t	Top managmt coef/t	Middle managmt coef/t	Skilled workers coef/t	Unskilled workers coef/t	Clerical workers coef/t
Technology index	**0.458*** **	**0.730*** **	0.346	**0.690*** **	0.210	-0.164
	(3.718)	(3.583)	(1.370)	(4.370)	(1.502)	(-0.785)
Average age of machines	**-0.047*** **	-0.026	-0.001	**-0.051** **	**-0.049** **	-0.027
	(-2.655)	(-0.875)	(-0.036)	(-2.224)	(-2.421)	(-0.886)
Quality index	0.050	**0.369* **	**0.620*** **	-0.044	-0.099	0.139
	(0.437)	(1.941)	(2.614)	(-0.299)	(-0.751)	(0.719)
Low-end/top-end index	**0.584*** **	0.314	0.280	0.102	**0.426*** **	0.134
	(4.073)	(1.342)	(0.946)	(0.550)	(2.588)	(0.550)
Firm characteristics						
Export dummy	-0.188	0.421	0.555	-0.101	-0.350	0.077
	(-0.898)	(1.224)	(1.263)	(-0.374)	(-1.467)	(0.213)
Manpower (log)	-0.097	**0.545*** **	**0.660*** **	**0.364** **	0.173	**0.528*** **
	(-0.858)	(2.909)	(2.740)	(2.492)	(1.329)	(2.647)
Capital (log)	**0.257*** **	**0.224* **	**0.465*** **	**0.241** **	**0.207** **	**0.314** **
	(3.421)	(1.801)	(2.880)	(2.467)	(2.394)	(2.356)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	4.635***	8.448***	3.994***	5.998***	2.397***	3.957***
	(7.116)	(7.691)	(2.869)	(6.941)	(3.162)	(3.431)
Number of observations	811	760	649	768	747	719
R2	0.158	0.144	0.140	0.180	0.077	0.062

t-statistics reported below estimated coefficients.
Significance level: 1% ***; 5% **; 10% *

Table 8. Earnings, exports, and quality

Exports and quality	**coef/t**	**coef/t**	**coef/t**	**coef/t**	**coef/t**	**coef/t**	**coef/t**
Export dummy	**0.115*** **	**0.125*** **	**0.140*** **	**0.113*** **	**0.123*** **	**0.127*** **	**0.124*** **
	(2.888)	(3.008)	(3.361)	(2.811)	(2.906)	(3.013)	(3.041)
Technology index	**0.022***	**0.022***	-0.018	**0.024***	**0.022***	**0.023***	-0.016
	(1.716)	(1.783)	(-1.067)	(1.882)	(1.776)	(1.795)	(-0.898)
Average age of machines	**-0.005***	**-0.004***	**-0.004***	**-0.012*** **	**-0.004***	**-0.004***	**-0.013*** **
	(-1.909)	(-1.733)	(-1.683)	(-3.295)	(-1.735)	(-1.698)	(-3.625)
Quality index	0.004	0.005	0.005	0.005	-0.012	0.005	-0.011
	(0.264)	(0.299)	(0.337)	(0.279)	(-0.578)	(0.308)	(-0.529)
Low-end/top-end index	**0.060*** **	**0.059*** **	**0.060*** **	**0.062*** **	**0.060*** **	0.040	**0.052** **
	(3.568)	(3.521)	(3.603)	(3.692)	(3.538)	(1.576)	(2.085)
Interaction terms with schooling							
Schooling x exports		0.002	0.001	0.003	0.002	0.002	0.003
		(0.667)	(0.406)	(1.025)	(0.676)	(0.569)	(0.765)
Schooling x Technology index			**0.005** **				**0.005** **
			(2.417)				(2.289)
Schooling x Average age of machines				**0.001** **			**0.001** **
				(2.182)			(2.549)
Schooling x Quality index					0.002		0.002
					(0.790)		(0.739)
Schooling x Low-end/top-end index						0.002	0.001
						(0.837)	(0.472)
Other regressors							
Female x exports		**-0.105*** **	**-0.105*** **	**-0.106*** **	**-0.105*** **	**-0.104*** **	**-0.107*** **
		(-3.732)	(-3.735)	(-3.782)	(-3.741)	(-3.714)	(-3.787)
Years of schooling	**0.046*** **	**0.044*** **	**0.041*** **	**0.034*** **	**0.042*** **	**0.039*** **	**0.024*** **
	(10.443)	(10.314)	(8.818)	(5.818)	(7.975)	(5.000)	(2.704)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Worker characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	12,710	12,710	12,710	12,710	12,710	12,710	12,710
R2	0.408	0.409	0.411	0.412	0.410	0.410	0.414

Estimated using weighted OLS with robust SE corrected for stratification and clustering at the firm-occupation level. The corresponding t-statistics are reported below the estimated coefficients. Significance level: 1% ***; 5% **; 10% *