Human capital and wages in exporting firms

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Abstract

This paper studies the link between the education level of workers, export performance and wages. We argue that firms may escape intense competition in international markets by using high skilled workers to differentiate their products. This story is consistent with our empirical results. Using a very rich matched worker-firm longitudinal dataset, we find that there is a weak negative direct effect of exporting on wages, but an interaction term between export intensity and skill intensity has a positive impact on wages. That is, we find an export wage premium, but only in firms where the skill intensity is sufficiently high.

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1. Introduction

There is a substantial empirical literature on wages in exporting firms. This literature was initiated by Bernard and Jensen (1995) who found evidence for productivity and wage premia in exporting firms. Since then there has been a large number of studies replicating and extending their analysis, and by now it seems to be a stylized fact that exporting firms are more productive and pay higher wages than non-exporting firms (see Schank, Schnabel and Wagner 2007 for a recent list of existing studies). There are competing theories as to why this is the case, but most support has been found for self-selection of the most productive firms into exporting as the explanation (see e.g. Clerides et al. 1998 and Bernard and Jensen 1999). Hence, the standard explanation is that the superior performance of exporting firms is due to unobserved heterogeneity.

In this paper, we consider whether the export wage premium is linked to the use of human capital in exporting firms. A distinguishing feature of exporting firms is that they use more highly educated labour than non-exporting firms. This is what international trade theory would suggest for countries that are relatively well endowed with educated labour, and this is confirmed by existing studies (e.g. Bernard and Jensen 1995). Therefore, one hypothesis is that the export premium in wages is actually an educated labour premium. In recent papers by Barth (2002), Battu, Belfield and Sloane (2003) and Martins (2004) evidence for the

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1 Tel.: +45 3815 2582; fax: +45 3815 2576.
2 With the exception of the analysis of Schank et al. (2007), this literature is almost solely based on firm level data, so possible selection of high-ability workers into exporting firms is not taken account of.

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An alternative hypothesis we consider is that there is an export premium in wages, but this premium interacts with the education level in firms. That is, the export wage premium is higher in firms using more educated labour. An explanation of this link between the skill level, international trade and wages has been suggested by Schott (2004). He documents that firms producing unskilled labour intensive goods are more likely to be in direct competition with firms from low wage countries in international markets. Therefore, a higher skill intensity in exporting firms may mitigate the effect of competition from low income countries, and, if there is rent-sharing between firms and workers, this lower level of competition may turn into higher wages (e.g. Dowrick (1989) and Slaughter (2001)).

This paper can be seen as combining the literature on the exporting wage premium with insights from the literature on human capital externalities. The evidence on the existence of human capital externalities are mixed. For example Acemoglu and Angrist (2000) find no impact of average skill levels on average wages in US states, while Moretti (2004) reports a significant positive impact of the share of graduates in US cities on individual worker wages. In the present context we are interested in human capital spillovers at the firm level and these may be particularly important because it is likely that individuals interact more and learn more from each other at this level compared to the city or region level. As mentioned, a few papers have recently found evidence of positive externalities at the firm level. Using a Norwegian panel data set of workers, Barth (2002) documents a significant effect of firm average level of education, while using cross sectional data for the UK, Battu, Belfield and Sloane (2003) find positive firm level external returns on individual wages. Martins (2004) uses a panel of Portuguese firms to also document substantial social returns to firm level education.

We have access to a unique matched worker-firm panel data set with information about firms’ export behavior. Our empirical approach is to analyse how wages of otherwise similar individuals depend on the export intensities and shares of highly educated workers in otherwise similar firms. In contrast to most of the literature on exporting wage premia, our data set allows us to control for observed and unobserved individual and firm characteristics such as ability of workers and productivity of the firm that are correlated with wages and export status of firms. It is likely that more productive firms select into being exporters, and high-quality workers sort into exporting firms. For example highly productive exporting firms may award observed and unobserved abilities better than less productive non-exporting firms, causing high-ability workers to select into exporting firms. In this case, the observed exporting wage premium might simply be due to differences in observed and unobserved worker and/or firm characteristics.

In our empirical analysis, we find that there is only a wage premium from exporting in firms where the skill intensity is sufficiently high, and the size of the export premium is increasing in the skill intensity of the firm. Moreover, when distinguishing between different types of labour, these effects are only found in wages of the least educated workers, whereas wages of workers with a further education are unaffected by the skill intensity and export intensity of the firm.

The rest of the paper is structured as follows. In the following section, we offer some theoretical considerations about the link between wages, education and exporting. In Section 3, we describe the data set. In Section 4 we specify the empirical model and present the estimation results. Finally, in Section 5 we conclude.

2. Two alternative hypotheses

The point of departure of our paper is that wages are higher in exporting firms than in non-exporting firms. The standard hypothesis in the literature is that this is a result of the most productive firms self-selecting into being exporters. This self-selection process may exist if there are fixed costs of exporting, because it is only the most productive firms who find it profitable to “invest” in exporting (e.g. Clerides et al. (1998), Bernard and Jensen (1999) and Melitz (2003)). A competing theory is that firms become more productive when entering foreign markets because of competition and learning in international markets, see e.g. Clerides et al. (1998). However, only a few empirical studies find that this is actually the case (see e.g. Girma, Greenaway and Kneller (2004) and De Loecker (2007)). For a comprehensive survey of the literature on exporting and productivity see Wagner (2007).

Irrespective of whether the exporting wage premium is a result of self-selection or learning in export markets, the premium is not necessarily related to the firms’ use of human capital. But this possibility is our focus, and we will consider two separate hypotheses in relation to this issue.

2.1. Hypothesis 1

The first hypothesis we propose is that the export premium found in empirical studies reflects a missing variable, namely the human capital level in the firms. Human capital intensive countries have a comparative advantage in human capital intensive production, and so exporting firms – i.e., the firms that exploit comparative advantage – employ more educated labour than non-exporting firms. Moreover, as suggested by the results found in Barth (2002), Battu, Belfield and Sloane (2003) and Martins (2004), there are human capital spillovers inside companies. The idea is that workers interact at the workplace and learn from each other, and this interaction effect is stronger the more high skilled workers there are. Notice that this human capital effect is in addition to the private return to education. Hence, according to this hypothesis, the wage level is higher in exporting firms than in non-exporting firms, but this is because exporting firms use more human capital than non-exporting firms.

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3 Even in countries intensive in the supply of unskilled labour, it may be the case that exporting firms use more skilled labour than non-exporting firms but less skilled labour than exporting firms in countries intensive in skilled labour, see e.g. Feenstra and Hanson (1997).
2.2. Hypothesis 2

The second hypothesis acknowledges the existence of an export premium in wages – for example due to the self-selection of the most productive firms into being exporters – but the size of the premium depends on the skill intensity in the firm. The foreign markets a firm is able to serve may depend on the type of labour employed in the firm. A firm producing clothes may for instance choose to produce a “standard” product. To do so it mostly needs unskilled labour and machines. Alternatively, the firm may produce expensive design clothes, and by doing so the firm may enter a market with product differentiation and a lower degree of competition. To enter such markets, the firm needs to employ highly skilled labour to develop and brand the product. As documented in Schott (2004), low wage countries mainly produce low priced (low quality) goods. Accordingly, firms that pick the first strategy and produce unskilled labour intensive “standard” goods should be more likely to compete with firms from low wage countries in export markets. In contrast, firms that pick the second strategy and employ high skilled labour may escape intense competition from low wage countries. Lower product market competition, in turn, is likely to spill over into wages if there is rent-sharing between workers and firms (see e.g. Dowrick 1989). There is solid empirical evidence documenting that spill-overs from the product market to the labour market exist, see e.g. Blanchflower, Oswald and Sanfey (1996), Hildreth and Oswald (1997), Slaughter (2001) and Arai (2003).

In addition, case studies of specific markets also offer support for the hypothesis that by using more skilled labour a firm may better serve markets with less competition. One example is Goldberg (1995) who finds that the demand elasticities for luxury and sports cars are lower than those for other types of cars. Another example is Hausman, Leonard and Zona (1994) who find that the demand elasticity for premium beer is lower than that for popular (standard) beer.

To sum up, our hypothesis is that if a firm produces a “standard good”, there is intensive competition in international markets from low wage countries. Fierce competition in turn puts downward pressure on the profit margin of the firm as well as on wages. By spending resources on product differentiation – i.e., employing more skilled labour to undertake e.g. innovation, design or branding – a firm may be able to sell goods in international markets where the degree of competition is lower. That is, the firm may sustain a higher profit margin, but workers also gain from a reduced competitive pressure through higher wages. Hence, our second hypothesis is that, if there is a positive export premium in wages, it should mainly be found in firms employing high-skilled labour – i.e., there is a positive interaction effect between exporting and the skill intensity in the firm on wages.

3. Data

We have access to a very rich matched worker-firm longitudinal data set covering the total Danish population for the years 1995–2002 – the so-called FIDA dataset which is based on administrative registers. Each individual and each firm is associated with a unique identifier, and most importantly all employed individuals are linked with a firm identifier at the end of each year. Detailed information on individual socio economic characteristics is available on an annual basis. These individual level variables are extracted from the integrated database for labour market research (IDA) and the income registers in Statistics Denmark, which have been used in numerous studies. For more details on the IDA dataset see e.g. Abowd and Kramarz (1999).

To this matched worker firm dataset we have merged detailed records on international trade for all firms from The Danish External Trade Statistics. The external trade statistics are compiled in two systems; Intrastat (trade with EU countries) and Extrastat (trade with non-EU countries), and the compilation follows internationally agreed principles for statistics on international trade, see Statistics Denmark (2003) for further details. If a firm exports a specific product to any given country in any given month, this is recorded as one observation in the data. That is, for each combination of firm, month, destination country and product code, the total (fob) value of the transaction is known.

In addition to the trade variables there is information about total sales of the firm, thus allowing us to calculate the export ratio of each firm in each year. Furthermore, we also construct a measure for the capital labour ratio of each firm as the value of land, buildings, machines, equipment and inventory divided by the number of full-time workers, and (log of) the size of the firm in terms of the workforce is also included in the analysis as a control variable. From the matched workers we also calculate the proportion of workers with further education at the firm level.

We restrict attention to trade with countries outside the EU countries and Norway for three reasons. First, while all trade with non-EU countries is recorded by customs authorities (and so the coverage rate in the data is close to complete), there is not a similar system in place for intra-EU trade. However, intra-EU trade is recorded through the so-called Intrastat system, where firms are obliged to report trade data on a monthly basis. An important source of inaccuracy in this system is that some firms appear not to report data to the system. Second, data on intra-EU trade is censored in a way such that only firms exporting goods with a total annual value exceeding a certain threshold are recorded in the files. No such data limitations exist for trade out of the EU. As a result the coverage rate in the Intrastat system is only in the range 85–90%. Third, Denmark is a small and very open economy in which a relatively large proportion of firms export. The formation of the internal market in the EU during the 1990s has abolished most trade impediments, and so the EU can increasingly be regarded as the domestic market for Danish firms, and due to the small size of the Danish market a relatively large part of all medium sized and large firms almost by definition must be exporters. By

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4 For commercial and privacy reasons the data can only be accessed at sites authorized by Statistics Denmark.

5 In our data period (1995–2002), the EU consists of: Germany, UK, France, Italy, Spain, Ireland, Portugal, Belgium, Greece, Austria, The Netherlands, Belgium, Finland, Sweden and Denmark. Norway is included in this group of countries because of the close economic interaction between Norway and Denmark.

6 This threshold was in the last year of the sample period 2.5 mill. Danish Kroner corresponding to 335,000 Euro.
Table 1
Manufacturing firms and exports

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of firms</th>
<th>Proportion that export</th>
<th>Proportion exported</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>1334</td>
<td>0.730</td>
<td>0.089</td>
</tr>
<tr>
<td>1996</td>
<td>1304</td>
<td>0.748</td>
<td>0.097</td>
</tr>
<tr>
<td>1997</td>
<td>1299</td>
<td>0.749</td>
<td>0.107</td>
</tr>
<tr>
<td>1998</td>
<td>1301</td>
<td>0.764</td>
<td>0.114</td>
</tr>
<tr>
<td>1999</td>
<td>1292</td>
<td>0.773</td>
<td>0.156</td>
</tr>
<tr>
<td>2000</td>
<td>1317</td>
<td>0.787</td>
<td>0.167</td>
</tr>
<tr>
<td>2001</td>
<td>1282</td>
<td>0.789</td>
<td>0.176</td>
</tr>
<tr>
<td>2002</td>
<td>1249</td>
<td>0.800</td>
<td>0.170</td>
</tr>
</tbody>
</table>

Notes: Firms are classified as exporters if they export to countries outside EU15 and Norway. Proportion exported is total exports out of EU15 and Norway as a percentage of exporting producers’ sales. Only manufacturing firms with more than 50 employees are included.

7 Bernard and Jensen (1995) exclude small US firms, while Eaton et al. (2004) include all French firms. They both include exports to all foreign destinations.
8 Rather than just looking at one part of the distribution, i.e., the mean, the Kolmogorov–Smirnov test tests for differences in all moments of the distribution. See e.g. Delgado, Fariñas and Ruano (2002) for an application of this approach to productivity differences between exporters and non-exporters.

focussing on trade with countries outside the EU we get more variation across firms, and such trade better resemble that of firms in larger economies like the US.

Throughout the paper we only analyze firms (and their workers) with more than 50 employees, and there are several reasons for this. First, the small firms are much less inclined to export. Second, the link between workers and the small firms is sometimes incorrect or missing. Third, data on firm level capital are imputed for the smallest firms. Finally, the number of workers with further education employed in a firm is in practice indivisible, and, therefore, in small firms our measure of skill-intensity becomes very sensitive to the hiring or firing of a single educated worker. This implies that our measure of skill-intensity would be very noisy in small firms. The resulting dataset still covers the majority of workers in the manufacturing sector; almost 3/4 of all workers are employed by firms with more than 50 employees.

A number of studies have documented substantial heterogeneity among firms within industries with respect to their export behavior, see Tybout (2003) for an overview. Far from all firms export, and this is also true even for Danish manufacturing firms with more than 50 employees, cf. Table 1. The share of firms exporting their products to countries outside EU15 and Norway has increased from 73% to 80% during the sample period. There is clearly a positive correlation between firm size and the propensity to export; if all firms with more than 10 employees had been included only approximately 50% would be counted as exporters in 2002 using the same export definition. Danish manufacturing firms sell around 17% to countries outside EU15 and Norway in 2002. Had we included EU15 and Norway in the export definition more than half of manufacturing production is exported. This, of course, reflects the fact that the EU countries are very important export destinations for Danish companies. For comparison Bernard and Jensen (1995) report for US manufacturing firms in 1987 that 15% export, while for French manufacturing firms in 1986 Eaton, Kortum and Kramarz (2004) report that 17% export.7 These are much lower numbers and indicate the inevitable negative correlation between domestic market size and export orientation. The percentages exported for these two countries are 10% and 22% respectively. This shows that by focussing on exports to countries outside EU and Norway the export behavior of firms is more comparable to that of firms in larger economies.

The standard practice is to evaluate and compare the performance of exporting firms and non-exporting firms. However, since the majority of the manufacturing firms we consider are exporters, it is more relevant to focus on the export intensity. Therefore, in Table 2 we divide all firms in 2002 into two groups of equal size based on the firm level export intensity and show sample means of a number of variables. It is seen that firms with high export intensities are indeed larger and use a higher share of workers with further education. That these differences are significant is evident from both the simple t-tests for differences in means and the more advanced Kolmogorov–Smirnov test for first order stochastic dominance of the distributions.8 With respect to average wages, firms with high export intensities pay higher wages to workers with further education, but in fact they pay somewhat lower wages to less skilled workers.

Among the individual level variables the hourly wage rate is obviously the most important one in the analysis, and this wage rate is calculated as total labor income divided by the total number of hours worked in any given year. A long list of individual socio economic characteristics are used as control variables in the analysis. There are self explanatory dummies for gender, the presence of children, the presence of two adults in the household, immigrant status and city size. We also include standard human capital variables, i.e., dummies for educational attainment, labour market experience, experience squared and job tenure. The classification of education groups rely on a Danish education code and requires more explanation since they are important in the empirical analysis. The variable ‘Further education’ basically corresponds to the two highest categories (5 and 6) in the International Standard Classification of Education (ISCO), i.e., the individual has a tertiary education. In what follows we share of workers in the firm with further education as a measure of the skill intensity in the firm. ‘Vocational education’ is defined as the final stage of secondary education encompassing programmes that prepare students for direct entry into the labour market. Thus persons with just high school or equivalent are not included in this category. In addition, there are dummies for membership of unemployment insurance funds and trade unions. We also include dummies for the occupation and industry of the individual. Occupational dummies are based on the Danish version of the ISCO-88 definition, and we operate with the nine main categories. The industry dummies are based on the three digit NACE level, which leaves us with 36 manufacturing industries.
4.1. Skills, exports and individual wages

The empirical strategy is to compare wages of otherwise similar workers who work in firms with different skill intensities and export behavior. Suppose that the hourly wage rate of worker $i$ in firm $j$ at time $t$ is determined by a simple Mincer human capital wage equation of the form

$$\log w_{ijt} = \beta' X_{it} + \gamma' Z_{jt} + x_{ijt} + \varphi_t + \epsilon_{ijt},$$

where $X_{it}$ represents worker characteristics, $Z_{jt}$ represents firm characteristics, $x_{ijt}$ captures the interaction between export and skill intensity, and $\epsilon_{ijt}$ is the error term.

We restrict the sample to include only full-time manufacturing workers in the age group of 18–65 years. In the final data set used for wage regressions there are 502,735 persons yielding 2,069,037 person-years. Again to illustrate the importance of the firm level export intensity, Table 3 shows sample means for two equally sized groups of observations defined from the firm level export intensity. For example, it is seen that workers in firms with high export intensities have less labour market experience but longer job tenure.

3.1. Firm level correlations

Before we proceed to a more rigorous econometric analysis we explore the relationship between wages, export intensity and skill intensity at the firm level by showing unconditional bivariate relationships among these variables. Table 2 and 3 indicated a positive correlation between the firm level export intensity and the firm level skill intensity. This is confirmed by a simple plot of average skill intensity against average export intensity for the firms in 2002, cf. Fig. 1.9

A similar plot of average wages against the export intensity also reveals a positive relationship thus suggesting the existence of an export wage premium, see Fig. 2. The slope of the line with fitted values is 0.08, i.e., 10 percentage points higher export intensity corresponds to 0.8% higher wages. Of course we have not controlled for any other firm level characteristics here, so this positive correlation might be explained, for example, by the fact that a higher export intensity is associated with a higher skill intensity which in turn should yield higher wages. This is related to our first hypothesis outlined in Section 2.

Alternatively, in line with our second hypothesis, it could be that the export premium in wages depends on the skill intensity such that it is highest in the most skill intensive firms. To obtain some suggestive evidence for such a link we plot wages against export intensities for two equally sized groups of firms; low skill intensity firms and high skill intensity firms, see Fig. 3. Consistent with the second hypothesis it is seen that the slope and intercept of the line with fitted values are highest for firms with high skill intensities.10 Among low skill intensity firms, the Figure indicates that a higher export intensity is associated with lower wages, but the slope is not significantly different from zero.

4. Empirical analysis

In this section we consider whether exporters are paying higher wages when worker characteristics are taken account of. If so, may this effect be explained by a lack of control for the skill intensity of the firm (our first alternative hypothesis)? And is it robust to the inclusion of an interaction term between export and skill intensity (our second alternative hypothesis)?
where $\varphi_t$ is an unobservable year effect. Individual covariates such as experience, experience squared and tenure are included in $x_{it}$ and firm specific variables – notably variables for whether firms are exporting and the share of workers in the firm having further education (the skill intensity) – are contained in $z_{jt}$. This model is a so-called job spell fixed effects specification (see e.g. Abowd et al. 1999), where $\alpha_{ij}$ is a time-invariant unobservable component of each unique worker–firm combination. Thus, in contrast to the vast literature on exporting and wages that rely on firm level data alone, we are able to control for observed and unobserved characteristics of the worker–firm combinations. Hence, identification is only based on within–firm variation over time for workers staying in the firm. However, to consider the importance of controlling for the unobserved characteristics of a job spell, we also report the outcome of a pooled OLS estimation (i.e. $\alpha_{ij}=\alpha$) where cross firm and cross worker variation contribute to the identification.

In Section 2 we outlined two different hypotheses concerning the export premium in wages, and Table 4 displays estimation results related to these hypotheses. The three models in the table are the results of running different specifications of the wage in

### Table 3
Sample means, workers 1995–2002

<table>
<thead>
<tr>
<th></th>
<th>Low export intensity</th>
<th>High export intensity</th>
<th>$p$-value of $t$-test</th>
<th>$p$-value of KS-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log wage rate (DKK)</td>
<td>5.078</td>
<td>5.087</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Age 18–24</td>
<td>0.080</td>
<td>0.070</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Age 25–29</td>
<td>0.123</td>
<td>0.117</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Age 30–39</td>
<td>0.314</td>
<td>0.329</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Age 40–49</td>
<td>0.255</td>
<td>0.259</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Age 50–59</td>
<td>0.204</td>
<td>0.200</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Age 60–65</td>
<td>0.016</td>
<td>0.016</td>
<td>0.138</td>
<td>0.963</td>
</tr>
<tr>
<td>Female</td>
<td>0.278</td>
<td>0.326</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Married</td>
<td>0.563</td>
<td>0.574</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Two adults</td>
<td>0.734</td>
<td>0.742</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Kids 0–6 years</td>
<td>0.230</td>
<td>0.237</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Immigrant</td>
<td>0.034</td>
<td>0.035</td>
<td>0.000</td>
<td>0.450</td>
</tr>
<tr>
<td>Copenhagen</td>
<td>0.050</td>
<td>0.044</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Big city</td>
<td>0.132</td>
<td>0.126</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Small city</td>
<td>0.818</td>
<td>0.830</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Unskilled</td>
<td>0.411</td>
<td>0.387</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Vocational education</td>
<td>0.446</td>
<td>0.430</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Further education</td>
<td>0.143</td>
<td>0.203</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Experience (years)</td>
<td>17.00</td>
<td>16.91</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Experience squared</td>
<td>377.2</td>
<td>375.0</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Tenure (years)</td>
<td>5.134</td>
<td>5.537</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Union membership</td>
<td>0.876</td>
<td>0.860</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>UI fund membership</td>
<td>0.937</td>
<td>0.940</td>
<td>0.000</td>
<td>0.001</td>
</tr>
<tr>
<td>Number of observations</td>
<td>1,037,000</td>
<td>1,036,460</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: Firms are classified as exporters if they export to countries outside EU-15 and Norway. Only workers in manufacturing firms with more than 50 employees are included. The $t$-test is a test of the null that the means of the two groups are equal against the alternative that the group with highest mean has significantly higher mean. The Kolmogorov–Smirnov test is a test of the null that the distributions are equal against the alternative that the distribution of the group with highest mean stochastically dominates the distribution of the group with lowest mean.

Fig. 1. Skill intensities and export intensities, firms 2002.
Eq. (1), and in all cases we include year dummies, industry dummies, observed firm characteristics and individual covariates as shown in Table 3 (coefficients not reported).

In the first model, we do not control for the skill intensity in the firm, and we do not allow for any interactions between skill intensity and exporting. This model, therefore, corresponds to the traditional approach in the literature on wage premia in exporting firms. In the model without spell fixed effects, we find that the decision to export or not has no impact on wages, but the export intensity has a significant positive impact. The estimated coefficient implies that a 10 percentage point increase in the export intensity corresponds to 0.49% higher wages. This result is very similar to the findings by Schank et al. (2007) who study a German matched worker–firm dataset. They also find no impact of the export dummy but a positive impact of the export intensity, and in their corresponding specification wages rise by 0.79% for blue collar workers and 0.24% for white collar workers when the export intensity rises by 10 percentage points. However, in the model with spell fixed effects no export variables have significant impacts on wages. This indicates that the significance of the export intensity in the model without fixed effects is a result of unobserved characteristics of the firms who export more than other firms (for instance higher productivity), and/or unobserved characteristics of the workers in the firms who export more than other firms. In contrast to our results, Schank et al. (2007) find that the effect of the export intensity on wages remain significantly positive when including spell fixed effects.
In the second model we include the share of workers in the firm with further education as our measure of the firm level skill intensity. First, we see that the skill intensity variable has a substantial and highly significant impact on wages — also when including spell fixed effects. Second, we see that inclusion of the skill intensity variable only slightly reduces the coefficient on the export intensity variable in the model without spell fixed effects. Thus, although exporting companies do have a much higher share of further educated workers, and a higher share of further educated workers leads to higher wages, the wage premium in exporting firms cannot be attributed to higher skill intensities in these firms. That is, we can reject the first alternative hypothesis.

In the third model, we include the interaction term between skill intensity and export intensity. Firms may hire more highly skilled workers to differentiate their products and in turn escape competition from low wage countries in world markets, and this benefit from the skill intensity is more pronounced the more involved the firms are in export markets. Thus, the inclusion of the interaction term allows us to better distinguish between the competing explanations behind the export and human capital premia. We find that the interaction term indeed enters the wage equation with a large positive effect. Furthermore, after inclusion of the interaction term, the coefficient on export intensity is no longer significantly different from zero in the model without spell fixed effects. The skill intensity still has a direct positive impact on wages in this model, but its magnitude has been reduced somewhat. In the model with spell fixed effects, the interaction term remains significant, and the estimated coefficient increases compared to the model without fixed effects. However, the skill intensity is no longer significant, and the export intensity has a weak negative effect on wages such that in firms with a very low skill intensity workers experience a negative relationship between wages and export intensity. Thus, perhaps the direct effect of exporting may actually for some workers signal more competition and lower wages such that in the model without spell fixed effects. The skill intensity still has a direct positive impact on wages in this model, but its magnitude has been reduced somewhat.

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An interesting extension is to allow for heterogeneity in the effects across educational subgroups of the workers. In the following we split the sample into three groups: unskilled workers, workers with vocational education and workers with further education, and Table 5 shows the results for the specification with job spell fixed effects.

First, in model 1 the export variables have no significant effects on wages for any of the three types of labour (with the exception of a weakly significant negative effect of the export dummy for workers with further education). In model 2, we find a positive effect of the skill intensity of the firm on wages of unskilled workers and workers with vocational education. In model 3, we find highly significant effects of the interaction term between skill intensity and export intensity on wages of unskilled workers and workers with vocational education. However, there is no significant effect of the interaction term on wages of workers having a further education. Hence, it is the least educated workers who gain in terms of higher wages if the export intensity increases in a firm where the skill intensity is high. Also, unskilled workers and workers with vocational education now realize a negative effect

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11 In Table 4 we focus only on firms with more than 50 employees for reasons outlined in Section 3. If instead we consider all firms with more than 10 employees the main result still holds; the coefficient on the interaction term in Model 3 (with spell fixed effects) is 0.3161 (significant at 1% level), and the coefficients on the skill intensity and export intensity are not significantly different from zero. Also, if all destination countries were included in the export definition we still get a positive and significant coefficient (0.1725 significant at 1% level) on the interaction term. The coefficient on the skill intensity is insignificant, while the coefficient on the export intensity is now significantly negative (-0.0427).

12 If the coefficient on the export intensity is taken to be zero (i.e. insignificant), a 10 percentage point increase in the export intensity implies that the wage increases by 0.3% if the skill intensity is 10% and 1.5% if the skill intensity is 50%.
of the export intensity. A 10 percentage point higher export intensity implies that wages of the least educated workers fall by 0.5% if the skill intensity in the firm is 10%, but rise by 1.1% if the skill intensity is 50%.

5. Conclusion

In this paper we have explored the relationship between a firm’s education level, export performance and wages of its workers. We have offered a brief discussion of the possible theoretical underpinning. We argue that firms may escape intense competition in international markets by using high skilled workers to undertake or improve innovation, design or branding and thereby differentiate their products. Lower product market competition, in turn, is likely to spill over into wages if there is rent-sharing between workers and firms. That is, we should find a positive association between a firm’s share of educated labour and wages of the workers.

Using a very rich matched worker-firm longitudinal dataset we first consider two separate results from the existing literature. First, when only controlling for observed worker and firm heterogeneity, we find that firms with higher export intensities pay higher wages. However, when also controlling for unobserved worker and firm heterogeneity, no export variable has significant effects on wages. Second, in line with a small literature on firm-level human capital externalities, we find that the firm level skill intensity increases wages in the firm. This indicates that interaction with high skilled workers at the workplace may lead to learning and higher productivity and wages for others.

Our main result is that inclusion of an interaction term between the export intensity and the proportion of educated workers at the firm level enters the wage equation with a significant positive effect. In addition, the skill intensity no longer has a significant impact on wages, and the export intensity has a weak negative effect on wages. Hence, a higher export intensity in firms with a very low skill intensity implies that wages fall — while a higher export intensity in firms where the skill intensity is high leads to higher wages. These results support the hypothesis that exporting firms may escape intense competition from low wage countries in international markets by using more skilled labour.

Our results also show that it is only for the least educated workers that the interaction term has a significant effect on wages. Workers with further education appear to be unaffected.

References


