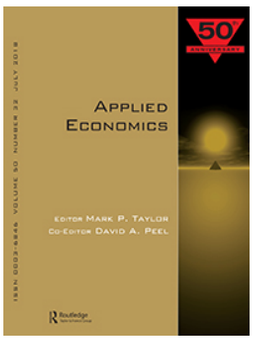

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The labour market effects of offshoring of small and medium-sized firms: micro-level evidence for Germany

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ABSTRACT

Small and medium-sized enterprises (SMEs) are the economic powerhouse of many OECD countries (perhaps most prominently so in Germany). Yet, the labour market dynamics caused by the internationalization of their production activities are largely unexplored. We use survey-based micro-level data for Germany to explore the employment effects of offshoring of SMEs, relying on propensity score matching and difference-in-difference analysis. We find evidence for a downsizing effect in the immediate aftermath of offshoring whereas, initially, job creation is not spurred. In the medium run, we find evidence for a slowing down of employment dynamics of offshoring firms (that tend to belong to the better performing SMEs in Germany) relative to non-offshoring firms. Even though our results do not point to a net employment loss in the medium run, our evidence suggests that offshoring may lead to less jobs being created. This conclusion cannot be confirmed for large companies.

KEYWORDS

Offshoring; SME; employment; difference-in-difference analysis; Germany

JEL

F23; F16; C22

I. Introduction

The fragmentation of the production chain is a characteristic feature of production in a globalized economy. Thanks to rapid technological progress, increasingly complex production processes can be split up and production activities be relocated abroad. Offshoring has thus become an inherent and very visible part of the ongoing internationalization of production not only for large multinational companies but also for small and medium-sized enterprises (SMEs). Against this backdrop, offshoring can be understood as the latest manifestation of international trade and, as such, will have repercussions on the home country and produce winners as well as losers.

Particularly, the labour market effects of offshoring have been explored in a number of theoretical and empirical studies. Yet, even though there is a consensus that offshoring affects employment and wages in the home country, the direction and strength of these effects are still subject to debate. The theoretical literature points to a complex interplay of several mechanisms that can drive the overall effect in different directions (Grossman and Rossi-Hansberg 2008). Empirical research also points to a range of factors such as skill level and industry sector (production versus non-production) that influence the precise labour market response, even though the majority of empirical research rejects the concern that offshoring has massive adverse effects on employment (see Crinò 2009 for a review).

The size of a firm belongs to those dimensions that usually are not explicitly taken into consideration when examining the effects of offshoring.[1] However, SMEs cannot be viewed as smaller versions of large organizations (e.g. Waehrens, Slepniov, and Johansen 2015; Welsh and White 1981). They have different qualities, needs and capabilities. This article attempts to fill that gap. Germany may be one of the most well-known cases of a country whose industrial structure is dominated by SMEs in many ways; the 'German Mittelstand' is famously referred to as the backbone and engine of the German economy. In Germany, SMEs account for about 60% of all employees (subject to social security contributions)

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[1]Musteen, Ahsan and Park (2017), Canham and Hamilton (2013) for New Zealand and the case study for 13 Canadian SMEs by Mohiuddin and Su (2013) are exceptions to the rule.

and contribute more than 50% to the country's GDP. More than 99% of all firms are SMEs.[2] It is well-known that SMEs are less experienced and less active than larger companies regarding internationalization activities. Still, more than 21% of all German SMEs pursue business activities abroad, generating almost 30% of their total turnover abroad. If very small SMEs with 50 employees or less are excluded, the share of SMEs operating abroad rises to more than 50%. Available data also show that the employment level of German SMEs that pursue business activities abroad is markedly higher than that of SMEs that only operate on the domestic market (Sollner 2016). Moreover, significantly more than 50% of all offshoring firms in Germany are SMEs with more than 100 but less than 249 employees (Statistisches Bundesamt 2009).

The capacity of SMEs to exploit the potential benefits of offshoring can be expected to differ from large companies'. SMEs usually face tighter (financial, physical and human) resource constraints than larger companies. Yet, offshoring requires a massive amount of resources and SMEs often find it more difficult to acquire them than larger companies. Access to the debt market is typically very limited for SMEs. A more constrained resource base also suggests that, compared to larger companies, credit conditions will tend to be less favourable for SMEs. Consequently, surveys indicate that roughly half of the offshoring SMEs encounter substantial difficulties in the financing stage of their (planned) relocation processes (Kranzusch and Holz 2013; Brutscher et al. 2012). For various reasons, attracting high-skilled labour also tends to be more difficult for SMEs than for large companies. For example, SMEs usually cannot match the more attractive financial packages offered by bigger companies (Cardon and Stevens 2004; Desouza and Awazu 2006). All in all, more limited financial, physical und human resources make it harder for SMEs to operate a fragmented international value chain. Hence, the benefits of offshoring may be more difficult to reap for SMEs, which suggests that the effects of offshoring on domestic employment may not be uniform across firms of different size.[3]

Using firm-level, survey-based data for Germany, we focus on the impact offshoring generates on both the employment level and the skill composition of the work force of SMEs, following the widely adopted convention in defining a SME as a firm with less than 250 employees.[4] We also compare the effects to those derived for a sample of large companies. In doing so, we distinguish between the immediate impact of offshoring and the medium-run evolution of our outcome variables. In this article, offshoring is understood as the relocation of production processes, or more generally business functions, outside the national borders. Our definition therefore includes the relocation of activities that were previously conducted in-house to external firms as well as the relocation to subsidiaries abroad (Olsen 2006).[5]

Our empirical strategy is based on a quasi-experimental approach.[6] The reason is that the causal effects of offshoring cannot be observed directly as the counterfactual is missing. We first use propensity score matching (PSM) to identify statistical twins for the offshoring firms and then apply a difference-in-difference (DiD) estimator to identify the causal effects of offshoring in our sample. DiDs estimators compare the difference in outcome between the treatment and the control group before and after the treatment, where changes are measured relative to pretreatment benchmarks.

Our results indicate that negative effects of offshoring on employment are short lived. Our findings confirm an initial displacement effect of offshoring but we also find evidence that, in the medium run, SMEs that offshored continue growing and creating jobs. The skill composition of employees also tends to change after offshoring in favour of high-skilled labour in the medium run. Yet, the picture is clouded by evidence that

[2]SMEs play an important role in other countries, too. For example, throughout the recent economic downturn, SMEs in 27 EU member states have maintained their role as the backbone of the European economy, with some 20.7 million firms accounting for more than 98% of all enterprises (Ecorys 2012).
[3]Using plant level data for the Irish electronics sector between 1990 and 1995, Görg and Hanley (2004) conclude that only plants that are considerably larger than the mean size gain from offshoring. They measure the benefits of offshoring as enhanced profitability.
[4]We follow the definition used by, e.g. the European Commission (http://ec.europa.eu/growth/smes/business-friendly-environment/sme-definition_en).
[5]Unfortunately, our data do not allow us to differentiate between these two cases of offshoring in our empirical analysis.
[6]We follow the approach recently adopted by Mitze and Kreutzer (2017) in a different context.

employment growth of SMEs after offshoring, even if it remains positive, loses steam relative to non-offshoring firms. Concerns that offshoring by SMEs leads to massive job exports are clearly contradicted by our analysis; but our results point to another adverse effect: offshoring may slow down job creation. Our evidence also points to a significant difference between SMEs and large companies. Neither the shift towards high-skilled labour nor the declining employment dynamics can be confirmed for large offshoring companies in the post offshoring period.

The remainder of this article is organized as follows. Section II provides a brief review of the related literature and motivates our hypotheses. Our empirical strategy and our data are presented in Sections III and IV. Section V presents and discusses our empirical findings. Section VI concludes.

II. Offshoring and employment

In this article, we are concerned with distinct but related questions: does offshoring impact employment? Does it lead to a significant change in the skill composition of labour? The body of empirical studies on the labour market effects of offshoring is voluminous, examining different countries (or groups of countries), sectors and time periods. Empirical results suggest that offshoring does not lead to a massive number of jobs being shipped from advanced to lower income economies as often suggested in popular press. The effects of offshoring on the employment level are typically found to be modestly negative, if at all, or even, as suggested by a range of studies, positive. However, offshoring tends to shift relative labour demand in favour of skilled labour.[7] Recent theoretical work also suggests that offshoring does not necessarily give rise to negative effects on employment. Grossman and Rossi-Hansberg (2008) point to the productivity effect of offshoring and argue that, if certain tasks, say low-skill tasks, are offshored, those firms that produce using these tasks intensively enjoy a steep increase in profitability and can expand relative to firms that rely more heavily on other factors such as high-skilled labour.[8] This may more than offset the initial fall in low-skill employment so that, overall, the demand for labour providing low-skill tasks may grow at an increased marginal product.

Perhaps somewhat surprisingly in light of their importance for the German economy, studies on the effects of offshoring of German SMEs do not exist to the best of our knowledge. Existing empirical research for Germany uses broader samples and does not give rise to an unambiguous picture. While Bachmann and Braun (2011) cannot find evidence for a negative impact of outsourcing on the German labour market (on the contrary, job stability in the service sector may increase), Geishecker (2008) reaches the conclusion that job security falls independently of workers' skill level. Both papers use individual-level labour market spell data to measure the risk of losing employment after offshoring has taken place. In related work, Geishecker (2006) and Geishecker and Görg (2008) find evidence that low-skill wages in Germany suffer and high-skill wages profit from offshoring. Focusing on service offshoring in Germany between 1995 and 2006, Winkler (2010) finds evidence for negative employment effects. She concludes that labour-reducing productivity and substitution effects dominate.

Wagner (2011) presents evidence that offshoring firms are typically more productive than their non-offshoring counterparts already before offshoring. While according to his evidence there is no negative effect on employment of offshoring firms, labour productivity and wages may benefit from offshoring. Even though Wagner (2011) also uses the PSM approach to find a suitable control group, he does not complement his analysis with a DiD analysis to take account of unobserved drivers that may give rise to common trends and confound results. In a recent contribution, Moser, Urban and Weder Di Mauro (2015) find evidence for a positive employment effect of offshoring on the offshoring firm for a broad sample of German firms for an earlier period (1998–2004).[9] Similar to our article, these authors use a combination of PSM and DiD estimations for their analysis.

It can be expected that a firm's capacity to benefit from offshoring (and, hence, the employment effects)

[7]See, e.g. Becker, Ekholm and Muendler (2013), Feenstra and Hanson (1999), Desai et al. (2009) and Munch (2010) for the manufacturing sector, Amiti and Wei (2005, 2009), Crinò (2010) and Hijzen, Inui and Todo (2010) for services offshoring and Ebenstein et al. (2014) for an analysis across sectors.
[8]Grossman and Rossi-Hansberg (2008) liken this effect to labour-augmenting technological progress.
[9]Moser, Urban and Weder Di Mauro (2015) also show that the employment effect of offshoring hinges critically on the offshoring motive. If the offshoring decision is part of a restructuring process in which parts of the production facilities are shut down or sold off, the employment effect is likely to be negative.

may not be independent of its size. Larger firms are in a better position to achieve economies of scale and scope and higher productivity, making them more competitive on international markets. Consequently, empirical evidence suggests that one of the key determinants for firm survival and their ability to withstand (international) competition is firm size (e.g. Giovannetti, Ricchiuti, and Velucchi 2011). Companies that offshore will usually relocate the least productive parts of their production processes and focus on their core competencies. A case in point is the offshoring of routine (low-skilled) labour-intensive tasks by firms in advanced countries. This leads to a restructuring of production towards activities with higher value added so that, over time, firms reach a higher productivity level (e.g. Görg, Hanley, and Strobl 2008; Olsen 2006; Moser, Urban, and Weder Di Mauro 2015). Hence, employment can be expected to rise eventually (i.e. after the initial downsizing caused by the relocation of former in-house production tasks) and the skill composition of labour demand will change towards high-skilled labour. Yet, it may be more difficult for SMEs to run an internationally fragmented value chain successfully than for larger companies. This reasoning is suggested by the resource-based view of the firm (Barney 1991; Wernerfelt 1984) that stresses that a firm's performance is essentially driven by the resources that it can commit to production. A resource is defined in a very broad and comprehensive sense, essentially encompassing everything that makes a firm more efficient and generates a (sustained) competitive advantage such as assets, capabilities, organizational processes, knowledge etc. (Barney 1991). It is well established in the literature that SMEs are less likely to engage in internationalization activities than larger companies. Not surprisingly, SMEs are generally less active and less experienced in offshoring than larger companies, even though evidence points to a significant recent growth in offshoring initiatives (e.g. Waehrens, Slepniov, and Johansen 2015). SMEs typically have a more constrained resource base than larger companies not only in terms of financial resources but also regarding high-skilled labour or management capacities (see, e.g. Acs et al. 1997; Capasso, Cusmano, and Morrison 2013; Hollenstein 2005; Kuo and Li 2003). Waehrens, Slepniov and Johansen (2015) report a significant overall increase in complexity due to offshoring based on a recent survey among Swedish and Danish SMEs. Notably communication, new decision-making and increased management needs as well as a modified division of work turn out to be important complexity-related cost drivers in their study. This suggests that SMEs may find it harder than large companies to exploit the potential for productivity gains that offshoring promises and translates it into growth, new high-skilled jobs and additional employment.

This is despite the fact that offshoring may be a means for resource-constrained SMEs to overcome resource-related constraints and shortages and increase their innovation capabilities (Musteen, Ahsan, and Park 2017). In line with this notion, evidence suggests that offshoring motives are indeed related to the size of the firm (Roza, Van Den Bosch, and Volberda 2011; Di Gregorio, Musteen, and Thomas 2009). Compared to large companies, medium-sized firms indeed tend to use offshoring more often as an element of a growth-driven and entrepreneurial business strategy, while cost drivers play a relatively less important role.

It should be noted that most of the empirical offshoring papers cited above use an approximation to measure offshoring based on the share of intermediate inputs (or changes thereof) from abroad (Feenstra and Hanson 1996). Although this approach is widely used, how reliably it measures the extent to which production activities are relocated abroad is the subject of an ongoing debate (see the discussion in Wagner 2011). Cheung, Rossiter and Zheng (2008) point out that offshoring measures based on the share of intermediate goods as derived from input-output-tables may give rise to a considerable measurement bias.[10] Moreover, this approach cannot adequately capture all dimensions of offshoring (e.g. if the final stage of production is carried out in an offshore location). It also cannot distinguish between offshoring defined, as in this article, as the relocation of production activities abroad and the substitution of domestic with foreign intermediate good suppliers. We therefore take a different route and resort to a direct measure of offshoring by making use of survey-based firm-level data that allow us to differentiate precisely

[10]They illustrate their point by showing that the gap between such a measure and a direct survey-based measure for the manufacturing sector in Canada can amount to 16 percentage points.

between offshoring and non-offshoring firms (Section V).

Even though the employment response to offshoring is theoretically and empirically not unambiguous, we follow the conclusions suggested by the majority view that has developed in the literature in formulating our hypotheses. We therefore expect offshoring to generate non-negative employment effects even though immediately after offshoring, a transitional negative effect on jobs is to be anticipated (this is reflected in our Hypotheses 1 and 5). Offshoring is also hypothesized to be a business strategy for firms with an already higher share of high-skilled workers and to lead to an increase in the share of high-skilled labour even though this effect is also expected to take time before reaching a noticeable level (Hypotheses 2–4). Our hypotheses will be detailed further below.

III. Empirical strategy

Answering our research questions requires dealing with a missing data problem. Let $D \in \{0, 1\}$ denote a dummy variable indicating if offshoring has taken place ($D_i = 1$) or not ($D_i = 0$) for firm i. The outcome in case of offshoring is given by Y_i^1 while Y_i^0 denotes the outcome if firm i did not engage in offshoring. The fundamental problem is that each firm i can only be in one of the two states so that either Y_i^1 or Y_i^0 can be observed but never both. Hence, *individual* treatment effects cannot be determined. However, the *average* causal effect of offshoring can be calculated. More specifically, the average effect of treatment (offshoring) on the treated (the offshoring firms) (ATT), can be studied.

$$\tau = E\left(Y^1|D = 1\right) - E\left(Y^0|D = 1\right) \quad (1)$$

The first term on the right-hand side describes the average outcome in the population of offshoring firms. The second term on the right-hand side is the average outcome the offshoring firms would have experienced if they had not relocated production processes abroad. As this clearly cannot be observed, a valid control group is needed to construct the missing counterfactual. The basic idea is to find firms that didn't undergo the treatment (i.e. didn't offshore) but are as similar as possible to the offshoring firms in all relevant pretreatment characteristics (covariates).[11] We will denote the vector of observed individual characteristics that are used as conditioning variables by **X**. Rosenbaum and Rubin (1983) suggest conducting the matching exercise on the basis of participants' propensity score. The propensity score is defined as the probability of treatment for a firm conditional on its covariates, observed before offshoring, $P(\mathrm{D} = 1|\mathbf{X}) = P(\mathbf{X})$. Hence, PSM reduces matching to a one-dimensional estimation.[12] The probability of offshoring is calculated with the help of a probit model.

The choice of covariates is restricted by the information provided in the survey data we use. The choice is further restricted by the fact that the annual surveys change from time to time. Moreover, firms do not provide answers to the same questions every year. Therefore, the number of covariates varies between our estimates for the short run and our panel data analysis (see Appendix B).[13] The underlying idea is that, if all variables that influence both the selection into treatment and the outcome are observed, the assignment of treatment is unconfounded (i.e. purely random for firms with similar values of the covariates).

Yet, the evolution of the outcome variables and the decision to offshore may also be subject to unobservable factors. Econometric tools offer a way to control for unobservables that affect firms in the treatment and the control group in both the pre- and post-treatment period in the same way.[14] Cross-sectional matching estimators, such as PSM, that compare the outcomes for the treatment and the control group after the treatment may yield unsatisfactory results because they do not account for such common trends. Hence, a post-treatment difference is not necessarily an accurate measure of the treatment effect. The DiD estimator eliminates the impact of time-invariant differences between both groups when identifying the treatment effect and is therefore, arguably, a more appropriate evaluation tool in quasi-experimental settings (see also Smith and Todd 2005). DiD estimators compare the change in outcome for the treatment group to the change in

[11]Using the mean outcome for the group of untreated (non-offshoring) firms as counterfactual would introduce a bias into the estimation because offshoring and non-offshoring firms can be expected to differ even in the absence of treatment.
[12]Caliendo and Kopeinig (2008) provide an in-depth discussion of PSM.
[13]The variables included in the set of covariates must not be influenced by the treatment and are measured before the treatment.
[14]This does not apply to time-*varying* unobservables.

outcome for untreated firms, where changes are measured relative to pretreatment benchmarks. More formally, the DiD approach is based on the assumption that $E[Y_{0t} - Y_{0t'}|P(\boldsymbol{X}),\ D = 1] = E[Y_{0t} - Y_{0t'}|P(\boldsymbol{X}),\ D = 0]$, where the subscript '0' indicates 'no treatment', t denotes the post-treatment period, while t' denotes the pretreatment period.[15] The ATT using the DiD approach can then be defined as $\tau_{DiD} = E[Y_{1t} - Y_{0t'}|P(\mathbf{X}),\ D = 1] - E[Y_{0t} - Y_{0t'}|P(\mathbf{X}), D = 0]$, where Y_{1t} is the outcome observed for treated firms in period t so that the corresponding estimator can be written as

$$\widehat{\tau_{DiD}} = \frac{1}{N_1}\sum_{i=1}^{N_1}\{(Y_{1it} - Y_{0it'}|P(\mathbf{X})) - \sum_{j=1}^{N_0} w_{ij}\big(Y_{0jt} - Y_{0jt'}|P(\mathbf{X})\big)\} \quad (2)$$

with w_{ij} denoting the weight attached to firm j from the control group (Heckman, Ichimura, and Todd 1997).[16] We use an Epanechnikov kernel function with a bandwidth of $h = 0.06$ to determine w_{ij}. Kernel estimators ensure that the weight assigned to elements from the control group depends inversely on $\big|P(X_i) - P\big(X_j\big)\big|$, i.e. more similar matches receive higher weights.

IV. Data

Our data source is the IAB Establishment Panel from the Institute for Employment Research in Germany (IAB).[17] The IAB Establishment Panel is a rich firm-level data set based on an annual survey of approximately 16,000 firms (see Ellguth, Kohaut, and Möller 2014; Fischer et al. 2009).[18] We first conduct a short-run analysis to study the immediate effects of offshoring on employment and the skill composition of labour. Our short-run analysis is based on survey data for 2008 only as the number of offshoring activities throughout our sample period reached its peak in 2008 ($n = 285$), i.e. we focus on firms which offshored in 2008 and analyse how they developed in the first year after the relocation relative to their non-offshoring twins.

We then make use of the surveys from 1999 to 2013 to create a panel data set in order to capture medium-term developments in addition. The data set contains pre- and post-treatment data where the pre- and post-treatment periods are separated by our treatment variable 'offshoring'. Yet, as the survey questions differ, precise data for offshoring activities are not available for every year. However, for 3 years, namely 2007, 2008 and 2010, exact survey questions allow the unambiguous identification of offshoring activities. Firms that confirmed offshoring for 2007, 2008 and 2010 therefore form the treatment group. The number of offshoring firms drops to $n = 153$ in our panel data set because firms only enter the data set if they participated to all surveys between 1999 and 2013.

The second step in the construction of our panel data set was to construct a suitable control group composed of non-offshoring firms. The identification of non-offshoring firms was complicated by the fact that for years other than 2007, 2008 and 2010, the available data only allowed distinguishing between firms that relocated production processes on a national or international scale and those that didn't do either. In order to avoid introducing a bias into our control group due to unobserved offshoring activities, all firms that relocated production but where precise information regarding the geographical scale on which these relocation activities took place (within Germany or internationally) was lacking had to be deleted from the sample. Table 1 presents sample details, separately for SMEs (less than 250 employees) and large companies (250 employees or more), comparing offshoring (off) to non-offshoring (no off) firms.[19]

Inspection of the data reveals that large offshoring firms tend to be somewhat older than smaller firms that offshore. While offshoring SMEs tend to have a markedly higher turnover than their non-offshoring counterparts, it is perhaps somewhat surprizing that

[15]The DiD estimator is conditioned on the firm's propensity score, i.e. their offshoring probability. This variant of the DiD analysis is therefore sometimes referred to as conditional DiD (see, for instance, Heckman, Ichimura, and Todd 1997; Lechner 2010).
[16]The STATA routine diff. is used for the calculations.
[17]The data were accessed with controlled data teleprocessing by the FDZ (Research Data Centre at the Institute for Employment Research).
[18]The panel comprises all establishments with at least one employee liable to social security with a response rate varying between 63% and 84% (Fischer et al. 2009).
[19]It should be noted that the choice of covariates is limited by data availability as discussed above.

Table 1. Descriptive analysis.

Covariate	SMEs (off)	Large (off)	SMEs (no off)	Large (no off)
Age (*year*)	1996	1994	1996	1995
Turnover (*in millions of €*)	12.9	264	7.88	734
Turnover in West Germany (*in %*)	51.29	35.90	57.31	56.10
Intermediate inputs (*in %*)	50.86	54.49	48.65	50.28
Investment (*in millions of €*)	0.50	17.6	0.27	9.06
Foreign turnover (*in %*)	23.75	49.76	4.98	20.81
Ratio high-skilled employees/ total employees	0.16	0.20	0.13	0.24
Employees (*absolute number*)	69.01	924	32.38	828.13
Industry 2 (*share*)	0.52	0.86	0.23	0.27
Industry 3 (*share*)	0.06	0.01	0.09	0.11
Industry 4 (*share*)	0.07	0.01	0.16	0.12
Industry 5 (*share*)	0.06	0.01	0.03	0.04
Industry 6 (*share*)	0.00	0.00	0.02	0.03
Industry 7 (*share*)	0.162	0.07	0.12	0.11
Industry 8 (*share*)	0.09	0.01	0.22	0.19
Industry 9 (*share*)	0.02	0.01	0.07	0.11

Average values. Industry 2: Manufacturing; Industry 3: construction; Industry 4: retail and repair; Industry 5: transport and communication, Industry 7: business-related services; Industry 8: other services; Industry 9: public sector.

turnover of large offshoring firms is smaller compared to large firms without any relocation activities. However, in general, offshoring firms realize a higher share of their turnover in foreign countries while their turnover in West Germany is lower compared to the control group. These figures support the notion that a larger share of foreign turnover often is the first step towards a deeper foreign engagement which could result in offshoring further down the line.[20] A greater embeddedness in value chains of offshoring firms is also suggested by their higher share of intermediate inputs in production compared to non-offshoring firms. Another covariate that shows an unambiguous relation between offshoring and non-offshoring firms is investment. The investment level is higher for offshoring firms irrespectively of firm size. Turning to employment, offshoring firms tend to employ a larger workforce compared to non-offshoring firms. This difference is particularly pronounced for SMEs. Offshoring SMEs are twice as big as their non-offshoring counterparts on average. But not only the absolute number of employees also the share of high-skilled labour is higher in offshoring SMEs. Large firms differ in this respect. The share of high-skilled labour is higher for non-offshoring firms. It should be kept in mind though from the discussion of our empirical strategy that a simple comparison of subsample means does not allow to derive statistically valid conclusions about causal relations. Our data set includes firms from the manufacturing and non-manufacturing sector with the vast majority of offshoring activities coming from the former.

V. Empirical results

Our empirical results are derived in two complementary steps. First, we examine the immediate effects of offshoring. To do that, we focus exclusively on offshoring activities in 2008 as this year showed the highest volume of offshoring activities in the whole data sample and analyse the immediate effects (i.e. in the same year). Second, we use a panel data set covering the years from 1999 to 2013 to add the medium-run effects of offshoring. Generally, we are interested in both the scale and the skill effect of offshoring on employment, i.e. changes in the level and the skill composition of labour employed.

Immediate effects

Offshoring works through several channels so that the overall effect on employment is not clear a priori (Grossman and Rossi-Hansberg 2008). Employment may suffer from downsizing when production tasks that used to be carried out in-house are relocated abroad.[21] However, output and employment may also be stimulated by productivity gains so that the overall development of employment is theoretically not unambiguous. Yet, the latter effect will need time before taking full effect. Hence, we formulate our first hypothesis as follows:

Hypothesis 1: *Offshoring leads to an immediate increase in downsizing.*

The nearest neighbour algorithm with five neighbours is used to conduct the PSM matching exercise. After the matching, no significant differences in any of the covariates between the treatment and the control group persist. Another indicator for the matching quality is that the pseudo R^2 improves

[20]This idea is based on the Proximity Concentration Model by Brainard (1997). The model posits that if the fixed costs of exports (monetary and non-monetary costs) exceed the costs of FDI, the firm will pursue an offshoring strategy.

[21]In a study using plant level data for Ireland, however, Görg and Hanley (2005) find that labour demand is significantly reduced by offshoring in the short run.

after matching. In other words, the matching algorithm found statistical twins for the offshoring firms.[22] In line with expectations, the DiD analysis points to a significant difference between the treatment and the control group (last column Table 2). The DiD estimation in the last column reports the estimated mean difference in the outcome variable between the treatment and control groups after the treatment. Offshoring is found to be responsible for a widening gap between the treatment and the control group, i.e. additional job losses.[23] Offshoring SMEs tend to make more people redundant on average than firms in the control group even though the share of firms with redundancies does not differ across both groups (Tables A1 and A2, Appendix).

Despite the negative dislocation effect on employment, recruitment (especially of highly skilled labour) might actually increase. There is ample evidence that offshoring leads to a relative shift in demand for labour in advanced economies, favouring high-skilled labour (see, e.g. Feenstra and Hanson 1996; Feenstra and Hanson 1999, for the United States; and Geishecker 2006; Wagner 2011, for Germany). Yet, finding suitably qualified labour takes time. Therefore, we do not expect to find evidence for these effects in the short run, i.e. in the same year that firms offshore. This is why we formulate our next two hypotheses as follows:

Hypothesis 2a: *In the short run, offshoring does not have a significant effect on recruitment of offshoring firms.*

Hypothesis 2b: *In the short run, offshoring does not lead to an increase in the share of high-skilled labour in offshoring firms.*

Given the lack of more precise data, employees with a higher education degree are used as a proxy for highly qualified labour. Our results lend support to both hypotheses.[24] As expected, we are not able to find any significant immediate impact of offshoring on recruitment (see Table 3). Neither the overall recruitment activities nor the demand for high-skilled labour, measured as the fraction of newly recruited high-skilled employees in overall recruitment, change in the immediate aftermath of offshoring relative to the control group (last column,

Table 2. Redundancies, average number of people in the period before 2007 and in 2008; $n = 72$ (common support).

	Pretreatment			Post-treatment			
	No relocation	Offshoring	Difference	No relocation	Offshoring	Difference	DiD
Redundancies	1.048	1.099	0.051	2.391	3.000	0.609**	0.558*
	(0.061)	(0.061)	(0.086)	(0.061)	(0.061)	(0.000)	(0.086)

***, **, and * denote significance at the 1%, 5% and 10% levels.
The SE is given in parentheses.
DiD: difference-in-difference.

Table 3. New recruitment and new recruitment of high-skilled labour, share of firms before 2007 and in 2008; $n = 72$; common support.

	Pretreatment			Post-treatment			
	No relocation	Offshoring	Difference	No relocation	Offshoring	Difference	DiD
New recruitment	0.742	0.889	0.147*	0.344	0.472	0.128*	−0.019
	(0.012)	(0.013)	(0.0021)	(0.022)	(0.023)	(0.024)	(0.025)
New recruitment,	0.105	0.149	0.043*	0.106	0.153	0.048*	0.004
high-skilled labour	(0.009)	(0.010)	(0.012)	(0.009)	(0.009)	(0.009)	(0.010)

***, **, and * denote significance at the 1%, 5% and 10% levels.
DiD: difference-in-difference.
The SE is given in parentheses.

[22]The nearest neighbour algorithm with five neighbours is used to conduct the PSM matching exercise. After the matching, no significant differences in any of the covariates between the treatment and the control group persist. Another indicator for the matching quality is that the pseudo R^2 improves after matching. In other words, the matching algorithm found statistical twins for the offshoring firms. Other matching algorithms (kernel, calliper, radius) confirm the results. Details of the PSM marching exercise are not shown here due to space constraints but are available upon request. Exemplarily, we present detailed matching results for the medium run analysis in the next section.

[23]We obtain the same result when we test Hypothesis 1 for 2007 and 2010, the other years for which our sample provides unambiguous offshoring data.

[24]Again, we use a nearest neighbour matching algorithm with five neighbours and are able to find good matching partners for our treatment groups for both hypotheses The PSM has to be repeated for every hypothesis. Not all firms respond to all questions so that the sample changes for every outcome variable.

Table 4. Share of high-skilled workers in total workforce subject to social security contributions; n = 102; common support.

	Pretreatment			Post-treatment			
	No relocation	Offshoring	Difference	No relocation	Offshoring	Difference	DiD
Share of high-skilled labour	0.102	0.135	0.032**	0.102	0.151	0.049**	0.015*
	(0.004)	(0.005)	(0.004)	(0.003)	(0.004)	(0.005)	(0.007)

***, **, and * denote significance at the 1%, 5% and 10% levels.
The SE is given in parentheses.
DID: difference-in-difference.

Table 3). The evidence, however, reveals that offshoring firms typically increase their recruitment activities, both in general terms and with respect to high-skilled labour, significantly already before they offshore (Table 3, column 3). Offshoring firms have already grown significantly more strongly before they offshore. This result can be understood as suggesting that offshoring primarily occurs from a position of economic strength but, at least partially overlapping with this, may also be driven by pre-offshoring preparatory changes (see also 'Effects in the medium run' section). It should be kept in mind that we identify offshoring by the actual relocation of production tasks even though organizational changes within the firm may have started before.

To check the robustness of our results, we again varied the matching algorithm for the PSM exercise. Both the kernel and the calliper algorithm delivered good matching results and confirmed the findings derived with the nearest neighbour algorithm. By contrast, the radius algorithm points to a significant effect of offshoring. Yet, the matching quality produced by the radius estimator is significantly poorer than those produced with the other algorithms, i.e. the treatment and the control group differ significantly in a considerable number of covariates even after matching (thus highlighting the importance of the matching quality for the analysis of causal effects in quasi-experimental studies).[25]

Effects in the medium run

The panel data set is based on annual survey data for the years 1999–2013. As mentioned above, precise data on offshoring are only available for the years 2007, 2008 and 2010. The treatment is therefore defined as 'offshoring in 2007, 2008 and/or 2010'.

Before we deal in more detail with the employment effects of offshoring in the medium run, we will have a closer look at the SMEs that offshore. For a survey-based data set covering larger German firms, Wagner (2011) concludes that substantial ex-ante differences exist between firms that offshore and those that do not. Offshoring firms are typically more productive and more human capital intensive than their non-offshoring counterparts. Following these results, we formulate the following hypothesis for SMEs in Germany:

Hypothesis 3: *The share of high-skilled labour is ex-ante higher in offshoring SMEs than in non-offshoring SMEs.*

Our results are presented in Table 4. As above, high-skilled labour is proxied by higher education graduates. The DiD estimation reveals a statistically significant difference between the treatment and the control group – 13.5% of high-skilled labour in offshoring firms versus 10.2% in the control group (columns 2 and 3) – suggesting that indeed SMEs that decide to relocate (parts of their) production abroad tend to have a higher share of high-skilled labour relative to their overall workforce already before that decision.

We will now turn to a re-examination of the effects of offshoring on the level and skill composition of employment. As pointed out above, previous research presents evidence that offshoring can be expected to change the skill composition of labour in favour of high-skilled workers. Such effects are absent in the immediate aftermath of offshoring as shown above (Hypothesis 2).

Hypothesis 4: *In the medium run, offshoring leads to an increase in the share of high-skilled labour.*

Our analysis provides support for Hypothesis 4 (Table 4). The skill composition of labour changes significantly more strongly in favour of high-skilled employment in the treatment group. While the

[25]Details are available upon request.

employment of high-skill labour rose to 15.1% from 13.5% in offshoring firms, this share remained constant for non-offshoring firms. The DiD analysis confirms that the widening gap in the share of high-skilled labour can be interpreted as a causal effect of offshoring (last column). As documented in Table B1, a valid control group could be found.[26] The standardized percentage bias is significantly reduced (in absolute value) through PSM, illustrating the good quality of the matching results.[27] The pseudo R^2 of the probit regressions drops significantly after re-estimating the propensity score on the matched sample, confirming the balancing quality of the PSM (Sianesi 2004).

As shown in Mitze and Kreutzer (2017), SMEs that offshore tend to be more innovative than non-offshoring establishments. As an additional robustness test, we expanded our set of covariates by including two binary innovation variables to control for process and product innovation in the matching process. Our results remain unaffected, underscoring their robustness (Table 5).[28]

Yet, it is not a priori clear if this effect is caused by a relative increase in the number of high-skilled employees or if total employment shrinks in the medium run with an overproportionate effect on low-skilled labour. In the next step, we therefore investigate the overall employment effect of offshoring in our panel data set.

While the displacement effect – tasks that used to be carried out in-house are relocated abroad – dominates in the short run, labour demand may increase once the intended cost saving and efficiency gains of offshoring materialize. As briefly pointed out above, overcoming resource constraints has been identified as an important driver for offshoring of SMEs. Referring to SMEs, Di Gregorio, Musteen and Thomas (2009) stress flexibility and the freeing up of scarce resources, network effects and learning as key benefits from offshoring, suggesting that offshoring is an element of a business strategy aimed at enhancing international competitiveness and expanding into a greater number of foreign markets. Even though the empirical literature for Germany does not give rise to an unambiguous picture as briefly discussed above, our last hypothesis therefore is

Hypothesis 5: *In the medium run, offshoring has a positive employment effect.*

As outcome variable, we use the (log) change in employment relative to the year before. A glance at the data reveals that employment develops positively in both the treatment and the control group after 2007, i.e. the first year for which offshoring data are available in our sample. Judged on the basis of a post-treatment comparison alone, no statistically significant difference between the treatment and the control group emerges (column 6, Table 6).[29] However, a different picture emerges after running the DiD analysis. First, we compare the treatment and the control group before offshoring and find evidence for a significantly stronger (annual) employment growth in the treatment group in the years before offshoring actually took place (column 3, Table 6). The employment growth differential between offshoring and non-offshoring firms is significant on the 1% level and suggests that economic

Table 5. Share of high-skilled workers in total workforce subject to social security contributions (innovation variables included); n = 101; common support.

	Pretreatment			Post-treatment			
	No relocation	Offshoring	Difference	No relocation	Offshoring	Difference	DiD
Share of high-skilled labour	0.112	0.128	0.015**	0.113	0.147	0.034**	0.019*
	(0.005)	(0.005)	(0.006)	(0.004)	(0.004)	(0.005)	(0.006)

***, **, and * denote significance at the 1%, 5% and 10% levels.
The SE is given in parentheses.
DID: difference-in-difference.

[26]Due to data restrictions – not all firms responded to all questions every year and not all covariates used for our short run analysis were included in every annual survey – the list of covariates used for the panel analysis differs from that of our short run analysis. Due to the mechanics of the matching procedure where close statistical twins are assigned a higher weight the empirical results may seem to differ sometimes from what a quick look at the descriptive analysis (where the whole sample is considered) may suggest.
[27]Formally, the standardized percentage bias is calculated as the difference of the sample means of treated and comparison firms as a percentage of the square root of the average of the sample variances in the treated and comparison group (Rosenbaum and Rubin, 1983).
[28]As the matching results are similar to those displayed in Table B1, they are not shown here, but available upon request.
[29]Note that the period for which employment effects of offshoring may occur (2007–2013) overlapped with the global financial crisis and the European debt crisis. Even though employment was not as adversely affected in Germany as in many other countries, recruitment went down.

Table 6. Logarithmized employment change; $n = 81$; common support.

	Pretreatment			Post-treatment			
	No relocation	Offshoring	Difference	No relocation	Offshoring	Difference	DiD
Employment change	0.411	0.578	0.167*	0.085	0.084	−0.001	−0.168*
	(0.010)	(0.010)	(0.015)	(0.010)	(0.010)	(0.015)	(0.021)

***, **, and * denote significance at the 1%, 5% and 10% levels.
The SE is given in parentheses.
DID: difference-in-difference.

Table 7. Logarithmized employment change; $n = 83$; common support; innovation variables included.

	Pretreatment			Post-treatment			
	No relocation	Offshoring	Difference	No relocation	Offshoring	Difference	DiD
Employment change	0.395	0.496	0.101*	0.081	0.08	0.006	−0.095*
	(0.007)	(0.009)	(0.094)	(0.002)	(0.012)	(0.013)	(0.095)

***, **, and * denote significance at the 1%, 5% and 10% levels.
The SE is given in parentheses.
DID: difference-in-difference.

success precedes offshoring. Second, we test if there are differences between both groups after offshoring has taken place. As pointed out, we cannot find any evidence that employment evolves differently in the treatment and the control group in the post-offshoring period (column 6, Table 6). Third, we use the DiD estimator to compare the employment growth differential between the treatment and the control group before and after offshoring has taken place. It turns out that the difference between employment growths in the two groups has actually declined (last column, Table 6).[30]

Again, we check for robustness by including the two binary innovation variables. The difference between the two periods remains highly significant (Table 7).

Even though the data sets used for our short-run and medium-run analyses differ – as outlined above, the number of offshoring firms considered varies – the following picture emerges. Our results suggest that firms that offshore typically show a stronger employment growth (Tables 6 and 7) – and employ more high-skilled labour (Hypothesis 3, Tables 4 and 5) – and can therefore already be suspected to be among the high-performing establishments before offshoring. Offshoring firms experience a negative initial impact on employment (Hypothesis 1, Table 2) but successfully adapt their workforce to more internationalized production within a few years (Hypothesis 4, Tables 4 and 5). These firms continue to grow and hire but at a more moderate pace than before offshoring (Hypothesis 5, Tables 6 and 7). Hence, all in all, offshoring slows down the employment growth of German SMEs even though the overall development of employment is still positive. While the fear of massive job losses in SMEs due to offshoring does not seem to be well founded, employment in those firms that offshore (and that tend to belong to the better performing SMEs in Germany) loses dynamics domestically. Hence, our evidence suggests that offshoring may lead to less jobs being created.[31]

Robustness check: size thresholds

It is well known that the classification criterion for an SME (less than 250 employees) applies to a range of potentially very heterogeneous firms. Therefore, it is common practice to create subcategories when analysing SMEs. We introduce three subcategories.[32] Our first subsample comprises so-called micro firms with max. 9 employees, small firms with 9–49 employees enter the second subsample and the third subsample contains the remaining SMEs (medium-sized firms) with up to 249 employees. Running our models again for these three groups separately allows us to judge if our evidence presented so far is driven by a particular type of SME and thus serves as a robustness check for

[30]Again, a valid control group could be found (Table B2). The *t*-tests for most variables are no longer significant after the matching process. The pseudo R^2 of the probit regressions drops significantly after re-estimating the propensity score on the matched sample, the χ^2 test points in the same direction.
[31]It should be noted that we focus on the effects of offshoring on the offshoring firms only. The analysis of the economy-wide employment effect of offshoring would have to take the repercussions on e.g. domestic competitors and suppliers into account and is left for future research.
[32]We again follow the categorization used by e.g. the European Commission (http://ec.europa.eu/growth/smes/business-friendly-environment/sme-definition_de).

Table 8. Logarithmized employment change; common support.

Firm size	Difference (before 2007)	Difference (2007–2013)	DiD
Micro firms (≤9 employees, $n = 20$)	0.035***	0.001	−0.034***
Small firms (>9 and ≤49 employees, $n = 34$)	0.062***	0.014	−0.048*
Medium-sized firms (>49 and ≤249 employees, $n = 41$)	0.143***	−0.008	−0.051**
Larger firms (>249 employees, $n = 39$)	0.173**	0.19	0.192

***, **, and * denote significance at the 1%, 5% and 10% levels.
DID: difference-in-difference.

our results. We start with the outcome variable 'employment change' (corresponding to Table 6).

It turns out that the employment effects of offshoring are uniform across all three subgroups of SMEs (Table 8). Table 8 also points to differences between SMEs and large companies where the latter are defined as firms with more than 249 employees. Large companies that offshore also show a more dynamic employment growth than the control group before offshoring. But, in contrast to offshoring SMEs, their employment growth does not fall behind that of their non-offshoring twins. The employment growth gap between offshoring and non-offshoring firms is still positive even though not significant anymore. The difference in outcome for SMEs and large companies corresponds to our expectations as formulated further above: even though offshoring may be an attractive option for SMEs to overcome their resource constraints and realize growth, operating in foreign markets is more difficult for SMEs because of the costs involved.

Table 9 reports the results for the outcome variable 'share of high skilled labour' for the different subcategories of firms (corresponding to Table 4). The results are broadly consistent with our previous results. Except for micro firms with nine employees or less the results for all SMEs show the expected sign, even though only the result for small firms is significant. Table 9 in combination with Table 4 also reveals that, again, large companies differ from SMEs. First, offshoring and non-offshoring large firms do not differ systematically in the run-up to an offshoring decision in terms of the employment share of high-skilled labour. Second, offshoring does not give rise to a significantly positive effect on the share of high-skilled labour.

Table 9. Share of high-skilled workers in total workforce subject to social security contributions; common support.

Firm size	Difference (before 2007)	Difference (2007–2013)	DiD
Micro firms (≤9 employees, $n = 30$)	0.046***	0.028**	−0.017
Small firms (>9 and ≤49 employees, $n = 50$)	0.041***	0.101***	0.060***
Medium-sized firms (>49 and ≤249 employees, $n = 69$)	−0.001	0.014*	0.015
Larger firms (>249 employees, $n = 41$)	0.021	0.039***	0.019

***, **, and * denote significance at the 1%, 5% and 10% levels.
DID: difference-in-difference.

As pointed out above, a firm's ability to develop a sustained competitive advantage is directly linked to its resource quantity and quality (Barney 1991). Our results can be interpreted as lending support to this view. Production tasks that are offshored are those that others can carry out relatively more productively. The reallocation of resources towards activities with higher value added offers the chance to realize a (sustained) gain in productivity (Olsen 2006), extend a firm's competitive advantage and create potential for growth and higher employment. Yet, the flip side of the coin is that managing a more fragmented international production chain is a resource-intensive task. In a study reviewing outsourcing by 50 IT companies, Barthélemy (2001) points to the costs of monitoring and possibly adapting contractual obligations as an important area of underestimated or hidden costs that can cancel out or even overcompensate the potential offshoring gains. Our results support the view that this can be particularly severe for SMEs, given their already tighter resource constraints.

VI. Conclusions

While public opinion is still very critical of offshoring, recent theoretical and empirical research emphasizes its potential benefits and points to employment and productivity gains that can outweigh the immediate displacement effects. We have analysed this for SMEs in Germany. SMEs differ from larger companies in dimensions – they typically face tighter (financial, physical and human) resource constraints – that can be expected to lead to specific patterns in the offshoring context.

Our empirical approach is designed with two steps consisting of PSM and a DiD estimation. More specifically, our empirical model feeds the matching results derived from a PSM exercise into a DiD analysis to eliminate distortions due to unobserved time trends which could give rise to a misidentification of causal treatment effects.

Even though we find evidence for a displacement or downsizing effect immediately after production

processes have been relocated, our results suggest that offshoring is not detrimental to jobs in the medium run. On the other hand, we cannot confirm the results derived in previous work that offshoring can unleash new employment dynamics and accelerate the creation of more jobs domestically. While the overall development of employment in offshoring firms is positive, our findings also imply that offshoring leads to less jobs being created than would be the case otherwise. Therefore, our study suggests that the main negative effect associated with offshoring by German SMEs is not the export of jobs but the slowing down of employment growth. However, our study for SMEs confirms that the skill composition of the labour force experiences a noticeable shift towards high-skilled labour. We also find evidence that SMEs that offshore have a higher share of high-skilled labour already before offshoring. This can be understood to indicate that offshoring firms tend to be among the more productive and innovative firms.

It should be kept in mind though that the article follows the usual dichotomy between high-skilled and low-skilled labour and differentiates between both when analysing the effects of offshoring. Recent work, however, has focused on the type of tasks workers perform in the offshoring context (Blinder 2007; Grossman and Rossi-Hansberg 2008). Moreover, our article does not intend to examine the economy-wide employment effects of offshoring. To add to our results, the indirect effects of offshoring of SMEs on, e.g. domestic suppliers, could be addressed in future work, for example as in Moser, Urban and Weder Di Mauro (2015).

Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendix

A Short-run analysis

To complement the results presented in the main body of this article, a related but slightly different outcome variable is used. Due to data limitations, a difference-in-difference analysis couldn't be run so that only the results for the PSM exercise can be presented. We are now calculating the *share* of firms and not the average number of redundancies per firm (Table A1). We also present the ATT for the PSM calculated with other matching estimators than the nearest-neighbour algorithm (Table A2).[33]

Table A1. Redundancies, share of firms in 2008.

	Offshoring	No relocation	Difference	*t*-Stat.
Unmatched	0.178	0.122	0.057	1.70
Matched	0.178	0.162	0.016	0.37

n = 101 (common support); own calculation with STATA (psmatch2, nearest neighbour 5).

Table A2. Redundancies, share of firms in 2008; alternative matching algorithms; kernel (1000), calliper (0.1).

	Kernel	Radius	Calliper
ATT	0.55	1.48	0.55

B List of covariates

Short-run analysis

Business volume, export turnover, job safeguarding, newly employed (higher education), skill shortage, collective wage agreement, pay scale, further education, works council, ownership (owner managed, family ownership, foreign owner) and legal status. We also included the three industries with the highest volume of offshoring activities (mechanical engineering, electrical engineering, steel and metals) as additional control variables.

Medium-run analysis

We use a rather broad set of covariates to reduce a possible selection bias due to missing confounders. However, despite the overall good matching quality, significant differences between the treatment and the control group could not be eliminated for all covariates. For example, we included 'foreign turnover' in our estimations even though we were only able to reduce but not level out the difference between both groups for this covariate and therefore, we cannot wholly rule out that a selection bias remains. We also run our estimations without 'foreign turnover' and results did not change (results are available on request).

Table B1. Results based on Kernel PSM under the common support restriction; *n* = 103.

Covariate	Coefficient probit eq.	SE	% reduction bias	*t*-Test (unmatched)	*t*-Test (matched)
Age	0.0000***	(2.07e-06)	−51.8	−0.21	−0.23
Legal status	0.0235***	(0.002)	63.1	3.21***	0.73
Turnover (in €)	−1.31e-10*	(7.24e-11)	65.2	4.90***	1.10
Turnover in West Germany (in %)	−0.0002***	(0.000)	97.5	−0.87	0.02
Intermediate inputs (in %)	−0.0002***	(0.000)	66.1	1.75*	0.43
Investment (in €)	−1.68e-09*	(8.89e-10)	55.8	1.79*	0.92
Foreign turnover (in €)	0.0014***	(0.000)	65.1	17.05***	2.30**
Industry2	−0.0271***	(0.005)	57.8	8.70***	2.37**
Industry3	−0.0304***	(0.005)	55.0	−2.51**	−1.04
Industry4	−0.0250***	(0.005)	51.5	−3.84***	−1.78*
Industry5	−0.0444***	(0.007)	30.8	1.18	0.52
Industry6	−0.0135	(0.016)	75.0	−0.19	−0.04
Industry7	0.1685***	(0.005)	19.5	0.81	0.45
Industry8	0.0209***	(0.005)	55.4	−4.51***	−2.12**
Unmatched	**Pseudo R^2** 0.147	LR-test χ^2 = 232.24	(*t*-Stat.) (0.00)		
Matched	**Pseudo R^2** 0.038	LR-test χ^2 = 16.72	(*t*-Stat.) (0.473)		

***, **, and * denote significance at the 1%, 5% and 10% levels.

Included industries are (1) manufacturing, (2) construction, (3) retail and repair, (4) transport and communication, (5) business-related services and (6) other services.

[33]Caliendo and Kopeinig (2008) discuss a range of matching estimators suggested in literature such as nearest neighbour, kernel, calliper and radius. The various matching estimators differ essentially in the way they define the acceptable range of matching 1075 partners for the treated firm and in the weight they attach to them.

Table B2. Results based on Kernel PSM under the common support restriction; $n = 81$.

Covariate	Coefficient probit Eq.	SE	% reduction bias	*t*-Test (unmatched)	*t*-Test (matched)
Age	0.0001***	(3.80e-06)	57.9	1.06	0.31
Legal status	0.0652***	(0.005)	44.9	4.10***	1.26
Turnover (in €)	−2.49e-10*	(1.44e-10)	41.6	3.51***	1.53
Turnover in West Germany (in %)	0.0007***	(0.000)	61.2	−0.36	−0.12
Intermediate inputs (in %)	−0.0002	(0.000)	41.5	2.48**	1.04
Investment (in €)	1.46e-09	(1.25e-09)	28.5	1.37	1.26
Foreign turnover (in €)	0.0009***	(0.000)	46.1	12.30***	2.79**
Skilled employees	0.0034***	(0.000)	41.6	7.68***	2.24**
Industry2	0.1346	(0.2645)	42.3	5.89***	2.20**
Industry3	0.4671	(0.3900)	40.0	−2.34**	−1.32
Industry4	0.1245	(0.3943)	43.0	−2.52**	−1.24
Industry5	0.6665*	(0.40362)	29.0	1.46	0.61
Industry 6	0.4532	(0.2564)	23.8	0.34	0.16
Industry7	0.5764	(0.3802)	−9.4	0.20	0.15
Industry8	0.4654	0.3857	36.4	−3.13***	−2.37**
Unmatched	**Pseudo R^2** 0.132	LR-test $\chi^2 = 130.69$	(*t*-Stat.) (0.00)		
Matched	**Pseudo R^2** 0.065	LR-test $\chi^2 = 18.95$	(*t*-Stat.) (0.216)		

***, **, and * denote significance at the 1%, 5% and 10% levels.

Included industries are (1) manufacturing, (2) construction, (3) retail and repair, (4) transport and communication, (5) business-related services and (6) other services.