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Abstract

There is evidence from the literature that firms enjoy higher productivity levels when the workforce employed is culturally more diverse. It is an open question whether this gain is utilized to shift the supply curve and set lower prices, in order to achieve a higher demand and possibly higher revenues. This knowledge gap is not addressed in the existing literature, and forms the departure of our research. We introduce a reduced-form model, inspired by the study of Melitz and Ottaviano (2008) on heterogeneous firms, and add labour productivity by using the approach of Ottaviano and Peri (2005) on cultural diversity.

In our empirical study, we employ German data, while the field of research is conducted for single plants, and industry-specific effects are taken into account. Our analysis shows significant positive effects of the cultural diversity of the high-skilled workforce on the market size of single establishments. We conclude that emerging productivity gains are not just paid as dividend or factor rewards but are also used to set lower prices in order to achieve higher demand.

Keywords: cultural diversity, firm heterogeneity, market size

JEL: J15, L11, L25, R12

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1. Introduction

We live in the age of migration, worldwide and in Germany. Because of immigration waves to Germany in the past few decades, and most recently the freedom of workplace choice within the European Union, the German labour supply has become increasingly culturally diverse. There is evidence for German regions and firms that a culturally diverse workforce yields productivity gains. For instance, Südekum et al. (2009) focus on the regional aspects of the influence of immigration on wages, and find positive effects for natives, as long as natives and migrants do not compete for jobs. Niebuhr (2010) and Ozgen et al. (2011b) provide evidence that research outcomes are positively related to the cultural diversity of high-skilled employees. Another study of Brunow and Blien (2011) analyses the impact of cultural diversity on plants' productivity. They show that the positive effects exceed the negative effects on average, so that the net effect of diversity is still positive for most establishments. Employing non-Germans may then give single plants a comparative advantage. So the question is: do they also set lower prices and increase total demand? This micro-economic channel is not addressed in the existing literature. This paper focuses on the above mentioned issue and adds to the literature that focuses on the effects of cultural diversity.

Firm heterogeneity in sectors yields different outcomes of productivity and revenues. Thus, the classical assumption of representative firms is invalid for empirical investigations. In our study we therefore employ a reduced-form equation of the heterogeneity model introduced by Melitz and Ottaviano (2003) and treat cultural diversity as in Ottaviano and Peri (2005). We use German plant data, and provide evidence that especially high-skilled employment gives single establishments a productivity advantage and increases their market size. Diversity of low-skilled employment appears to yield neither productivity gains nor losses. Furthermore, we do not find negative net effects of cultural diversity.

The structure of our study is as follows. Section 2 introduces the reduced-form equation from a theoretical perspective, and formulates research hypotheses. Section 3 then focuses on the data basis, describes the variables under consideration, and gives a brief descriptive overview. Section 4 provides multivariate regression results and discusses the impact of cultural diversity on plant productivity and revenues. Finally, Section 5 makes some concluding remarks.

2. Theoretical Background

Classical trade and growth theory typically reduces the economy to a two-consumption goods, two-regions, and two-production factors world. Even those strong assumptions explain fundamental patterns of trade and growth, and, on an aggregate level empirical evidence supports the general mechanisms; the models rely on the restricting assumption of representative firms. There is, however, evidence of the heterogeneity of both firms and export behaviour, and of differences in production technology and in marginal costs, even when firms operate in the same (disaggregated) sector or industry. ‘Newer’ theoretical work relaxes the assumption of representative firms. One of these models is the approach of Melitz and Ottaviano (2008) that considers firm heterogeneity emerging from research and development activities. Then, improvements in production technology lead to efficiency gains within single firms. It emerges that produced quantity, revenues and profits are higher for more productive firms, even if those firms set higher mark-ups on marginal cost. This is so because the competitive advantage shifts the supply curve, and allows the productive firms to set relative lower prices compared with less productive firms, and the lower price raises demand.

Despite ‘hard production factors’ based on innovation and technology, ‘soft production factors’ might also lead to comparative advantages. In the last couple of years a branch of literature has appeared that focuses in particular on the impact of cultural diversity on productivity of establishments, research activities, and on consumption amenities. For instance, Brunow and Blien (2011) provide evidence that a single establishment employs less labour when the degree of cultural diversity increases. Their research is inspired by neoclassical production technology, and cultural diversity is modelled as suggested by Ottaviano and Peri (2005). A limitation of the chosen approach is the missing link between the productivity gain from cultural diversity and the establishment’s product demand. A main question remains: Does the productivity advantage of a culturally diverse workforce lead to lower prices, and therefore to higher demand, and, finally, to higher revenues as the model of Melitz and Ottaviano (2008) predicts? Or do employees achieve higher wages and shareholders a higher dividend, such that the price-demand-revenue mechanism is unaffected?

We take the theoretical result of Melitz and Ottaviano (2008) and the empirical finding of Brunow and Blien (2011) as the starting point of our research. Because we will compare firms, our research is conducted on a sector level. Consider a firm n producing in region r and sector i which possesses unit labour costs c_{ni}. Labour is the only input in production in the model of Melitz and Ottaviano (2008). Households demand features 'love-for-variety' for single products produced exclusively by different firms. They apply a quasi-linear utility specification which offers the advantage of a flexible elasticity of substitution along the demand curves. Before a firm enters the market, research and development activities yield an uncertain value of c_{ni}, which finally leads to firm heterogeneity. A firm starts to produce if there are at least zero profits. Maximizing households' utility and equalizing the resulting product demand of firms with its product supply, referring to Melitz and Ottaviano (2008), the reduced form of revenues $R_{ri}^{n}(c_{ni})$ may be expressed as a function of total regional population L_r, some parameter of households utility function γ_i, and a productivity cutting value c_D^{ri}:

$$R_{ri}^{n}(c_{ni}) = \frac{L_r}{4\gamma_i}\left(\left(c_D^{ri}\right)^2 - {c_{ni}}^2\right), \tag{1}$$

where c_D^{ri} describes the level of unit labour cost that raises a firm's price to such a level that the resulting household demand is driven to zero, implying $0 < c_{ni} \leq c_D^{ri}$ to produce at all. If a firm is relatively more productive than others, which means relatively lower values of c_{ni}, then the productivity differential increases, and salaries increase as well. This relatively simple theoretical derived equation for a firm's revenue already includes the supply shift – demand – price – relation, and therefore is compatible with our research question.

The formulation also controls for market size: Salaries are higher in bigger markets. Thus, the revenues of a firm may be solely expressed as a function of market size, and the firm has a specific productivity parameter c_{ni}.

So far, producers within an industry are assumed to produce for local markets. This assumption is, however, not made in reality. We therefore extend the model to a more general framework, as suggested by Melitz and Ottaviano (2008). Employing iceberg trade costs, the revenue of a firm operating in region r that can be achieved in another region s may expressed as:

$$R^n_{rsi}(c_{ni}) = \frac{L_s}{4\gamma}\tau^2_{rs}((c^{rs}_{Xi})^2 - c_{ni}{}^2) = \frac{L_s}{4\gamma}\left(\left(c^{si}_D\right)^2 - \left(\tau_{rs}c_{ni}\right)^2\right), \tag{2}$$

where $\tau_{rs} > 1$ denotes trade cost between both regions, and c^{rs}_{Xi} is the productivity level to break even in the exporting market. Melitz and Ottaviano (2008) show that c^{rs}_{Xi}=c^{si}_D/τ_{rs}, which implies that an increase in trade barriers makes it harder for exporting firms to break even relative to domestic producers in the potential export market. The second part of equation (2) therefore shows that higher trade costs reduce revenues for exporters because transportation costs reduce the productivity differential.

The cutting values c^{si}_D are derived from individual draws of a process that generates the productivity levels of all firms in region s. Assuming that this process is unique for all regions within a country, we may assume that this cutting value is identical for all firms in the market, and, is therefore, unaffected by a firm's location, thus $c^{si}_D = c^i_D\ \forall\ s$. Assuming that each firm potentially exports to any regions, we may express revenues as the sum over all S regions, namely:

$$R^n_{ri}(c_{ni}) = \frac{1}{4\gamma}\sum^S_s L_s\left(\left(c^i_D\right)^2 - \left(\tau_{rs}c_{ni}\right)^2\right). \tag{3}$$

After we introduce the reduced-form equation that describes revenues, we now focus on the production technology and the implementation of cultural diversity. The model of Melitz and Ottaviano (2008) assumes that labour is the only input in production and the relation between output q_{ni} and workforce E_{ni} can be described by:

$$q_{ni}(c_{ni}) = \frac{1}{c_{ni}}E_{ni}. \tag{4}$$

Following Ottaviano and Peri (2005), the workforce might be culturally diverse. The diversity might have both positive and negative effects on output. For instance, special skills and knowledge of other cultures broadens the overall stock of knowledge within a single firm and relates therefore to productivity gains. Also, employing non-natives with special knowledge on the habits and taste of other countries could be used to develop products in country-specific design that makes exports to other countries more successful. On the other hand, because of language barriers or ethnic conflicts, a culturally diverse workforce could also generate a loss in productivity. Then, considering solely E_{ni} would not address the issue of the cultural mix of the workforce employed. Let, therefore, E_{ni}^m be the number of workers of the m-th nationality employed, then the production function is augmented by:

$$q_{ni}(c_{ni}) = \frac{1}{c_{ni}}(1 - \propto_{ni})\left[\sum_m^M (E_{ni}^m)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}, \tag{5}$$

as Ottaviano and Peri (2005) suggest. Here, σ describes the elasticity of substitution between the different cultural groups employed; and $\propto_{ni}$ is a parameter that also increases with the degree of cultural diversity. Like Ottaviano and Peri (2005), we leave the functional form of $\propto_{ni}$ open but limit it in the range between 0 and 1. Then $(1 - \propto_{ni})$ captures the possibly negative effects emerging from a culturally-diverse workforce. With $\sum_m^M E_{ni}^m = E_{ni}$ and $s_{ni}^m = E_{ni}^m / E_{ni}$, we eventually find:

$$q_{ni}(c_{ni}) = \frac{1}{c_{ni}} E_{ni}(1 - \propto_{ni})\left[\sum_m^M (s_{ni}^m)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} = \frac{1}{c_{ni}} E_{ni}(1 - \propto_{ni}) DIV_{ni}. \tag{6}$$

Thus, the degree of cultural diversity of the workforce employed changes factor productivity. Note, that an increase in DIV_{ni} leads to an increase in output even if the employed workforce is the same. Conversely, an increase in the degree of cultural diversity also increases $\propto_{ni}$, which leads to a loss in productivity. The question, which of both effects dominates is an empirical one. If we let $\widetilde{c_{ni}} = \frac{c_{ni}}{(1-\propto_{ni})DIV_{ni}}$, then we may now express market size as:

$$R_{ri}^n(\widetilde{c_{ni}}) = \frac{1}{4\gamma}\sum_s^S L_s\left(\left(\tilde{c}_D^i\right)^2 - \left(\tau_{rs}\widetilde{c_{ni}}\right)^2\right). \tag{7}$$

Hypotheses

The derived reduced-form equation (8) allows a number of hypotheses to be formulated. As $\tilde{c}_D^i$ is the productivity level that forces demand to zero, and is therefore related to the most unproductive firm, all firms with $\widetilde{c_{ni}} < \tilde{c}_D^i$ will enjoy positive revenues. An increase in productivity will then increase the productivity differential, i.e. the term in the brackets. Thus, relatively more productive firms earn higher profits. Assume that the net effect of cultural diversity on productivity is positive. Holding all other things equal, a relatively culturally more diverse firm would experience a higher productivity differential. This raises overall revenues, as long as the productivity advantage yields lower consumer prices that will raise demand. In the empirical specification, we therefore expect that productivity-related variables are positively related to revenues.

If, however, achieved productivity gains are paid to workers and other factors in the sense of an additional premium, the price-demand-revenue relationship is unaffected. Thus, in that case we expect insignificant results. We then conclude that the possible productivity gains of those variables are not utilized as a competitive advantage.

The revenue of single firms also depends on the distribution of consumers. If a firm is located close to bigger markets, the negative effect of distance on revenues is relatively smaller compared with firms that are far away from these markets. Put differently, the relative weight of consumers on revenues diminishes with distance but the effect should be positive.

In the next section we explore empirically the relationship between revenues, firm productivity and, especially, the degree of cultural diversity.

3. The empirical model, data, and descriptive overview

The last section derives a reduced-form approach for a firm's market size on the basis of the consumer distribution and industry-specific and firm-specific productivity factors. We relate the following empirical specification to the theoretical model:

$$lnR_{ri}^{n} = \beta_0 + \beta_1 ln\left(\frac{L_r}{B_r}\right) + \beta_2 W ln\left(\frac{L_{-r}}{B_{-r}}\right) + \beta_3 x_{ri}^{n} + \mu_i + \mu_t + \varepsilon_{ri}^{n}. \qquad (8)$$

The β's and μ's are parameters to be estimated: the β-coefficients relate to variables, and the μ's relate to industry- and time-specific effects; ε_{ri}^{n} refers to the idiosyncratic error term. The analysis is conducted for the time period 1999 to 2008.

To capture the demand effect, we employ population density L_r/B_r instead of total population L_r to avoid problems of heteroscedasticity[3]. Furthermore, we split the demand effects into two terms: one relates to the region of the firm's location (β_1), and the other to all other regions (β_2). As hypothesized, the effect of the demand

[3] As a robustness check, we also estimate the model with regional population. This change of the explanatory variable does not affect other estimates in terms of significance and parameter value.

effects reduces over distance. We therefore measure the demand effects of all other regions on the basis of a spatial potential, where W relates to a spatial weights matrix[4], as suggested by Niebuhr (2001). All regional variables are collected on the NUTS-3 level (Kreise). Data on population and regional size are taken from the regional GENESIS database provided by the Official Statistics Office of the Federal Republic of Germany.

The variable vector x_{ri}^{n} includes firm-specific variables that are supposed to influence productivity, and that relate to cultural diversity. Data is taken from the German Establishment Panel (EP) and the German Establishment History Panel (BHP), both provided by the Institute for Employment Research (IAB). Whereas the former data set is a survey of single establishments, the latter data set covers the total population of all German establishments employing at least one person subject to social security. It is based on administrative data, and is therefore highly reliable. Information on the workforce and especially the cultural background is taken from this data set. It is the only data set in Germany on establishment level that covers the issue of cultural diversity. Therefore, our analysis is limited to the establishment instead of the firm level.

The EP survey covers, among labour-related information, also information describing establishment-specific variables that relate to productivity. As a proxy for the establishment market size R_{ri}^{n}, we use revenues. We restrict our sample, and consider only establishments that achieve revenues. Therefore, the public and financial sectors are not considered. Hence, our sample is not representative for the German economy, but mainly covers private establishments, for which it is expected that the theoretical model is applicable.

The following variables that we applied are provided by the EP. The state of the art of machinery and equipment serves to capture productivity effects but also the product life cycle of single products. It is measured using an ordinal scale, and we therefore dichotomize it. The categories are 'newest equipment', 'new equipment', 'older equipment', and 'out-of-date equipment'. We would expect that establishments

[4] An element w_{ij} of W is computed by $w_{ij} = \exp(-\varphi d_{ij})$, where d_{ij} relates to the distance of the geographical centers of two regions i and j, and φ is a distance-decay parameter.

operating with rather old equipment experience lower revenues compared with those that produce with the newest machinery, which serves as reference category.
We control for the legal status and employ two variables. The first one is whether the establishment is privately-owned. It is expected that these are rather small firms which produce for local markets and therefore achieve lower revenues. A second dummy indicator is set to unity when the establishment is foreign-owned. Those establishments are expected to be more productive and have higher efficiency levels (Conyon et al. 2002). The EP also provides information on the export behaviour of establishments. As our model suggests, exporting firms achieve higher revenues as they have to be more productive to enter foreign markets (Melitz, 2003). We therefore add the export share to EU countries, s_{export}^{EU}, to control for productivity aspects but also to obtain a relative higher market size, which is not captured in the population density measures[5].

The share of employed human capital, s_h, measured as the proportion of people holding a university degree, is taken from the BHP, and aims to control for additional productivity effects of the workforce employed. If we consider two establishments, ceteris paribus, according to the theoretical model a firm with a higher proportion of human capital is assumed to be more productive, and therefore has a competitive advantage and enjoys possibly higher revenues.

Since we are interested in differences between establishments operating in similar branches of trade, the research is conducted on the industry level. We chose the 2-digit level (wz93) and observe 58 distinct sectors. At a higher level of industry aggregation differences between production units become too large. Conversely, on a lower level the number of observed establishments within that sector declines. Therefore, the 2-digit level helps to solve the trade-off between a loss of comparability between establishments and the number of included establishments within each industry.

The BHP covers the nationality of employees. We use this information to measure the establishment's cultural diversity on the basis of a Hirschmann-Herfindahl index.

[5] Instead of the export share, we also use a dummy indicator to test whether the firm is an exporter to EU regions. The result interpretation is robust against this change.

If we let s_m be the proportion of the m-th of M cultural groups employed, then the diversity measure is calculated as follows[6],

$$H = 1 - \sum_{m}^{M} s_m^2. \tag{9}$$

The measure increases with the degree of cultural diversity and is therefore suitable for our purposes, as DIV_{ni} and $\propto_{ni}$ of our theoretical model suggest an increase. Brunow and Blien (2011) provide evidence of positive net-effects of cultural diversity for single establishments. Then, where the positive effect of cultural diversity overrides the negative effects, we expect the estimate to have a positive sign. Where possible effects do not affect the price-demand-relation, then the estimate will be insignificant.

Niebuhr (2010) considers the effect of cultural diversity on regional R&D outcomes. She provides evidence that positive effects occur in the presence of the cultural diversity of high-skilled employees. We therefore not only consider the overall diversity but also split it into 'low-' and 'high-skilled' cultural diversity. We apply the diversity measure, but separate employees with respect to their skill level. A related study of Ozgen et al. (2011a) supports these findings.

Other data taken from the BHP is the workforce employed, measured as the average annual employment and the average wage paid. The proportion of employed women, s_{women}, aims to control for part-time work and its possible impact on productivity.

Combes et al. (2004) suggest employing the log of the number of represented industries in a region to capture possible spillover-effects emerging from urbanization externalities. A broader supply of products and services of different sectors possibly raises the stock of available specialized intermediates that could possibly contribute to firms' own productivity. We therefore include this measure, and also relate the count of industries to the 2-digit level, assigned as $\ln No.Ind$.

Additionally, we control for the regional type and employ two dummy indicators. One is set to unity when the establishment's location is in an agglomeration region, and the other is set to unity when the location is in a rural area. Therefore the reference group is the location in an urbanized region.

[6] See Ottaviano and Peri (2005).

A descriptive overview of the main variables under consideration is provided in Table 1. The upper part of the table reports the mean values, standard deviation and the range, and the lower part shows the correlation structure of the variables. So far, all variables are positively correlated with the endogenous variable. In order to assure that this bivariate correlation remains in a multivariate context, the next section considers multivariate regression results.

4. Regression results

The model, as outlined in equation (9), is tested empirically using multivariate regression techniques. As the model suggests, the regression should be performed on an industry level, and therefore panel data techniques are applied. In the presence of significant industry-specific effects μ_i, OLS estimates will be inconsistent. Then fixed or random effects models are preferred. The theoretical model includes industry-specific parameters that are unobserved, and are therefore included in μ_i. This is especially the case for the cut-value $\tilde{c}_D^i$, which is also assumed to be correlated with some of the explanatory variables. This possible correlation among μ_i and included variables is in favour of the fixed effects model over the random effects counterpart which assumes no correlation. The test suggested by Arellano (1993) may be applied to test the possibly emerging inconsistency resulting from the zero correlation assumption of the random effects approach[7]. The test results reject the random effects model. A joint test of the significance of the μ_i estimated by the fixed effects model cannot be rejected, because OLS will be inconsistent. The test procedure holds for all estimates and we therefore only present results obtained by the fixed effects approach.

All reported estimates are robust against arbitrary heteroscedasticity on industry level. In the fixed effects model, possible issues of endogeneity are not fully addressed. There is a large body of literature that focuses on the identification of agglomeration effects and their impact on single firms. Martin et al. (2011) argue that, in the presence of agglomeration forces, total factor productivity is higher. This would indeed, influence the regression results, as long as those forces are not accounted for. In our case one might expect that a productivity gain due to agglomeration forces

[7] The traditional Hausman-Test is only valid under the assumption of homoscedasticity. We therefore use the test of Arellano (1993), and employ the xtoverid-command for Stata provided by Schaffer and Stillman (2010).

would shift the supply curve of the firm, and, finally, the revenues of such a firm are expected to be higher. However, our approach already captures agglomeration effects as explanatory variables, i.e. the market size, dummy indicators for rural, urbanized, and agglomeration regions, and the number of existing industries. As we compare single establishments within an industry, the possibly positive impact of agglomeration regions is therefore controlled for. Another concern is the self-selection process of firms: more productive firms tend to locate in agglomeration regions. Again, as we control for both agglomeration effects and differences in productivity, we also account for the selection issue.
As a last point, the left-hand-side variable is the establishment's market share measured by revenues. It is less likely that there is a problem with causality, as it is unreasonable to assume that the revenue of a single plant notably influences the demand and agglomeration measures.

In Table 2 we present regression results obtained without controlling for cultural diversity as the baseline specification. Columns 1-3 present models that consider distinct spatial weights matrices. While distance is strongly discounted in Column 1, it is less discounted in Column 2 and again much less discounted in Column 3. As an additional robustness check, in Columns 4-6 we provide the results where the row elements in each of the three weighting matrices add up to 1, i.e. the matrices employed in Columns 1-3 are row-standardized. While Columns 1-3 relate to a 'true' market potential for the spatial demand term, Columns 4-6 relate to an average market potential of all other regions.

The estimated coefficients are all jointly significant, indicating that the model has some explanatory power. Most of the variables under consideration are significant and have the expected sign. Comparing the estimates obtained from the different weights matrices clearly shows that the strength of the distance-discounting does not affect the overall picture and direction. We therefore draw the following general picture: the establishment's revenue will be higher in denser regions. If the market potential of all the other regions also increases, this raises firm's market size. Thus, location matters: being in denser regions gives single establishments a higher market share, as the model predicts. The dummy indicators that control for the regional type are insignificant in almost every model. They control for possibly occurring productivity effects, but also for the regional market potential. In the latter case, obviously the population density has enough power. In the former case, one might conclude that productivity levels do not depend on the establishment's location. On average, in terms of revenues privately owned establishments are smaller. This is not surprising, as private owners typically operate in local markets, and are potentially less productive. On the other hand, foreign owned establishments achieve higher revenues, as they are more profit-oriented. When an establishment increases its EU exports, it also enjoys higher revenues. This can be seen as a market-increasing factor that is not addressed in the population density measures, but also as a factor that relates to productivity. Exporting firms have to be more productive to compensate trade cost.

If equipment and machinery matures, revenues will decline. The newest production technologies give a competitive advantage that raises revenues. While there is no effect of the proportion of women employed, an increase in the proportion of human capital raises productivity, and therefore revenues. Establishments do not enjoy productivity gains when they are located in regions that offer a broader variety of established industries.

In Table 3, we present the estimates where the cultural diversity of the workforce employed is taken into account. We restrict ourselves to the presentation of results obtained using the weights matrix[8] $W_{0.5}$ and its row standardized companion $\widetilde{W}_{0.5}$. In Columns 1 and 3, we present the results obtained for the overall degree of cultural diversity of the workforce within each plant, in Columns 2 and 4 we separate the effect of ‘low-’ and ‘high-skilled’ labour.

The results of the baseline specification are almost unaffected by the augmentation of culturally diversity. Once we control for cultural diversity, the dummy for agglomeration regions becomes significant. The estimate is, in contrast to our prior expectations, negative, suggesting that plants located in an agglomeration will experience lower revenues compared with plants located in urbanized areas. An explanation for this intriguing result is that firms located in agglomerations experience higher competition that lowers total revenues. Another reason could be that there is still unobserved heterogeneity between establishments: in particular, lower rental

[8] Results obtained using the other weights matrices confirm the presented estimates.

cost in urbanized regions favours producing plants, whereas in agglomeration regions other (within-) industry establishments are located. We will return to this point later, when we control for establishment size.
Focusing on the diversity measure we find a highly significant positive estimate for the overall effect, and also for the separation of skill levels. Then, employing a rather diverse workforce increases overall firm performance that raises revenues. In relation to the theoretical model, this result also implies that the positive effects of cultural diversity promote productivity gains. These gains are not just paid as a dividend to workers and shareholders but are also used to set lower prices, which shifts the supply curve, and therefore raise demand, while the overall effect on revenues is positive. Additionally, the effect is stronger for the employment of high-skilled labour, indicating that human-capital effects are more important to achieve a comparative advantage.

However, this first picture might be driven by establishment size, and especially the size of the workforce employed. As the descriptive overview reveals, the correlation of workforce with revenues is 0.91. This high correlation is not controlled for, and could therefore be included in other related variables. This is especially the case for the diversity measures: a higher degree of cultural diversity is more likely to be observed when the stock of employees increases. We therefore additionally control for the workforce employed, and estimate a parameter of about 0.95, which basically supports the high correlation of both variables. The interpretation of other estimates is unaffected by this additional control variable. On average, the values become smaller, and some of the estimates become insignificant. Since we cannot reject the hypothesis that the parameter of the workforce employed could also be equal to 1, we present in Table 4 the estimates where the endogenous variable is now revenues per employee (in log). This approximates labour productivity, and the advantage is that it is unaffected by establishment size. Since we changed the LHS variable we provide the baseline model in Columns 1 and 4. Columns 2 and 5 consider the overall degree of cultural diversity, and Columns 3 and 6 separate cultural diversity into the two skill groups. Again, Columns 1-3 relate to the unstandardized, and Columns 4-6 to the row-standardized weights matrix.
All variables are again jointly significant, indicating that this model has explanatory power. As was the case for the previous regression results, the OLS and RE

approach is rejected by statistical tests, and hence we only report FE estimates. The influence of explanatory variables is almost identical in the baseline specification and the models that account for cultural diversity. All directions of influence obtained in the foregoing tables are mainly confirmed. Now, however, the agglomeration dummy becomes highly significant and positive. Thus, average labour productivity is higher in agglomeration regions compared with urbanized areas, but urbanized regions, on the other hand, enjoy higher revenues. Also, now the degree of regional urbanization, namely, the number of available industries, becomes significant and has a positive sign. Thus, a larger possible supply of intermediate products and services increases a firm’s labour productivity. Interestingly, it does not affect revenue levels. Thus, there is an indirect effect: urbanization externalities only affect factor productivity, and then the cause higher factor productivity, but the externality itself does not influence revenues positively.

Let us now turn to the issue of cultural diversity. The overall effect is insignificant and the separation by skill groups reveals that only the degree of cultural diversity of high-skilled labour affects factor productivity. Because of the high correlation between H and $H^{low\ sk.}$, we conclude that most of the establishment’s cultural diversity is due to low-skilled workers. Therefore, the overall effect presented in Columns 2 and 4 is mainly dominated by low-skilled employment. However, high-skilled labour still contributes positively to establishment productivity – in the overall diversity index, the effect of this relatively small sub-group disappears. The significant positive estimate is in line with the findings of Niebuhr (2010) or Ozgen et al. (2011b) who focus on the effects of high-skilled people. Then, different country-of-origin specific knowledge and experience, but also different approaches to problem solving by high-skilled employees, raises overall labour productivity, and gives single establishments a competitive advantage.

The insignificant effect of low-skilled workers should not be seen as an unsatisfactory result. The freedom of workplace choice within the EU possibly yields cultural diversity in single establishments. Native employers might fear the effect of unsatisfactory results on their establishment performance based on the employment of non-natives because of language barriers or unknown qualifications of foreign workers. Especially in Germany the foreign qualification degree might not be fully accepted. Our empirical evidence concludes that, at least, losses in productivity are compensated by possible gains emerging from a diverse workforce for the group of low-skilled employees. Note, that in the case of the non-existence of gains and losses, the net effect is also 0. In both cases, the freedom of workplace choice does not reduce establishment performance significantly, because a common labour market does not yield efficiency losses.

While we find a positive relationship between low-skilled diversity and revenues, the effect disappears when focusing on productivity aspects. We interpret this result as an indicator of establishment size. Thus, the result obtained when considering the revenue equation might not be influenced by the cultural diversity aspects of the low-skilled. The picture is, however, different for high-skilled cultural diversity. In both approaches that consider revenues and labour productivity, the effect of this employment group is positive and highly significant.

Does the cultural diversity of the high-skilled really control for the issue? Could it be related to other factors? The general effect of human capital is absorbed by the proportion s_h. The likelihood of employing high-skilled foreigners also increases in agglomeration areas, which is captured in the dummy for agglomeration regions. The likelihood to employ non-natives increases in the case of export orientation. This effect is already captured in s_{export}^{EU}. Furthermore, establishments that are foreign-owned might also hire non-Germans more frequently. We control for that.
Finally, there might be unobserved uncontrolled heterogeneity of the workforce employed. We therefore reestimate the model, and augment it by the average wage paid to the workforce. As the Mincer-wage equation suggests, wages are influenced by the worker's age, gender, skills and experience and other unobserved characteristics. According to Tabuchi and Thisse (2011), wages also control for migration patterns, as labour (and especially high-skilled labor) is highly mobile and potentially moves to other regions, where nominal wages are higher. Their theoretical research is based on interregional real factor price equalization. Thus, controlling for wages partially overcomes the selection problem of migrants.

The results of the wage-augmented regression are provided in Table 5. The results obtained are robust against this modification. We therefore directly explore the

diversity issues. Wages do not influence the effect of high-skilled cultural diversity. It is significant, and the estimate is robust against this modification. Then, even if wages capture unobserved characteristics that are related to overall firm performance, we find a productivity and demand-linked effect of high-skilled cultural diversity. Moreover, if productivity gains due to cultural diversity are paid to workers, then the emerging effect of cultural diversity is captured by wages, as both variables are interrelated. However, even if this is true, we still observe an additional effect of the diversity measure. This lets us conclude that, in relation to the underlying model, this kind of cultural diversity increases plant's competitiveness.
Consider two almost identical establishments within an industry: both face the same demand (population measures), offer the same legal status, employ the same proportion of human capital, are both located in the same area type, and, most importantly: they possess the same amount of exports. Then, the one establishment that is culturally more diverse in terms of high-skilled employment has a productivity advantage and achieves higher revenues. The negative effects are compensated by the positive ones, and the overall effect is positive. This finding adds to the existing literature, and supports the general mechanisms of cultural diversity of innovation on performance – in our case it is the competitiveness within sectors.

5. Conclusion

This paper explores the impact of a culturally diverse workforce on an establishment's productivity and revenues. The theoretical model of Melitz and Ottaviano (2008) introduces firm heterogeneity within sectors which is based on productivity differences. More productive firms are, on average, larger as their prices are lower. Thus, productivity gains secure a competitive advantage. It is not solely used to pay higher factor rewards. Does the degree of cultural diversity of the workforce employed increase productivity and firm performance? If so, does it give a competitive advantage? We use German plant data, and control for a variety of well-accepted determinants that influence productivity. Our empirical evidence suggests that the degree of cultural diversity of low-skilled workers does not yield productivity gains but seems to raise achieved revenues. The latter effect is explained by establishment size. However, the insignificant result also suggests that there are neither productivity gains nor losses of firm performance. Thus, possible negative effects are compensated by positive counterparts. We find significant positive effects of cultural diversity on productivity and revenues for culturally-diverse high-skilled workers. Different skills and experience, problem solution aspects, and cultural-specific knowledge of employed high-skilled workforce gives establishments a competitive advantage. As we control for export behaviour, foreign ownership, regional market size, agglomeration area effects and wages that capture other unobserved productivity effects, the empirical findings support the impact of high-skilled employees on establishment performance and revenues.

From a policy perspective and especially from an EU point of view that suggests free movement of labour, an important lesson found is that cultural diversity within establishments does not lead to negative net effects. Our evidence supports that in the presence of cultural diversity the average effect for low-skilled employees is zero, while for high-skilled employees it is positive.

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Table 1: Descriptive Overview of variables

	$\ln R_{ri}^{n}$	$\ln\left(\frac{L_r}{B_r}\right)$	$W_{0.5} * \ln\left(\frac{L_{-r}}{B_{-r}}\right)$	$\ln(wage)$	$\ln(E_{ri}^{n})$	s_{export}^{EU}	s_h	H	$H^{low\ sk.}$	$H^{high\ sk.}$
Descriptive Statistics										
Mean	14.767	5.911	72.03	3.395	3.044	4.701	0.066	0.065	0.066	0.013
Std. Dev.	2.138	1.296	32.472	0.582	1.872	12.31	0.139	0.13	0.131	0.058
Min	7.601	3.642	17.52	-2.454	-4.514	0	0	0	0	0
Max	24.103	8.36	150.204	5.163	10.875	100	1	0.875	0.875	0.844
Correlation structure										
$\ln R_{ri}^{n}$	0.0999	1								
$W_{0.5}\ln(L_{-r}/B_{-r})$	0.1385	0.1909	1							
$\ln(wage)$	0.1259	0.0440	0.0780	1						
$\ln(E_{ri}^{n})$	0.9106	0.0751	0.1063	-0.0093	1					
s_{export}^{EU}	0.3601	-0.0026	0.0769	0.1048	0.3173	1				
s_h	0.1582	0.1166	-0.0173	0.0448	0.1338	0.0906	1			
H	0.2442	0.2177	0.2710	-0.0708	0.2672	0.1493	-0.0439	1		
$H^{low\ sk.}$	0.2498	0.2196	0.2722	-0.0697	0.2734	0.1506	-0.0520	0.9895	1	
$H^{high\ sk.}$	0.2666	0.0976	0.0980	0.0294	0.2633	0.1823	0.1542	0.2329	0.1812	1

N=67416; $W_{0.5}$: spatial weights matrix based on a distance-decay function

Table 2: Revenue equation: baseline specification

$\ln R_{ri}^{n}$	(1)	(2)	(3)	(4)	(5)	(6)
Weights matrix	$W_{0.3}$	$W_{0.5}$	$W_{0.7}$	$\widetilde{W}_{0.3}$	$\widetilde{W}_{0.5}$	$\widetilde{W}_{0.7}$
$\ln(L_r/B_r)$	0.107***	0.095***	0.085***	0.109***	0.112***	0.113***
	(0.025)	(0.025)	(0.024)	(0.025)	(0.025)	(0.025)
$W_x \ln(L_{-r}/B_{-r})$	0.002***	0.005***	0.011***	0.631***	0.428***	0.323***
	(0.001)	(0.001)	(0.001)	(0.094)	(0.061)	(0.047)
D private owner	-2.142***	-2.144***	-2.148***	-2.145***	-2.149***	-2.152***
	(0.106)	(0.106)	(0.106)	(0.105)	(0.106)	(0.106)
D foreign owner	1.017***	1.010***	1.008***	1.015***	1.012***	1.012***
	(0.091)	(0.090)	(0.089)	(0.091)	(0.090)	(0.090)
s_{export}^{EU}	0.032***	0.031***	0.032***	0.031***	0.031***	0.031***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
D new equipm.	-0.166***	-0.166***	-0.165***	-0.162***	-0.164***	-0.165***
	(0.037)	(0.037)	(0.037)	(0.037)	(0.038)	(0.037)
D older equipm.	-0.552***	-0.552***	-0.555***	-0.553***	-0.554***	-0.555***
	(0.060)	(0.060)	(0.060)	(0.060)	(0.060)	(0.060)
D out-of-date eq.	-0.915***	-0.918***	-0.921***	-0.920***	-0.920***	-0.919***
	(0.089)	(0.090)	(0.090)	(0.089)	(0.090)	(0.089)
s_h	1.175***	1.187***	1.176***	1.238***	1.220***	1.194***
	(0.393)	(0.397)	(0.395)	(0.407)	(0.403)	(0.398)
s_{women}	-0.298	-0.291	-0.286	-0.272	-0.271	-0.274
	(0.194)	(0.193)	(0.192)	(0.190)	(0.189)	(0.189)
D agglom. region	0.026	-0.018	-0.049	-0.029	-0.043	-0.060*
	(0.039)	(0.036)	(0.035)	(0.035)	(0.035)	(0.034)
D rural region	0.008	0.001	-0.033	0.017	0.017	0.008
	(0.046)	(0.044)	(0.044)	(0.043)	(0.042)	(0.042)
$\ln No.Ind.$	0.173	0.388	0.46	0.144	0.058	-0.049
	(0.386)	(0.377)	(0.375)	(0.373)	(0.379)	(0.384)
Time Dummy	yes	Yes	yes	yes	yes	yes
F	90.12***	91.67***	92.32***	113.14***	111.87***	107.25***
RMSE	1.526	1.525	1.527	1.523	1.524	1.526
Within R2	0.373	0.374	0.372	0.375	0.374	0.372
Between R2	0.607	0.606	0.602	0.608	0.607	0.604
Overall R2	0.42	0.421	0.419	0.421	0.421	0.419

Note: N=67416, No. Groups=58; robust s.e. in (); * p<0.1, ** p<0.05, *** p<0.01; W_x.. spatial weight matrix as in column's header, $\widetilde{W}_x$ .. row standardized weights matrix; D.. Dummy

Table 3: Revenue equation: including cultural diversity

$\ln R_{ri}^{n}$	(1)	(2)	(3)	(4)
Weights matrix	$W_{0.5}$	$W_{0.5}$	$\widetilde{W}_{0.5}$	$\widetilde{W}_{0.5}$
$\ln(L_r/B_r)$	0.070***	0.063***	0.081***	0.072***
	(0.025)	(0.023)	(0.025)	(0.024)
$W_x \ln(L_{-r}/B_{-r})$	0.004***	0.003***	0.279***	0.251***
	(0.001)	(0.001)	(0.048)	(0.045)
D private owner	-2.072***	-2.039***	-2.076***	-2.043***
	(0.104)	(0.099)	(0.105)	(0.099)
D foreign owner	0.932***	0.822***	0.934***	0.824***
	(0.089)	(0.091)	(0.09)	(0.091)
s_{export}^{EU}	0.029***	0.027***	0.029***	0.027***
	(0.003)	(0.003)	(0.003)	(0.003)
D new equipm.	-0.173***	-0.173***	-0.172***	-0.172***
	(0.035)	(0.036)	(0.035)	(0.036)
D older equipm.	-0.557***	-0.552***	-0.559***	-0.553***
	(0.059)	(0.058)	(0.059)	(0.058)
D out-of-date eq.	-0.934***	-0.931***	-0.935***	-0.932***
	(0.089)	(0.091)	(0.089)	(0.091)
s_h	1.339***	1.142***	1.360***	1.161***
	(0.375)	(0.353)	(0.378)	(0.357)
s_{women}	-0.271	-0.263	-0.258	-0.252
	(0.185)	(0.18)	(0.183)	(0.178)
D agglom. region	-0.080**	-0.097***	-0.097***	-0.112***
	(0.032)	(0.032)	(0.032)	(0.032)
D rural region	-0.007	-0.021	0.004	-0.01
	(0.045)	(0.045)	(0.043)	(0.043)
$\ln No.Ind.$	0.184	0.165	-0.026	-0.016
	(0.374)	(0.351)	(0.368)	(0.341)
H	2.195***		2.180***	
	(0.215)		(0.206)	
$H^{low\ sk.}$		2.001***		1.985***
		(0.196)		(0.188)
$H^{high\ sk.}$		4.366***		4.369***
		(0.387)		(0.386)
Time Dummy	yes	yes	yes	yes
F	103.61***	113.00***	112.23***	116.56***
RMSE	1.503	1.483	1.503	1.483
Within R2	0.391	0.408	0.392	0.408
Between R2	0.613	0.626	0.615	0.626
Overall R2	0.432	0.446	0.432	0.446

Note: N=67416, No. Groups=58; robust s.e. in (); * p<0.1, ** p<0.05, *** p<0.01; W_x .. spatial weight matrix as in column's header, $\widetilde{W}_x$ .. row standardized weights matrix; D.. Dummy

Table 4: Revenue per employee: baseline and cultural diversity

$\ln(R_{ri}^n/E_{ri}^n)$	(1)	(2)	(3)	(4)	(5)	(6)
Weights matrix	$W_{0.5}$	$W_{0.5}$	$W_{0.5}$	$\widetilde{W}_{0.5}$	$\widetilde{W}_{0.5}$	$\widetilde{W}_{0.5}$
$\ln(L_r/B_r)$	0.027***	0.030***	0.030***	0.033***	0.037***	0.036***
	(0.007)	(0.008)	(0.008)	(0.007)	(0.008)	(0.008)
$W_x \ln(L_{-r}/B_{-r})$	0.002***	0.002***	0.002***	0.191***	0.210***	0.208***
	(0.001)	(0.001)	(0.001)	(0.018)	(0.023)	(0.023)
D private owner	-0.131**	-0.139**	-0.136**	-0.133**	-0.142***	-0.140***
	(0.056)	(0.052)	(0.053)	(0.055)	(0.052)	(0.052)
D foreign owner	0.276***	0.285***	0.275***	0.276***	0.286***	0.276***
	(0.033)	(0.030)	(0.03)	(0.033)	(0.031)	(0.03)
s_{export}^{EU}	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
D new equipm.	-0.082***	-0.081***	-0.081***	-0.081***	-0.080***	-0.080***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
D older equipm.	-0.192***	-0.191***	-0.191***	-0.192***	-0.191***	-0.191***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
D out-of-date eq.	-0.322***	-0.320***	-0.321***	-0.323***	-0.321***	-0.321***
	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)
s_h	0.646***	0.630***	0.610***	0.668***	0.650***	0.631***
	(0.112)	(0.107)	(0.107)	(0.111)	(0.108)	(0.107)
s_{women}	-0.209**	-0.211**	-0.210**	-0.200**	-0.201**	-0.201**
	(0.097)	(0.096)	(0.096)	(0.097)	(0.096)	(0.096)
D agglom. region	0.074***	0.081***	0.080***	0.059***	0.066***	0.064***
	(0.017)	(0.02)	(0.02)	(0.016)	(0.019)	(0.019)
D rural region	0.037	0.037*	0.036	0.054**	0.056**	0.055**
	(0.022)	(0.022)	(0.022)	(0.023)	(0.023)	(0.023)
$\ln No.Ind.$	0.337**	0.359**	0.359**	0.26	0.27	0.273*
	(0.153)	(0.164)	(0.164)	(0.157)	(0.162)	(0.162)
H		-0.236			-0.277	
		(0.187)			(0.183)	
$H^{low\ sk.}$			-0.251			-0.291
			(0.184)			(0.179)
$H^{high\ sk.}$			0.353***			0.344***
			(0.106)			(0.102)
Time Dummy	yes	yes	yes	yes	yes	yes
F	46.88***	48.32***	50.13***	48.33***	49.64***	50.16***
RMSE	0.737	0.737	0.736	0.735	0.735	0.734
Within R2	0.092	0.093	0.094	0.096	0.098	0.099
Between R2	0.244	0.243	0.251	0.26	0.26	0.266
Overall R2	0.104	0.107	0.107	0.108	0.112	0.112

Note: N=67416, No. Groups=58; robust s.e. in (); * p<0.1, ** p<0.05, *** p<0.01; W_x .. spatial weight matrix as in column's header, $\widetilde{W}_x$ .. row standardized weights matrix; D.. Dummy

Table 5: Revenue per employee: wage augmented model

$\ln(R_{ri}^n/E_{ri}^n)$	(1)	(2)	(3)	(4)	(5)	(6)
Weights matrix	$W_{0.5}$	$W_{0.5}$	$W_{0.5}$	$\widetilde{W}_{0.5}$	$\widetilde{W}_{0.5}$	$\widetilde{W}_{0.5}$
$\ln(L_r/B_r)$	0.019***	0.019***	0.019**	0.024***	0.024***	0.024***
	(0.007)	(0.007)	(0.007)	0.006	(0.007)	(0.007)
$W_x \ln(L_{-r}/B_{-r})$	0.001***	0.001***	0.001***	0.143***	0.145***	0.144***
	(0.001)	(0.001)	(0.001)	0.017	(0.018)	(0.018)
D private owner	-0.153***	-0.153***	-0.151***	-0.154***	-0.155***	-0.153***
	(0.042)	(0.041)	(0.041)	0.042	(0.041)	(0.041)
D foreign owner	0.243***	0.243***	0.235***	0.243***	0.245***	0.236***
	(0.033)	(0.032)	(0.031)	0.033	(0.032)	(0.031)
s_{export}^{EU}	0.008***	0.008***	0.008***	0.008***	0.008***	0.008***
	(0.001)	(0.001)	(0.001)	0.001	(0.001)	(0.001)
D new equipm.	-0.067***	-0.067***	-0.067***	-0.066***	-0.066***	-0.066***
	(0.01)	(0.01)	(0.01)	0.01	(0.01)	(0.01)
D older equipm.	-0.168***	-0.168***	-0.168***	-0.169***	-0.169***	-0.168***
	(0.011)	(0.011)	(0.011)	0.011	(0.011)	(0.011)
D out-of-date eq.	-0.284***	-0.284***	-0.284***	-0.285***	-0.285***	-0.285***
	(0.031)	(0.031)	(0.031)	0.031	(0.031)	(0.031)
s_h	0.605***	0.605***	0.588***	0.621***	0.619***	0.603***
	(0.106)	(0.108)	(0.107)	0.107	(0.109)	(0.108)
s_{women}	0.153	0.153	0.153	0.155	0.154	0.154
	(0.101)	(0.099)	(0.099)	0.101	(0.099)	(0.099)
D agglom. region	0.060***	0.060***	0.059***	0.049***	0.049***	0.048***
	(0.015)	(0.016)	(0.016)	0.014	(0.015)	(0.016)
D rural region	0.025	0.025	0.024	0.038*	0.038*	0.037*
	(0.019)	(0.019)	(0.019)	0.019	(0.019)	(0.019)
$\ln No.Ind.$	0.340**	0.340**	0.339**	0.278*	0.279*	0.281*
	(0.139)	(0.144)	(0.144)	0.145	(0.147)	(0.146)
$\ln(wage)$	0.425***	0.425***	0.425***	0.420***	0.419***	0.419***
	(0.039)	(0.038)	(0.038)	0.039	(0.038)	(0.038)
H		-0.003			-0.035	
		(0.107)			(0.104)	
$H^{low\ sk.}$			-0.019			-0.05
			(0.107)			(0.103)
$H^{high\ sk.}$			0.329***			0.324***
			(0.102)			(0.101)
Time Dummy	yes	Yes	yes	yes	yes	yes
F	77.23***	74.82***	71.95***	77.28***	74.41***	72.15***
RMSE	0.708	0.708	0.707	0.707	0.707	0.706
Within R2	0.163	0.163	0.164	0.166	0.166	0.166
Between R2	0.315	0.315	0.318	0.327	0.327	0.33
Overall R2	0.169	0.169	0.169	0.172	0.172	0.172

Note: N=67416, No. Groups=58; robust s.e. in (); * p<0.1, ** p<0.05, *** p<0.01; W_x .. spatial weight matrix as in column's header, $\widetilde{W}_x$ .. row standardized weights matrix; D.. Dummy