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Abstract

Theoretical and empirical contributions on export behavior highlight the importance of firms' productivity and their levels of economies of scale on firms' export success in `foreign' markets. In the context of agglomeration economies, firms enjoy productivity gains when they are located close to competitors or upstreaming industries and they benefit from knowledge spillovers and other positive externalities. In such a stimulating environment, firms become more prone to be exporters. Beyond the role played by externalities, firms may benefit when they employ a diverse workforce and when the interaction of distinct knowledge and related problem-solving abilities increases productivity and secures export success. In this paper, we ask whether German firms (i.e., establishments) benefit from localization and urbanization externalities and face higher export proportions. We also control for a variety of establishment characteristics and workforce diversity. For this purpose, a comprehensive German data set that combines survey data and administrative data is used. While controlling for firm heterogeneity in a fractional response model, we provide evidence that manufacturing establishments and smaller establishments (up to 250 employees) benefit most from externalities and especially from knowledge spillover. There is weak evidence supporting the benefit of workforce diversity; however, that factor could explain between-establishment variation.

Keywords: Export behavior, firms, agglomeration economies, cultural and workforce diversity

JEL: D 22, F 14, J 24, M 14, R12

1. Introduction

The German economy is said to be an exporting economy, and the exporters are individual firms. They enter foreign markets to supply their products and services in order to generate additional revenues and to cover, for instance, fixed costs of innovation; they may also enter foreign markers merely for reasons of profit and higher dividends. In any case, the theoretical literature on exports highlights the necessity of profitability (Melitz, 2003) and competitiveness in the export market. Firm profitability depends not just on the technology employed but also on firm-internal economies of scale, which yield productivity gains due to falling average costs. In addition to size effects, firms might be more productive when the workforce employed is rather diverse (Ottaviano and Peri, 2005). Interactions among workers who differ with regard to specific knowledge and abilities can increase overall productivity.

Not just firm-internal resources contribute to productivity differentials among firms. In the presence of agglomeration economies, those firms that are located in an agglomerated environment benefit from positive externalities, thus becoming more productive. Due to their common labor markets, shared resources, human capital spillover effects and urbanization effects due to a diverse environment or other concentration effects, localization economies in particular are discussed in the literature (e.g., by Glaeser et al., 1992; Henderson, 2003); the aforementioned factors yield productivity gains for individual firms.

Many empirical contributions consider the export behavior of firms and focus mainly on firm-internal variables. Literature on the effect of workforce diversity or agglomeration economies on export success is scarce; therefore, this paper adds to the literature and estimates the effect of agglomeration variables and workforce diversity on export success. To this end, we make use of data from a large German survey at the establishment level and combine it with administrative data from the German Social Security System. By controlling for the fixed effects of industry and region, establishment heterogeneity is explicitly taken into account. To the best of our knowledge, this is the first study examining the impact of agglomeration externalities on export behavior in the German economy. We provide evidence that both agglomeration economies and workforce diversity are requisites for export success. However, workforce diversity mainly explains between-establishment variation. For manufacturing establishments alone, workforce diversity yields positive effects on export proportions. Agglomeration effects are present and, again, are crucial for manufacturing establishments and those establishments that employ up to 250 employees.

The paper is structured as follows. Section 2 provides an overview of the theoretical aspects of exports. Section 3 reviews empirical evidence and derives hypotheses on productivity, agglomeration economies and workforce diversity. In Section 4, the estimation strategy is introduced, whereas Section 5 introduces the data set and variables, followed by a descriptive analysis in Section 6. Finally, Section 7 presents and discusses the estimation results. Section 8 summarizes the findings and concludes.

2. Theoretical aspects

Several explanations are discussed in the literature on international trade for why countries import and export goods. The early works of Ricardo and of Heckscher and Ohlin explain trade flows between countries on the basis of comparative advantages resulting from different factor endowments and different sector-specific production functions. Therefore, traded goods are those of different sectors. Krugman (1979) explains international trade flows at the firm level of a horizontal diverse market instead of at the aggregated sector level. The model is based on monopolistic competition in which each firm produces a unique product, and due to people´s love of variety, countries begin to trade in 'similar' goods, and firms start exporting their products to distant markets. This simple model provides basic mechanisms of firms' incentives to trade in general but does not explain why some firms export and others only produce for the local market. Taking this limitation into account, Melitz (2003) adds to the literature by developing a model in which heterogeneous firms are in monopolistic competition to each other. The heterogeneity is explained by productivity differentials between firms. Additionally, there are sunk costs as for market research and developing a transportation network owing to export market entry. To be successful in export markets, firms have to compensate for these sunk costs with additional revenues through exporting. These revenues depend on firm-specific productivity, which has to exceed a certain threshold such that the profit is high enough to compensate for sunk costs and to compete with firms in the distant market. Then, more productive firms export, whereas less productive firms only produce for the domestic market. Melitz's model therefore shows that, within industries, it is possible that some firms enter export markets although others do not. It is worth mentioning that firm-specific internal scale effects, as discussed by Krugman, relate to productivity levels. Specifically, higher productivity might be achieved in the presence of agglomeration economies emerging due to (localized) knowledge spillovers, vertical linkages, (local) demand effects, and scale effects at higher levels of hierarchy, among other causes. The effect of agglomeration economies on productivity is well examined in empirical assessments

(Ciccone, 2002; Ciccone and Peri, 2006, Henderson, 2003; Glaeser et al., 1992; Combes et al., 2004; Martin et al., 2011). In any case, the theoretical literature relates firms' productivity to their export behavior. Causality seems to run initially from a firm's productivity to its tendency to export. However, in the presence of agglomeration economies, this causality might be reversed as well.

Many empirical studies analyze not only the impact of firms' productivity but also other determinants on export activities. Owing to the fact that this paper focuses on the export share of total sales, the following literature review sheds light on this specific relationship.

3. Literature review and hypotheses

Recent work provides empirical evidence on the determinants of firms' export behavior. There is a large body of literature explaining the likelihood of a firm's being or becoming an exporter. Because this paper focuses on the export share, i.e., the fraction of exports relative to total sales, the following focuses on literature relating to this topic.

Based on Melitz's (2003) theoretical foundations, the productivity of firms has been implicated as one key factor. Several contributions underpin the positive impact of firm productivity on export intensity, measured as the export/sales ratio; Du and Girma (2007) investigate this relative to Chinese manufacturing firms, whereas Stiebale (2011) does so for Italian manufacturing firms and Eickelpasch and Vogel (2011) do so for German service firms.

Firm size is employed as an indicator of economic strength and as a proxy for the degree of increasing scale economies at the firm level. With increasing numbers of employees, lower levels of average costs can be achieved; accordingly, larger firms become more competitive in foreign markets because they can compensate for the additional costs of exporting. Empirical evidence of a positive relationship between firm size and export behavior is provided by Du and Girma (2007), Gourlay et al. (2005), Greenaway et al. (2007), Love and Mansury (2009), Roberts and Tybout (1997), Roper et al. (2006), Sjöholm, (2003), and Wakelin (1998), among others. It is further argued that the relationship between export share and firm size is nonlinear, which is reasonable considering the additional coordination costs that are involved with increasing numbers of employees (Wagner, 2001). Barrios et al. (2003) explore this nonlinear relationship in Spanish production firms; Gourlay et al. (2005) not only investigates negative, nonlinear impacts in UK establishments but also identifies an inverted U-shaped pattern in the export/sales ratio. However, the evidence is rather mixed: other studies, such as

those by Guan and Ma (2003) and Love and Mansury (2009), find no such nonlinear relationship.

Another controversial factor discussed in the literature is a firm's age. According to Love and Mansury (2009), older firms have had more time to improve their transportation network and gain more experience with foreign markets. On the other hand, Contractor et al. (2007) argue that older firms are more likely to be inflexible and less able to adapt to changes at the export market. Empirical results are therefore mixed: Stiebale (2011) provides evidence for French firms and Roberts and Tybout (1997) for Colombian manufacturers that firm age is positively related to export potential. By contrast, Sjöholm (2003) finds a negative relationship. The studies of Du and Girma (2007) and Barrios et al. (2003) find positive significant effects of firm age on export intensity, whereas Love and Mansury (2009) find no significant impact. Barrios et al. (2003) investigate the impact of a firm's squared age and confirm a nonlinear, inverse U-shaped relationship.

Clearer evidence exists about the effects of innovative activities and R&D, which are crucial to gaining essential knowledge that facilitates successful competition against other firms. R&D can improve the quality of products, which increases the possibility of operating more successfully in foreign markets (Barrios et al., 2003). A firm's internal R&D has a positive impact on its decision to export, as confirmed by Love and Manury (2009), Roper and Love (2002) and Gourlay et al. (2005). Basile (2001) shows evidence for Italian manufacturing firms that process and product innovation increase export likelihood. Other evidence shows the positive significant effects of R&D and innovations—e.g., Sterlacchini (2001) for Italy and Roper at al. (2006) for Ireland and Northern Ireland with respect to export rates; Salomon and Shaver (2005) for Spain with respect to export revenues. Roper and Love (2002) find no significant relationship between export share and innovations. They argue that innovative behavior positively influences the probability of export but does not increase export intensity. Griliches (1979) introduces the concept of the 'knowledge-production-function'. Such a production function connects innovative outcomes with 'innovative' inputs. Because parts of innovation and knowledge have the characteristics of public goods, the (firm's) production of new knowledge depends not only on internal resources, such as the firm's employment of human capital, but also on an external-to-the-firm factor, which then leads to a positive knowledge-spillover effect within the firm. Such a spillover channel is theoretically considered in the 'endogenous growth theory,' where it has been analyzed empirically (e.g., Grossman and Helpman, 1995; Audretsch and Feldman, 2004; Greenaway et al., 2004; Moretti, 2004). The study highlights positive spillover effects stemming from multinational enterprises (MNEs) and especially their R&D expenditures. The authors empirically

demonstrate that MNEs generate large amounts of technological knowledge and that other firms seek to imitate these innovations. Thus, firms profit from the R&D of other firms and therefore are able to increase their export shares. The evidence is supported by the results of Aitken et al. (1997), who find positive effects of MNEs on the export decisions of Mexican firms. The evidence provided by Lages et al. (2009) suggests that firms gain experience from knowledge spillover and social contact with other firms, which improve a firm´s own innovative skills and consequently increase export intensity.

The performance (and, thus, productivity) and the innovative capacity of companies are strongly linked to the quality of human capital available to the firm. It is expected that the skills of employees are positively related to export intensity; hence, the qualifications of the employees are crucial (Love and Mansury, 2009). Roper et al. (2006) use the share of high qualified workers and Barrios et al. (2003) employs the average wage to measure the human capital of a firm. Both studies provide evidence for a positive, significant effect of human capital on success in foreign markets. Eickelpasch and Vogel (2011) find significant positive effects for average labor costs as a proxy for human capital; however, when unobserved heterogeneity is taken into account, the effect vanishes. Ottaviano and Peri (2005) argue that cultural diversity in the workforce yields (at the regional level) productivity gains because of different problem-solving approaches or distinct knowledge. Other evidence of such an effect is also provided by Niebuhr (2010), Ozgen et al. 2012 and Suedekum et al. (2014), A similar channel may be posited at firm level, leading to increasing efficiency (Page 2007, Fujita and Weber 2003, Ozgen et al. 2011, Brunow and Blien 2014). In particular, exports may yield positive effects when country-specific knowledge is available to an individual firm. Of course, negative effects of the employment of a culturally diverse workforce also exist, such as language barriers and cultural conflicts. To generalize the concept of Ottaviano and Peri, one may argue that a diverse workforce with respect to culture, occupations, human capital, tasks, etc. provides productivity gains that result in export success.

Not only the human capital endowment but also the general economic environment plays an important role in export success (Greenaway and Kneller, 2008). The proximity to agglomeration favors increases in the export/sales ratio. Lower costs for production, transportation and transaction through shared resources and better communication to suppliers and customers are the main advantages of a firm´s location in an agglomeration—advantages that can also increase firm productivity (Malmberg et al. 2000; Cohen and Paul, 2009). There might also be knowledge spillovers to foster reduced R&D costs (Griliches, 1979). Positive agglomeration effects are described as localization economies, where firms of the same or

related industries are concentrated in an area, and urbanization economies, which arise if firms of various sectors agglomerate in the same area (Henderson, 2003).

Because firms improve their productivity and save costs through these economies, taking localization and urbanization effects on export activities into account when analyzing the impact of spatial agglomerations is also important (Chevassus-Lozza and Galliano, 2003). Several empirical investigations examine such relationships and provide mixed results. Malmberg et al. (2000) considers Swedish manufacturing firms in 1994, Greenaway and Kneller (2008) analyze UK manufacturing firms between 1988 and 2002 and Mittelsteadt et al. (2006) investigate U.S. firms. Evidence from these studies shows a significant effect of localization and urbanization economies on export share and the possibility of exporting, respectively. Further, Henderson (2003) finds significant positive effects of localization economies on the productivity of the US branches of high-tech firms that are positively related to export share, whereas he does not identify significant effects through urbanization. In contrast, Antonietti and Cainelli (2011) find positive effects of urbanization economies on both extensive and intensive export margin for Italian manufacturing firms but fail to find significant evidence for localization economies. Furthermore, Kneller and Pisu (2007) find positive localization effects of MNEs on the likelihood of exporting and export share for British manufacturing firms between 1992 and 1999. In contrast, no significant results—neither for positive localization nor urbanization economies—are found in Rodríguez-Pose et al.'s (2013) analysis of agglomeration effects on export activities for Indonesian manufacturing firms during 1990-2005. Although the evidence is mixed in terms of significance, however, the findings are positive in magnitude.

In addition to localization and urbanization effects, the presence of exporters influences export activities of other firms has been discussed. The evidence provided by Koenig et al. (2010) and Todo (2011) indicate a positive relationship between export spillovers and the decision to export. In the case of Koenig et al. (2010), these spillover effects on the possibility of export are stronger for firms exporting the same product to the same destination. This could be interpreted in the context of localization economies. Aitken et al. (1997) find no significant effect of export spillover on the decision to export. The study by Rodríguez-Pose et al. (2013) not only confirms the positive effect of export spillover but also provides significant evidence that export intensity's positive effect due to exporters' existing in one region becomes smaller if adjacent (i.e., neighboring) regions contain a high share of exporting firms. Conversely, Barrios et al. (2003) and Bernard and Jensen (2004) do not report significant evidence for the presence of exporters influencing other’s firm export behaviors.

The impacts of a firm's legal status its ownership structure are also discussed in the literature. According to Clerides et al. (1998), exports serve to fix costs, such as marketing costs, to attract consumers' attention or to set up new distribution networks. If firms are part of an MNE, these costs are lower, because essential knowledge and other important networks already exist (Stiebale, 2011; Roper et al., 2006; Greenaway et al., 2004). Greenaway et al. (2007) show that foreign ownership of firms is positively related to the possibility of exporting. This is in line with the results of a French study by Stiebale (2011), Roper et al.'s (2006) study of Irish manufacturing firms and Roper and Love's (2009) study of companies in Germany and UK, all of which confirm that foreign ownership is significantly and positively related to the export share. Stiebale (2011) and Eickelpasch and Vogel (2011) provide evidence that limited public companies tend to have a higher export rate than other firms.

To summarize, the recent literature provides evidence, albeit partly mixed, that productivity, firm size, R&D activities and innovation, foreign ownership and human capital as well as localization and urbanization economies explain the export behavior of firms. Our variables of interest include agglomeration economies and workforce diversity while controlling for other determinants discussed in the literature. Based on this model, we can derive the following hypotheses on the variables of interest.

Hypothesis 1: Productivity, firm size and highly skilled workers have a positive impact on the export ratio.

Hypothesis 2: Diversity of the employed labor force raises the available knowledge within the firm, which offers an additional human-capital effect in favor of higher export proportions. Diversity may relate to cultural diversity and occupational diversity. There might be distinct effects between low- and high-skilled workers.

Hypothesis 3: Urbanization effects may be positive when intra-regional, inter-industrial linkages among firms within the production process are important.

Hypothesis 4: Localization effects (MAR-externalities) may have positive and negative effects on export propensity. Being located in an area with a relatively larger number of intra-industrial competitors may increase exports because one is located within the industry’s agglomeration and because there are positive externalities at industry level. On the other hand, higher competition puts pressure on firms, and because of lower ‘domestic’/local demand, firm-internal economies of scale cannot be fully developed. Then, firms lose competitiveness, and this may reduce export success. Another source of MAR externalities relates to within-industry human-capital spillover effects, which are expected to influence exports positively.

4. Methodology and estimation strategy

The dependent variable is the proportion of exports on total sales. We observe firms that have an export proportion of zero, indicating that they do not export, and other firms that do export, having an export ratios of sales as high as one.

As Melitz argues, firms enter the foreign market when they are productive enough to compete in these markets. The question becomes whether the decision to become an exporter and the consequent decision on the volume of exports are met simultaneously or whether they require a two-step approach in a sense of Heckman's (1979) selection model. Wagner (2001) discusses such a two-step approach that first estimates the propensity to export. Taking into account the propensity to export, the intensity is modeled in the second stage for all exporting firms. However, Wagner (2001) argues that this procedure has less theoretical foundation: Firms seek to maximize their profits by setting marginal costs equal to marginal revenues, which also influences the firms' export prices and their quantities of exported goods. A firm will not export if the export price does not compensate for the variable costs related to export market entry. Accordingly, firms choose their optimal profit-maximizing export shares, which may be zero. We therefore adopt the one-step approach wherein both decisions are considered simultaneously.

To model the export/sales ratio in an empirical investigation, one has to take the bounded nature between zero and one into account. Various approaches have been discussed in the literature. A simple option is estimation with ordinary least squares (OLS). However, this method fails to estimate export shares within the desired range. One can overcome this shortcoming and by taking the limited dependent variable character into account with a simple log-transformation of the data and still applying OLS. There is a cost to such a transformation, however, in that the boundary values cannot be transformed. This is a drawback, especially because the majority of firms never export. The same disadvantage occurs when using the beta-distribution, which is characterized by high flexibility when modeling the conditional mean of the dependent variable (Ramalho et al., 2011; Wagner, 2001).

Another strategy for estimation is to use a censored Tobit model with censoring at zero and one. Although this approach seems to be appropriate for estimation, with respect to content, there is no censoring in the sense used in the Tobit approach: the export proportion is between zero and one per the definition and not per the censor. Finally, based on a quasi-maximum-likelihood estimation method, the fractional response approach introduced by Papke and Wooldridge (1996) is developed especially for the bounded structure of proportional

variables, especially for observations at the limits. Assuming a nonlinear function with $0 \leq G(\cdot) \leq 1$, e.g., any cumulative standard normal distribution, and using Bernoulli log-likelihood function, it is possible to estimate fractional responses, as is the case for export proportions. This approach is therefore the preferred model for estimation. In response to the specific characteristic of the presented methods, the following estimation techniques are used to ensure robustness: OLS, Tobit and the fractional response model (FRM). Because of the non-linear approaches used by Tobit and FRM, marginal effects have to be evaluated. They are computed as average marginal effects.

Because our sample has panel characteristics, firm fixed-effects are preferentially used to control for time-constant, unobserved effects. However, because of the non-linearity of Tobit and FRM, a dummy variable has to be estimated for each firm. This is not feasible for the relatively rare number of observations per firm. Furthermore, the incidental parameter problem applies. We therefore estimate correlated random effects (CRE) models, where the time average of the explanatory variables is added to the regression models (Papke and Wooldridge, 2008; Wooldridge, 2010; Cameron and Trivedi, 2005). Wooldridge (2010) argues that, for FRM models such as CRE models, specification can be applied for unbalanced panels through the addition of the average of the time dummy-variables to the regression.

5. Data and variables

We make use of the German IAB Establishment Panel (IAB-EP), which is a largely representative survey of German establishments that slightly oversamples larger establishments. Approximately 16,000 individual establishments are asked about labor-related issues on an annual basis; it also surveys economic establishment-specific variables such as revenues, innovation behavior and exports (as a fraction of total sales). From this data source, we also make use of establishment characteristics, such as the legal status and the modernization of equipment and machinery. We limit ourselves to establishments that earn revenue, because our theory relates to market-oriented establishments. Therefore, both the public and the financial sectors are excluded. We also exclude establishments that change industries and/or locations. Both cases seldom occur; therefore, any potential bias due to such exclusions is expected to be small. A final exclusion restriction relates to outliers: We estimate the FRM model including all control variables and exclude all observations that have been identified as outliers on the basis of Cook's D.

Although we know the exact regional location at the district level (NUTS3, German Kreise), the IAB Establishment Survey does not include information on the district itself. Because we are interested in intra-industrial regional influences on export success, we also make use of special sampling from the IAB Employment History Panel (IAB-EH). These data covers the entire population of employees in Germany whose work is subject to social security contributions. These are administrative data collected at the individual level, and they are highly reliable because individual social benefits, in the case of unemployment, and pensions are calculated from these data. The IAB-EH reports vast information on individuals, including gender, age, nationality, full-time/part-time employment, occupation, education, and the average daily gross wage rate as well as the region of the workplace, the industry of the job and the unique establishment number. Using the establishment identifier, we can uniquely relate individuals to the establishments surveyed in the IAB-EP. The special draw of the IAB-EH is that it is an aggregated database operating at the establishment level of all establishments in Germany. Thus, it covers the entire population. Because we also have information on the district and industry (2 digit, Classification WZ2003, which is equivalent to NACE Rev.1.1), we can aggregate across establishments at higher levels of aggregation.

Although the IAB-EP is not fully representative of the German economy, it is the only sample that is available in Germany which fits the research question regarding the identification of agglomeration economies on export behavior insofar as it can be uniquely linked to administrative data to generate a linked-employer-employee data set. Such a linkage allows the disentangling of establishment-specific factors from those emerging at higher hierarchical levels.

An important characteristic in the aggregation of individual employment periods to the establishment level of the IAB-EH is that it not only considers employment on a specific date (such as June 30 of each year) but it also aggregates daily employment within a year. Thus, we explicitly take seasonal employment fluctuations into account and therefore consider the total work volume. Additionally, we control for full-time and part-time workers and derive the annual establishment-specific work volume in full-time equivalents[1]. These employment data are then used to compute the following variables.

[1] Eickelpasch and Vogel (2011) analyze the impact of half-time work on exports and provide a negative estimate. The approach to estimate the workforce in this study already takes full-time versus part-time differences into account.

The log of total employment serves as proxy for establishment size and as a measure for internal increasing returns to scale. The log of revenues per capita (also measured in full-time equivalents) relates to the productivity of establishments in relation to overall productivity.

Following the seminal idea of Autor et al. (2003), the human capital measure used in this study relates to an advanced task-based approach that controls for job characteristics and formal qualification instead of formal qualifications in isolation. Such a concept has drawn attention particularly in the immigration literature, where recent studies provide evidence that immigrants sort themselves into specific jobs (Sparber and Peri, 2009; D´Amuri and Peri, 2014). Focusing on formal qualifications alone ignores consideration of over- and under-education, which has been shown to exist in the German labor market (Brunow and Hirte, 2009). Our definition of `human capital' is therefore built on the average time spent in analytical work (relative to analytical and manual work) and the time spent for non-routine work (relative to routine and non-routine work), whereas formal qualifications are measured as the proportion of university degree holders for single occupations. This classification has been previously used and is introduced in greater detail by Brunow and Nafts (2013), which, in turn, is an updated version of that suggested by Trax et al. (2012). We define highly skilled workers as people who are employed in occupations with large amounts of non-routine and analytical work and large proportions of graduates.

The following variables are derived from the IAB-EP as control variables: For the legal form, we introduce two dummy indicators that are set to one if the establishment is a sole trading company or a private partnership company, respectively. Therefore, the reference category is any type of capital-based company. We further introduce two dummy indicators for being a headquarters or a branch (office). The reference category therefore is "single-establishment-single-firm", which is the case for 70% of all observations. Thus, most of the establishments are single firms. Then, there is a dummy variable controlling whether the establishment has a foreign owner who may have an interest in highly productive firms that export to increase the owner's return. Lastly, there is a set of control dummy variables that relate to the modernization of the technology and machinery/equipment used in production. The categories range from newest to out-of-date equipment, with the former serving as the reference category.

From the IAB-EH, we construct the proportion of human capital employed, the number of employees measured in full-time equivalents over the entire year (and its squared value), the establishment's age categorized in three groups (0-4 years, 5-14 years, and 15 years and older, with the youngest group serving as the reference group). By means of the fractionalization

index, we control for occupational diversity separated by the two skill groups, the employment of migrants as proportions within each skill group and diversity over the distinct nationalities employed. A shortcoming of the IAB-EH is that we only observe first-generation migrants on the basis of nationality. However, because we expect that country-specific (foreign) knowledge is mostly present for first-wave immigrants, the limitation fits our research topic.

To characterize the regional environment, we make use of urbanization and location measures as suggested by Combes et al. (2004). Urbanization is measured by the log of the number of industries present in the region and inter-regional diversity as a fractionalization of establishments across the industries. The location measures employed are the log of the number of establishments of the same industry located in the region (and its spatially lagged values) and the proportion of human capital employed in all other establishments of that industry and region (and, again, its spatially lagged values).

Last, a labor productivity measure is constructed from both data sources. It is measured as the level of revenues divided by total employment in full-time equivalents for the entire year.

6. Descriptive analysis

Approximately 23% of all establishments export, and this proportion is nearly time constant. Considering exporters alone, the average proportion of exports relative to total sales is approximately 26.1%; the median value, however, is 20%. Only 10% of all exporters have an export share larger than 60%. Table 1 reports some descriptive statistics regarding economic variables of the establishment and its economic environment. In the left panel, only those establishments are considered that do not export, whereas on the right panel, the exporting establishments are summarized. These statistics show that exporters are on average more productive, are larger with respect to employment levels and employ a higher proportion of human capital. Interestingly, employment levels of human capital within the industry are also higher on average (15% vs. 19% for the value within the region and 14% vs. 17% in the surrounding regions). However, consideration of the number of competitors within the region and the surrounding areas reveals that exporters typically face less competition. However, this result has to be considered with care because it does not control for the intra-industrial location and distribution of competitors. Controlling for the means of the regional intra-industrial variables at the industry level reveals that exporters are located in industry-specific, concentrated areas, as theory suggests. Last, the urbanization measures are identical for both groups, indicating that there is no specific selectivity in space between exporting industries.

[Table 1 about here]

Table 2 shows some descriptive statistics regarding workforce diversity within establishments. Exporters employ a higher proportion of low-skilled jobs in production-related occupations. Additionally, the diversity in both skill groups among occupations is larger; exporters are larger in employment levels and therefore enjoy the possibility of higher diversity. Employment levels of non-Germans are also slightly larger for exporters, and cultural diversity is also higher.

[Table 2 about here]

For completeness, Table 3 shows the proportions of other control variables. Exporting is typically undertaken by capital-owned companies (87%) but not by sole traders or private companies. As reported in the literature review, risk aversion may explain this picture. Our sample suggests that foreign ownership is associated with export activities. Exporting companies seem to be relatively older, indicating some learning effects. Finally, exporters' equipment and machinery is relatively newer, but the differences are rather small.

[Table 3 about here]

The descriptive analysis provides a first look and partly supports the hypotheses. However, it only shows bivariate statistics; therefore, the next section presents and discusses the results of the regression analysis.

7. Results

Table 4 shows the results of the baseline specification. We report three different approaches. Columns 1, 2 and 4 report the estimated coefficients of the OLS, Tobit and FRM approaches, respectively, whereas columns 3 and 5 show the average marginal effects (AME) for the Tobit and FRM models, respectively. As has been argued, the FRM model is specifically designed for fractional response variables and therefore serves as the preferred model. OLS and Tobit are provided for comparison purposes. In all models, the fixed effects of time, industry and region are controlled for by means of dummy variables. Whereas the fixed effects of time control for unobserved temporary shocks, the fixed effects of industry and region control for unobserved heterogeneity and also serve to reduce endogeneity issues. The inclusion of the fixed effects of industry is important because we are interested, for instance, in the effect of

human capital. Some industries employ hardly any human capital (and do not export), whereas other industries employ human capital and exports. This variation is controlled for by the fixed effects of industry; therefore, the results are conditional on the average values within industries. A similar argument can be made for the fixed effects of region, i.e., rural areas vs. agglomeration areas. Additionally, the fixed effects of region partly control for the selectivity of establishments in space and their (past) location decision.

[Table 4 about here]

Irrespective of the models presented, all parameters are jointly significant, indicating the relevance of the included variables. This joint significance also holds when we compare the results as outlined in Table 4 with a 'constant-only' fixed-effects model that only takes the fixed effects of time, industry and region into account. Thus, the included variables significantly explain differences in the export proportions of individual establishments.

The estimated coefficients are in line with the expectations: more productive establishments have a higher propensity to export. The number of employees as a measure of establishment size provides a nonlinear but insignificant relationship. Although it is difficult to interpret because of the nonlinear nature of FRM models, the quadratic term for employment levels notably offers a positive sign. An investigation of sub-samples reveals a significant structure: positive linear or quadratic (see Tables 6 to 8). This indicates that there must be (weak) economies of scale in production, because we do not observe an inverted U-shaped pattern. Such economies of scale reflect increasing returns at the establishment level because of fixed costs, such as market entry costs for exporters, as the Melitz model suggests. A higher proportion of highly skilled workers employed also raises the fraction of sales abroad. This is in line with the findings of Love and Mansury (2009), who argue that human capital is involved in innovation processes such as the introduction of new products and especially in improvements in quality (Sjöholm, 2003). According to Gourlay et al. (2005), highly skilled workers may have experience with international markets, therefore, making exports more likely. The findings are thus far in line with hypothesis 1, which is supported. Because we also include the proportion of foreigners employed, we can add to the argument and analyze whether human capital from abroad secures export success. We find a significant and positive effect of the proportion of low- and high-skilled foreign workers as well as a positive effect of the diversity of foreigners for low-skilled foreign employees. Thus, different cultural backgrounds contribute positively to export success, as expected and also suggested by Ottaviano and Peri (2005). Peri and Sparber (2009) argue that low-skilled foreigners are typically those working in routine jobs with manual tasks (in the US). Because we already

control for tasks in the definition of low- and high-skilled workers, it might be that 'overeducated' migrants are employed in jobs that require fewer qualifications. Then, the proportion of low-skilled migrants and diversity might contribute positively to export success. However, if migrants work in jobs that relate solely to the production process, such a positive effect may not emerge, because interactions with other employees are weak or missing. This effect is controlled for by the proportion of production-related jobs being included in the regression. Not surprisingly, the more workers are employed in production-related jobs, the effect on exports is positive. This is in line with increasing returns in production. Thus, for two near-identical establishments, the one that employs more workers in occupations related to the production process achieves higher revenues abroad. Although this variable controls for the selectivity of foreign workers in the production process, we still find an additional effect of the proportion of low-skilled migrant workers and its diversity on exports. This finding indicates that this group provides additional knowledge on foreign habits, tastes, etc. to the establishment. Another form of workforce diversity is occupational diversity. As was the case for cultural diversity, occupational diversity increases the stock of distinct knowledge, and interaction of such knowledge within the firm increases the available stock of human capital (Ottaviano and Peri, 2005; Brunow and Nafts, 2013). For both skill groups, we provide evidence that occupational diversity is positively related to export success. The evidence on workforce diversity supports hypothesis 2: Workforce diversity enhances the knowledge base of the establishment and positively influences export proportions.

We now set our focus on urbanization and localization effects, starting with the former. Whereas the number of industries present in the region is insignificant, the distribution of establishments across these industries (measured by a fractionalization index) is significant. This indicates that a broader variety and diversity of products and services from other sectors increase incentives to export. An increase in the number of varieties of specific services available to the region, for instance, is associated with a cost advantage, because transaction costs are expected to decline. Thus, urbanization matters, which is in line with the hypothesis.

With regard to intra-industrial variables, we provide evidence for concentration effects and likely human capital spillover effects. Being located in the 'core' of an industry yields higher exports when the number of direct competitors is relatively larger. As theory suggests, in agglomerations, establishments can benefit from economies of scale at the industry level and therefore become more productive, which increases competitiveness and thus raises exports. Additionally, horizontal (within-industry) linkages in the production processes due to a broader supply of horizontally diverse and specialized products increases productivity and

therefore raises exports. Establishments located somewhere rather remote, on the other hand, cannot benefit from such increasing returns at the industry level; consequently, they may be local producers who are letting decline their incentives to export. Additionally, as theory suggests, market crowding may occur: less productive establishments are more 'remotely' located to avoid competition; in such a circumstance, exports again become less likely.

The other variable for intra-industrial spillover effects relates to the proportion of human capital employed in the other establishments within the region and industry. It is highly significant. Thus, not just pure concentration within the industry but also higher employment levels of human capital raise the incentive to export. Because the proportion of human capital employed is a proxy for innovativeness and knowledge-intensive production, the goods produced in such areas are new and competitive in global markets. Thus, such likely knowledge-based economies favor exportation.

For both variables, we also test a spatially lagged variable controlling for the number of establishments and the proportion of human capital employed in the surrounding regions. We additionally test for spatial heterogeneity, which is important because the regions are defined at a rather small scale (the NUTS3-level), despite the agglomeration effects' possibly having a wider range. Because both variables ultimately are significant, we conclude that not only being in a relatively larger intra-industrial area but also having the surrounding region offer relatively more competitors and employed human capital increases export proportions. Thus, regional spillover effects exist, and intra-industrial clustering favors exports. Based on the evidence, we conclude that hypothesis 4 is supported: localization and urbanization economies exist and are of importance for the export success of individual establishments.

Let us briefly consider the control variables. The legal status of the establishment reveals that capital-owned companies are more likely to have higher proportions of exports. One reason for this association is that individual traders in particular produce relatively more for domestic, and especially local, markets. Another reason is that exporting is risky and that, typically, individual traders and private partnership companies are less risk friendly, (in part) because their private capital can be used when obligations cannot be paid back. Foreign ownership is associated with higher export proportions, as suspected, because foreign owners may have an interest in higher dividends and returns, which can be achieved by expanding markets. We find no effect of being a branch (office) relative to the one-firm-one-establishment reference. Thus, there is no bias with regard to when firms have more than one plant. However, headquarters are less likely to have exports because they are specialized in

the organization of the company; therefore, their export volumes are smaller. Last, there is no effect of the establishment's age.

The results obtained so far relate to between-establishment correlations. It was argued that establishment effects may yield biased results. Although fixed effects are preferred, the models cannot be identified. Therefore, we present in Table 5 the results obtained when the time average of all variables is added to the regression. These results relate to the so-called correlated random effects (CRE) models. Here, the variables of interest relate to the within-establishment correlation, whereas the averaged variables relate to the between-establishment correlation. If the latter are significant, we can only state that there are between-establishment correlations, but we still have no information about where the between-establishment variation originates.

[Table 5 about here]

The results of that model indicate that the most important variables at the establishment level from a theoretical point of view remain significant: productivity, the number of employees and the human capital measure. However, most of the workforce diversity characteristics become insignificant, indicating that between-establishment variation explains export success, because the average variables remain significant.

The urbanization measures both become significant, indicating the importance of the regional industry mix. However, the localization variables are insignificant. This result is twofold: first, a change in the regional environment, e.g., establishment formation and closure, will not change the export behavior of individual establishments in a strong manner. Only strong local shocks will affect export behavior, but this does not appear in the data. Additionally, if there are spillover effects emerging at the industry level, the observed (small) changes in the regional environment do not reduce or increase spillover effects to a meaningful extent. Second, the implication might also reflect the location decision. Export-oriented establishments locate in intra-industrial cores—small changes in the environment do not affect export behavior. Last, the localization and urbanization measures relate to some external-to-the-establishment effects and characterize the spatial environment instead. For that reason, it is not surprising that the average variables (not shown) are positive and significant. Thus, unobserved heterogeneity explains the location decision and the export behavior.

The evidence shows the importance of theory-led factors in influencing exports. Although our findings are conditional on the fixed effects of industry and region, they are considered a pooled sample. We therefore split the sample and consider sub-samples in the following. This

provides deeper insights in parameter heterogeneity among groups. Because the FRM model is the preferred approach, we only report these models with and without controlling for unobserved heterogeneity.

Table 6 reports the results for manufacturing firms. The models for service firms do not converge because there seems to be too little variation that significantly explains export behavior. The finding for manufacturing establishments provides a quite similar picture to that of the entire sample. Changing labor productivity and employment size has a stronger effect, as expected, as manufacturing is more production related and economies of scale at the firm level become more pronounced. It also reflects that the German economy, especially the manufacturing sector, is export oriented. It is worth mentioning that knowledge spillover from within the industry can become significant when the establishment heterogeneity is controlled for (column 2 in Table 6), indicating that the individual establishment benefits from human-capital-intensive production in the region with respect to exports. Additionally, the diversity of occupations and distinct nationalities of the highly skilled workers promotes export success. Thus, a diverse, highly skilled workforce provides diverse knowledge and broadens the human capital basis.

[Table 6 about here]

In columns 3 and 4 of Table 6, the results are presented for those establishments that actually export. Thus, the decision about being an exporter is already met; therefore, we consider changes in export proportions. Increasing productivity remains significant and the quadratic term remains significant in the baseline model. Because the number of observations per establishment is rather small in the exporter subsample, the CRE approach may not be the best approach. Because of the positive and significant effects, we conclude that economies of scale in particular are important for export success. This is very much in line with theory, wherein fixed cost requirements for exporting exist. Additionally, workforce diversity is important, and establishments gain from urbanization and localization effects.

[Table 7 about here]

Table 7 compares establishments with respect to their employment size. Increasing returns to scale are of more importance for the ‘small’ establishments, and the effect of human capital is much larger for ‘large’ establishments on export proportions. Workforce diversity is also important, but the effect partly disappears when the CRE approach is considered. Focusing on the urbanization and localization effects reveals the importance of ‘small’ firms that benefit

from a diverse and intra-industrial agglomerated area. It is worth mentioning that, for 'small' establishments, intra-industrial concentration is important, whereas for 'large' firms the proportion of human capital in other establishments is relevant.

The urbanization and localization variables control for spatial heterogeneity and describe the location of each establishment. There might be a selectivity of establishments in space, which is uncontrolled here because the location decision of establishments is not considered (because establishment formation happened in the past). We therefore split the sample by macro-regions on the basis of a definition of regions provided by the German Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR). The classification assigns single regions (Kreise) to one of the three groups: agglomeration areas, urbanized areas and rural areas. The definition is mainly built on population density and centrality. The results are presented in Table 8. For agglomeration and urbanized areas, the results confirm the interpretation provided so far. Only in rural areas do most of the variables become insignificant, indicating that establishments in those regions have special characteristics that are uncontrolled.

[Table 8 about here]

To summarize the evidence, we find evidence for productivity, human capital effects and economies of scale in production and their positive impact on export proportions, which confirms hypothesis 1. We partly provide evidence for hypothesis 2: workforce diversity matters when between-establishment characteristics are considered, however, diversity among highly skilled employees' principally matters for subsamples in which the establishment heterogeneity is controlled for. Finally, the evidence suggests that urbanization and localization effects are present (hypotheses 3 and 4) and especially relevant for 'smaller' firms with employment levels up to 250 employees.

8. Conclusion

This paper analyses the export behavior of German establishments, with a twofold focus. As argued in the theoretical literature, productivity is a central and relevant determinant for export success (Melitz, 2003); workforce diversity is seen as a source for increasing productivity (Ottaviano and Peri, 2005). Therefore, we are interested in the effect of occupational and cultural diversity as a proxy for workforce diversity on export success. The other focus is set on localization and urbanization economies, because in the presence of (positive) externalities, establishments can be more productive when they are located in a

stimulating environment. The dependent variable is the proportion of exports relative to total sales as a measure of export orientation. While controlling for a variety of establishment characteristics, such as age, legal form and equipment/machinery, we make use of fixed effects of region, industry and time to control for unobserved effects at the industry and regional levels. We also control for unobserved heterogeneity at the establishment level by means of a CRE approach (Wooldridge, 2010(b)). Our evidence suggests that workforce diversity significantly explains exports, when the between-establishment variation is not absorbed by means of the CRE approach. The effects of workforce diversity vanishes when establishment heterogeneity is considered for the entire sample. This lets us conclude that workforce diversity is relevant for export success, but it remains unclear why some establishments are more diverse than others. However, the workforce diversity of highly skilled employees remains partly significant when only manufacturing and exporting establishments are considered. Because manufacturing establishments produce products for the export market, we can conclude that, at least for manufacturing establishments, workforce diversity among the highly skilled significantly improve export success, even after controlling for heterogeneity. We conclude that different problem-solving abilities, distinct knowledge and interactions among diverse workers within the establishment, exist which significantly contribute to export success.

Regarding the externalities, we provide evidence of urbanization, localization and human capital spillover effects when the between-establishment correlation is taken into account. When controlling for establishment heterogeneity, the effects of the localization economies vanish; this is not surprising as those effects are rather time constant and, in a sense, external to the establishment. Thus, they only indirectly affect factor productivity and therefore overall productivity which is already controlled for and remains significant. As was the case for workforce diversity, externalities are still present for the subsample of manufacturing firms, when heterogeneity is controlled for. Establishments especially benefit from urbanization and human capital-related externalities. Our evidence also suggests that establishments with employment levels up to 250 employees benefit from externalities. Due to specialized products (and services), the necessity of externalities is important for export success, and it also links to the upstreaming industries. Finally, as region fixed effects are considered in any estimation, the results are not biased due to unobserved regional heterogeneity.

To conclude, more productive, larger firms that employ a higher fraction of human capital are more prone to export; which supports hypothesis 1. Higher proportions of export are associated with establishments employing a diverse workforce, when the between-

establishment variation is considered. Controlling for heterogeneity among establishments lets us conclude that employing a more diverse workforce only significantly raises exports for manufacturing and exporting establishments. Thus, hypothesis 2 is partly supported. Finally, we find evidence of localization and urbanization effects, which support hypotheses 3 and 4. Smaller establishments and manufacturing establishments benefit from externalities most.

For policy makers our evidence suggests that intra-industrial concentration may achieve (regional) gains, when especially manufacturing firms are attracted. Additionally, supporting network activities at the regional level that makes urbanization effects more pronounced are supportive when the local's economy aim is export orientation.

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Table 1: Descriptive statistics of focus variables

	Domestic producers		Exporters	
	Mean	s.d.	Mean	s.d.
ln (labour productivity)	5.86	(0.90)	6.18	(0.81)
ln (employees)	7.86	(1.74)	9.7	(1.73)
prop. human capital	10%	(0.20)	19%	(0.21)
prop. human capital in i and r	15%	(0.13)	19%	(0.15)
W prop. human capital in i and r	14%	(0.10)	17%	(0.11)
ln(No. establishments in i and r)	5.52	(1.65)	4.25	(1.67)
W ln(No. establishments in i and r)	62.63	(31.9)	46.51	(27.01)
ln(No. of industries in r)	3.97	(0.05)	3.97	(0.05)
frac. over industries in r	0.93	(0.01)	0.93	(0.01)

Note: Descriptives provided for the year 2009; $N_{domestic}$=5,862; N_{export}=1,944.

Table 2: Descriptive statistics of workforce diversity related variables

	Domestic producers	Exporters
prop. production related jobs	40%	56%
frac. occupational diversity low-skilled	0.29	0.54
frac. occupational diversity high-skilled	0.12	0.41
prop. foreigners among low-skilled	3%	5%
prop. foreigners among high-skilled	1%	2%
frac. foreigners among low-skilled	0.08	0.22
frac. foreigners among high-skilled	0.02	0.07

Note: Descriptives provided for the year 2009; $N_{domestic}$=5,862; N_{export}=1,944

Table 3: Descriptive statistics of control variables

	Domestic producers	Exporters
Proportion sole traders	43%	9%
Proportion private company	6%	4%
Proportion capital owned companies	51%	87%
Proportion branch (office)	3%	10%
Proportion headquarters	8%	15%
D foreign owner	2%	11%
Establ. age <5 years	18%	9%
Establ. age 5-14 years	21%	17%
Establ. age 15years and more	61%	74%
Proportion newest equipment	18%	19%
Proportion new equipment	48%	52%
Proportion older equipment	30%	26%
Proportion out-of-date equipment	4%	3%

Note: Descriptives provided for the year 2009; $N_{domestic}$=5,862; N_{export}=1,944

Table 4: Proportion of exports; baseline specification

	OLS	Tobit		FRM	
	Coeff. (1)	Coeff. (2)	AME (3)	Coeff. (4)	AME (5)
ln (labour productivity)	0.016***	0.073***	0.014***	0.213***	0.017***
	(0.003)	(0.009)	(0.002)	(0.021)	(0.002)
ln (employees)	-0.056***	-0.009	-0.002	-0.011	-0.001
	(0.015)	(0.028)	(0.006)	(0.077)	(0.006)
ln(employees)²	0.004***	0.002	0.000	0.006	0.000
	(0.001)	(0.001)	(0.000)	(0.004)	(0.000)
prop. human capital	0.044**	0.175***	0.035***	0.613***	0.049***
	(0.018)	(0.036)	(0.007)	(0.106)	(0.008)
D sole trader	0.008	-0.060***	-0.012***	-0.226***	-0.018***
	(0.005)	(0.014)	(0.003)	(0.042)	(0.003)
D private company	0.000	-0.018**	-0.004**	-0.102***	-0.008***
	(0.003)	(0.009)	(0.002)	(0.022)	(0.002)
D branch (office)	0.002	-0.010	-0.002	-0.035	-0.003
	(0.006)	(0.009)	(0.002)	(0.027)	(0.002)
D headquarter	-0.009**	-0.049***	-0.010***	-0.112***	-0.009***
	(0.004)	(0.012)	(0.002)	(0.030)	(0.002)
D foreign owner	0.098***	0.127***	0.025***	0.331***	0.027***
	(0.013)	(0.013)	(0.002)	(0.032)	(0.003)
Establ. age 5-14 years	-0.001	0.002	0.000	0.021	0.002
	(0.002)	(0.008)	(0.002)	(0.023)	(0.002)
Establ. age 15years and more	0.004	0.002	0.000	0.023	0.002
	(0.002)	(0.008)	(0.002)	(0.021)	(0.002)
D new equipment	-0.003	-0.005	-0.001	-0.023	-0.002
	(0.002)	(0.005)	(0.001)	(0.015)	(0.001)
D older equipment	-0.003	-0.004	-0.001	-0.010	-0.001
	(0.003)	(0.007)	(0.001)	(0.022)	(0.002)
D out-of-date equipment	-0.011**	-0.019	-0.004	-0.088**	-0.007**
	(0.004)	(0.012)	(0.002)	(0.039)	(0.003)
prop. production related jobs	0.005	0.047*	0.009*	0.197***	0.016***
	(0.007)	(0.024)	(0.005)	(0.070)	(0.006)
frac. occupational diversity low-skilled	0.035***	0.144***	0.028***	0.437***	0.035***
	(0.011)	(0.027)	(0.005)	(0.075)	(0.006)
frac. occupational diversity high-skilled	0.042***	0.137***	0.027***	0.401***	0.032***
	(0.012)	(0.021)	(0.004)	(0.066)	(0.005)
prop. foreigners among low-skilled	0.017	0.094**	0.019**	0.320***	0.026***
	(0.016)	(0.045)	(0.009)	(0.121)	(0.010)
prop. foreigners among high-skilled	0.010	0.090**	0.018**	0.405***	0.033***
	(0.013)	(0.035)	(0.007)	(0.102)	(0.008)
frac. foreigners among low-skilled	0.023**	0.033**	0.006**	0.141***	0.011***
	(0.010)	(0.016)	(0.003)	(0.038)	(0.003)
frac. foreigners among high-skilled	0.082***	0.044*	0.009*	0.089	0.007
	(0.023)	(0.025)	(0.005)	(0.055)	(0.004)
ln(No. of industries in r)	0.041	0.070	0.014	0.467	0.038
	(0.027)	(0.114)	(0.023)	(0.319)	(0.025)
frac. over industries in r	0.552	3.906***	0.773***	9.795***	0.790***
	(0.342)	(0.946)	(0.187)	(3.134)	(0.254)
ln(No. establishments in i and r)	0.013***	0.024***	0.005***	0.048**	0.004**
	(0.004)	(0.008)	(0.002)	(0.020)	(0.002)
W ln(No. establishments in i and r)	-0.001***	-0.001***	-0.000***	-0.003***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
prop. human capital in i and r	0.066***	0.131***	0.026***	0.335***	0.027***
	(0.022)	(0.040)	(0.008)	(0.120)	(0.010)
W prop. human capital in i and r	0.165**	0.229*	0.045*	0.665**	0.054**
	(0.066)	(0.120)	(0.024)	(0.330)	(0.027)
Constant	-0.657	-4.869***		-15.13***	
	(50.284)	(0.813)		(2.774)	

Note: N= 106,727; cluster robust s.e. in () at industry level (58 cluster); * p<.1; ** p<.05; *** p<.01; D.. dummy, frac. Fractionalization index, prop. proportion, i.. industry, r..region (NUTS 3); Time, industry and region FE included; FRM Fractional Response Model.

Table 5: Proportion of exports; CRE approach

	OLS	Tobit		FRM	
	Coeff. (1)	Coeff. (2)	AME (3)	Coeff. (4)	AME (5)
ln (labour productivity)	0.012***	0.046***	0.147***	0.008***	0.012***
	(0.003)	(0.005)	(0.012)	(0.001)	(0.001)
ln (employees)	-0.002	0.052***	0.175**	0.009***	0.014**
	(0.005)	(0.019)	(0.071)	(0.003)	(0.006)
ln(employees)²	0.001**	-0.000	-0.002	-0.000	-0.000
	(0.000)	(0.001)	(0.004)	(0.000)	(0.000)
prop. human capital	0.018**	0.052	0.190*	0.009	0.015*
	(0.008)	(0.038)	(0.105)	(0.007)	(0.008)
D sole trader	-0.009**	-0.027*	-0.109*	-0.005*	-0.009*
	(0.004)	(0.015)	(0.060)	(0.003)	(0.005)
D private company	-0.011**	-0.019*	-0.080**	-0.003*	-0.006**
	(0.005)	(0.010)	(0.033)	(0.002)	(0.003)
D branch (office)	-0.004	-0.009*	-0.032*	-0.002*	-0.003*
	(0.002)	(0.005)	(0.017)	(0.001)	(0.001)
D headquarter	-0.003*	-0.010**	-0.040***	-0.002**	-0.003***
	(0.002)	(0.004)	(0.012)	(0.001)	(0.001)
D foreign owner	0.019*	0.015	0.066*	0.003	0.005*
	(0.010)	(0.013)	(0.038)	(0.002)	(0.003)
Establ. age 5-14 years	0.005**	0.027***	0.097***	0.005***	0.008***
	(0.002)	(0.007)	(0.024)	(0.001)	(0.002)
Establ. age 15years and more	0.008***	0.032***	0.112***	0.006***	0.009***
	(0.002)	(0.008)	(0.024)	(0.001)	(0.002)
D new equipment	-0.000	0.003	0.009	0.001	0.001
	(0.001)	(0.003)	(0.010)	(0.001)	(0.001)
D older equipment	-0.001	-0.000	-0.002	-0.000	-0.000
	(0.001)	(0.004)	(0.012)	(0.001)	(0.001)
D out-of-date equipment	-0.008	-0.022	-0.103*	-0.004	-0.008*
	(0.005)	(0.015)	(0.056)	(0.003)	(0.004)
prop. production related jobs	0.004	0.007	0.089*	0.001	0.007*
	(0.002)	(0.015)	(0.052)	(0.003)	(0.004)
frac. occupational diversity low-skilled	0.002	0.022	0.060	0.004	0.005
	(0.003)	(0.019)	(0.064)	(0.003)	(0.005)
frac. occupational diversity high-skilled	0.004	0.019	0.053	0.003	0.004
	(0.005)	(0.017)	(0.057)	(0.003)	(0.005)
prop. foreigners among low-skilled	-0.002	0.026	0.170**	0.005	0.014**
	(0.005)	(0.026)	(0.083)	(0.005)	(0.007)
prop. foreigners among high-skilled	0.011	0.044	0.154	0.008	0.012
	(0.008)	(0.028)	(0.094)	(0.005)	(0.008)
frac. foreigners among low-skilled	0.007**	0.014*	0.034	0.002*	0.003
	(0.003)	(0.007)	(0.022)	(0.001)	(0.002)
frac. foreigners among high-skilled	0.009	0.007	0.022	0.001	0.002
	(0.006)	(0.011)	(0.030)	(0.002)	(0.002)
ln(No. of industries in r)	0.046**	0.123*	0.495***	0.022*	0.040***
	(0.018)	(0.066)	(0.178)	(0.012)	(0.014)
frac. over industries in r	0.424*	2.318***	6.468***	0.413***	0.520***
	(0.230)	(0.777)	(2.282)	(0.140)	(0.184)
ln(No. establishments in i and r)	-0.008	-0.025*	-0.076	-0.005*	-0.006
	(0.006)	(0.015)	(0.051)	(0.003)	(0.004)
W ln(No. establishments in i and r)	0.001	0.003*	0.007	0.001*	0.001
	(0.001)	(0.002)	(0.006)	(0.000)	(0.000)
prop. human capital in i and r	0.028	0.049	0.203	0.009	0.016
	(0.018)	(0.040)	(0.127)	(0.007)	(0.010)
W prop. human capital in i and r	0.128**	0.069	0.522	0.012	0.042
	(0.055)	(0.124)	(0.405)	(0.022)	(0.032)
Constant	-0.826	-5.876***	-17.95***		
	(.)	(1.603)	(5.479)		

Note: N= 106,727; cluster robust s.e. in () at industry level (58 cluster); * p<.1; ** p<.05; *** p<.01; D.. dummy, frac. Fractionalization index, prop. proportion, i.. industry, r..region (NUTS 3); Time, industry and region FE included

Table 6: Fractional Response models for Manufacturing and Exporters only

all: average	Manufacturing		Exporters only	
marginal effects	Base (1)	CRE (2)	Base (3)	CRE (4)
ln (labour productivity)	0.040***	0.029***	0.037***	0.033***
	(0.004)	(0.003)	(0.004)	(0.004)
ln (employees)	0.053***	0.059**	-0.068***	0.015
	(0.009)	(0.024)	(0.014)	(0.024)
ln(employees)²	-0.001***	-0.002	0.004***	0.000
	(0.000)	(0.001)	(0.001)	(0.001)
prop. human capital	0.139***	0.035	0.121***	0.057*
	(0.026)	(0.025)	(0.031)	(0.033)
D sole trader	-0.045***	-0.020	-0.021**	-0.030**
	(0.005)	(0.012)	(0.009)	(0.015)
D private company	-0.018***	-0.014**	-0.032***	-0.025***
	(0.004)	(0.007)	(0.007)	(0.008)
D branch (office)	-0.002	-0.004	-0.009	-0.010**
	(0.006)	(0.004)	(0.006)	(0.004)
D headquarter	-0.013***	-0.005***	-0.009	-0.011**
	(0.004)	(0.002)	(0.006)	(0.004)
D foreign owner	0.049***	0.012	0.072***	0.031**
	(0.006)	(0.008)	(0.008)	(0.012)
Establ. age 5-14 years	0.005	0.016***	0.000	0.018**
	(0.005)	(0.006)	(0.006)	(0.009)
Establ. age 15years and more	0.008*	0.019***	0.001	0.024***
	(0.004)	(0.005)	(0.005)	(0.008)
D new equipment	-0.005	-0.001	-0.010**	0.002
	(0.003)	(0.002)	(0.004)	(0.003)
D older equipment	0.002	-0.002	-0.006	0.000
	(0.004)	(0.002)	(0.007)	(0.004)
D out-of-date equipment	-0.004	-0.016	-0.041***	-0.029*
	(0.007)	(0.011)	(0.010)	(0.016)
prop. production related jobs	0.041***	0.023*	0.054***	0.044**
	(0.014)	(0.012)	(0.015)	(0.019)
frac. occupational diversity low-skilled	0.081***	0.008	0.053***	0.003
	(0.017)	(0.023)	(0.016)	(0.022)
frac. occupational diversity high-skilled	0.063***	0.019***	0.060***	0.005
	(0.011)	(0.006)	(0.014)	(0.017)
prop. foreigners among low-skilled	0.050*	0.015	0.028	0.011
	(0.027)	(0.028)	(0.032)	(0.033)
prop. foreigners among high-skilled	0.072***	0.030	0.109***	0.037*
	(0.022)	(0.026)	(0.029)	(0.022)
frac. foreigners among low-skilled	0.039***	0.009**	0.044***	0.009
	(0.008)	(0.004)	(0.012)	(0.009)
frac. foreigners among high-skilled	0.008	0.002	0.035***	0.003
	(0.008)	(0.006)	(0.013)	(0.008)
ln(No. of industries in r)	0.153***	0.107***	0.110	0.075
	(0.054)	(0.038)	(0.072)	(0.053)
frac. over industries in r	1.385**	0.965**	0.713	1.005
	(0.701)	(0.472)	(0.896)	(0.842)
ln(No. establishments in i and r)	0.008*	-0.003	0.008*	-0.017
	(0.005)	(0.011)	(0.004)	(0.016)
W ln(No. establishments in i and r)	-0.000	-0.001	-0.001**	0.000
	(0.000)	(0.001)	(0.000)	(0.002)
prop. human capital in i and r	0.043	0.050*	0.062*	0.067
	(0.028)	(0.028)	(0.034)	(0.041)
W prop. human capital in i and r	0.141**	0.151*	0.121	0.261*
	(0.063)	(0.089)	(0.108)	(0.135)
Average X's included	no	yes	no	yes

Note: cluster robust s.e. in () at industry level; * p<.1; ** p<.05; *** p<.01; D.. dummy, frac. Fractionalization index, prop. proportion, i.. industry, r..region (NUTS 3); Time, industry and region FE included

Table 7: Fractional Response models for different establishment size's

all: average	Employment <=250		Employment >250	
marginal effects	Base (1)	CRE (2)	Base (3)	CRE (4)
ln (labour productivity)	0.013***	0.010***	0.043***	0.034***
	(0.001)	(0.001)	(0.007)	(0.009)
ln (employees)	-0.011*	0.004	-0.080	-0.020
	(0.006)	(0.005)	(0.111)	(0.116)
ln(employees)²	0.001***	0.000	0.004	0.001
	(0.000)	(0.000)	(0.004)	(0.005)
prop. human capital	0.033***	0.011*	0.267***	0.239**
	(0.006)	(0.007)	(0.046)	(0.103)
D sole trader	-0.016***	-0.009**	-0.045	0.001
	(0.003)	(0.004)	(0.045)	(0.032)
D private company	-0.007***	-0.008***	-0.027***	0.010
	(0.002)	(0.003)	(0.011)	(0.009)
D branch (office)	-0.007***	-0.003**	0.016***	-0.000
	(0.002)	(0.001)	(0.005)	(0.004)
D headquarter	-0.010***	-0.004***	-0.007	0.003
	(0.002)	(0.001)	(0.009)	(0.005)
D foreign owner	0.024***	0.008**	0.047***	-0.010
	(0.002)	(0.003)	(0.011)	(0.010)
Establ. age 5-14 years	0.001	0.007***	0.010	0.009
	(0.001)	(0.002)	(0.016)	(0.014)
Establ. age 15years and more	0.001	0.008***	0.032*	0.019
	(0.001)	(0.002)	(0.018)	(0.020)
D new equipment	0.000	0.001	-0.015***	0.002
	(0.001)	(0.001)	(0.004)	(0.004)
D older equipment	0.000	-0.001	-0.001	0.011*
	(0.001)	(0.001)	(0.006)	(0.006)
D out-of-date equipment	-0.005*	-0.007**	-0.017	-0.001
	(0.003)	(0.003)	(0.019)	(0.021)
prop. production related jobs	0.009**	0.005	0.164***	0.108**
	(0.004)	(0.004)	(0.027)	(0.053)
frac. occupational diversity low-skilled	0.028***	0.002	0.112***	0.047
	(0.005)	(0.004)	(0.031)	(0.088)
frac. occupational diversity high-skilled	0.027***	0.002	0.065**	0.123**
	(0.004)	(0.004)	(0.033)	(0.048)
prop. foreigners among low-skilled	0.018**	0.006	0.099***	0.207***
	(0.008)	(0.005)	(0.037)	(0.074)
prop. foreigners among high-skilled	0.025***	0.009	0.104	0.019
	(0.007)	(0.006)	(0.106)	(0.103)
frac. foreigners among low-skilled	0.007**	0.002	0.055***	0.000
	(0.003)	(0.002)	(0.016)	(0.017)
frac. foreigners among high-skilled	0.006	0.000	0.018	-0.005
	(0.004)	(0.003)	(0.017)	(0.009)
ln(No. of industries in r)	0.035	0.031**	0.057	0.129*
	(0.025)	(0.014)	(0.080)	(0.069)
frac. over industries in r	0.653***	0.535***	1.355	0.101
	(0.207)	(0.179)	(1.477)	(1.241)
ln(No. establishments in i and r)	0.004***	-0.007**	-0.006	0.003
	(0.001)	(0.003)	(0.008)	(0.018)
W ln(No. establishments in i and r)	-0.000**	0.001*	0.000	-0.002
	(0.000)	(0.000)	(0.000)	(0.003)
prop. human capital in i and r	0.021***	0.004	0.077*	0.104**
	(0.007)	(0.010)	(0.042)	(0.049)
W prop. human capital in i and r	0.042*	0.036	0.246*	0.096
	(0.024)	(0.030)	(0.130)	(0.219)
Average X's included	no	yes	no	yes

Note: cluster robust s.e. in () at industry level; * p<.1; ** p<.05; *** p<.01; D.. dummy, frac. Fractionalization index, prop. proportion, i.. industry, r..region (NUTS 3); Time, industry and region FE included

Table 8: Fractional Response models for establishments depending on their regional location

all: average	Agglomeration areas		Urbanized areas		Rural areas	
marginal effects	Base (1)	CRE (2)	Base (3)	CRE (4)	Base (5)	CRE (6)
ln (labour productivity)	0.016***	0.011***	0.020***	0.011***	0.0148***	0.012***
	(0.002)	(0.001)	(0.0031)	(0.0030)	(0.0021)	(0.002)
ln (employees)	-0.007	0.003	-0.018**	0.006	0.0004	0.011
	(0.007)	(0.007)	(0.0088)	(0.0087)	(0.0065)	(0.013)
ln(employees)²	0.001*	0.000	0.001***	0.000	0.0006*	0.000
	(0.000)	(0.000)	(0.0004)	(0.0005)	(0.0003)	(0.001)
prop. human capital	0.056***	0.021*	0.057***	-0.018	0.0288**	0.010
	(0.009)	(0.012)	(0.0155)	(0.0229)	(0.0127)	(0.015)
D sole trader	-0.021***	-0.014	-0.014*	-0.004	-0.0191***	-0.010
	(0.004)	(0.011)	(0.0079)	(0.0066)	(0.0048)	(0.008)
D private company	-0.010***	-0.009**	-0.005	0.012***	-0.0079	-0.014**
	(0.003)	(0.004)	(0.0051)	(0.0045)	(0.0055)	(0.006)
D branch (office)	-0.002	-0.001	0.001	0.000	-0.0097*	-0.003
	(0.002)	(0.002)	(0.0043)	(0.0019)	(0.0037)	(0.002)
D headquarter	-0.011***	-0.004***	-0.006	0.003	-0.0057	-0.005**
	(0.003)	(0.001)	(0.0045)	(0.0021)	(0.0036)	(0.002)
D foreign owner	0.023***	0.010***	0.039***	-0.004	0.0235***	0.012***
	(0.003)	(0.004)	(0.0050)	(0.0065)	(0.0052)	(0.003)
Establ. age 5-14 years	0.007**	0.010***	-0.009**	0.005	-0.0019	0.001
	(0.003)	(0.003)	(0.0040)	(0.0033)	(0.0025)	(0.002)
Establ. age 15years and more	0.007**	0.010***	-0.013***	0.005	-0.003	0.002
	(0.003)	(0.003)	(0.0044)	(0.0036)	(0.0024)	(0.003)
D new equipment	-0.001	-0.000	-0.006**	0.000	0.0007	0.002
	(0.002)	(0.001)	(0.0029)	(0.0018)	(0.0021)	(0.001)
D older equipment	0.002	0.001	-0.008**	-0.000	0.0008	-0.000
	(0.002)	(0.002)	(0.0035)	(0.0022)	(0.0031)	(0.002)
D out-of-date equipment	-0.007*	-0.007	-0.000	-0.004	-0.0014	-0.010
	(0.004)	(0.005)	(0.0064)	(0.0055)	(0.0056)	(0.006)
prop. production related jobs	0.014**	0.011**	0.009	-0.007	0.0094	0.001
	(0.006)	(0.005)	(0.0091)	(0.0065)	(0.0092)	(0.009)
frac. occupational diversity low-skilled	0.045***	0.004	0.028***	0.014	0.0128**	-0.003
	(0.007)	(0.007)	(0.0108)	(0.0090)	(0.0059)	(0.009)
frac. occupational diversity high-skilled	0.034***	0.006	0.044***	-0.007	0.0243***	0.005
	(0.007)	(0.006)	(0.0076)	(0.0083)	(0.0068)	(0.006)
prop. foreigners among low-skilled	0.025***	0.013	0.077**	-0.020	0.0130	-0.038**
	(0.009)	(0.008)	(0.0320)	(0.0162)	(0.0190)	(0.017)
prop. foreigners among high-skilled	0.020*	0.013	0.087***	0.047**	0.0538***	0.014
	(0.010)	(0.012)	(0.0257)	(0.0195)	(0.0198)	(0.019)
frac. foreigners among low-skilled	0.016***	0.001	0.016***	0.007	-0.0011	-0.001
	(0.005)	(0.003)	(0.0058)	(0.0042)	(0.0049)	(0.004)
frac. foreigners among high-skilled	0.009	-0.005**	-0.002	0.009	0.0151	0.002
	(0.006)	(0.003)	(0.0089)	(0.0056)	(0.0092)	(0.007)
ln(No. of industries in r)	-0.005	-0.001	0.034	0.067	0.0817*	0.038
	(0.031)	(0.030)	(0.0474)	(0.0447)	(0.0455)	(0.029)
frac. over industries in r	1.268**	0.774*	0.365	0.447	0.7695*	0.122
	(0.502)	(0.448)	(0.5134)	(0.3532)	(0.4155)	(0.362)
ln(No. establishments in i and r)	0.003*	-0.003	0.009***	-0.019**	0.0071**	0.001
	(0.002)	(0.006)	(0.0027)	(0.0084)	(0.0032)	(0.006)
W ln(No. establishments in i and r)	-0.000***	0.000	-0.001***	0.001	-0.0004*	-0.001
	(0.000)	(0.001)	(0.0002)	(0.0012)	(0.0002)	(0.001)
prop. human capital in i and r	0.046***	0.019	0.019	-0.007	0.0174	-0.002
	(0.014)	(0.014)	(0.0179)	(0.0192)	(0.0131)	(0.015)
W prop. human capital in i and r	0.015	-0.058	0.143*	0.066	0.0161	0.158*
	(0.044)	(0.048)	(0.0752)	(0.0917)	(0.0512)	(0.087)
Average X's included	no	yes	no	yes	no	yes

Note: cluster robust s.e. in () at industry level; * p<.1; ** p<.05; *** p<.01; D.. dummy, frac. Fractionalization index, prop. proportion, i.. industry, r..region (NUTS 3); Time, industry and region FE included