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Does offshoring boost productivity? A comparison of SMEs and large firms for Germany

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Abstract

We use plant-level evidence for Germany to explore the productivity effects of offshoring of small and medium-sized enterprises (SME) and compare them to those derived for a sample of large German companies. SMEs usually face tighter resource constraints than larger companies, thus making it harder for them to reap the potential productivity gains associated with offshoring. We find evidence for the group of SMEs that plants that offshore business activities tend to be among the more productive ones, ex ante. However, offshoring plants lose this edge over their non-offshoring counterparts. The initial productivity gap is reversed, and the productivity of offshoring plants lags behind even several years after off-shoring has actually taken place. Neither observation can be confirmed for large companies.

Keywords: Offshoring; SME; Productivity; Difference-in-difference analysis; Germany
JEL Classification Codes: F16, F23, J24

1. Introduction

The international fragmentation of value chains promises productivity and efficiency gains for the individual offshoring firms. Offshoring offers firms the chance to split up the production chain and focus on tasks they can perform relatively efficiently in-house. Yet, operating an internationally fragmented value chain is a resource intensive task. An increasingly voluminous literature points to ambiguous results of offshoring and seeks to understand the factors that give rise to the gap between expected and realized performance (e.g., Larsen et al, 2013; Mykhaylenko et al., 2015). An element that has not yet received substantial attention in this ongoing debate about the challenges of offshoring is firm size. Offshoring requires a range of resources and capabilities that SMEs typically find more difficult to acquire and maintain than larger companies. In other words, it can be suspected that SMEs may find it harder than large companies to exploit the potential for productivity gains that offshoring promises. To shed light on this issue, this paper explores the productivity effects of offshoring for a sample of SMEs and compare them to those derived for a sample of large German companies.

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The identification of a link between offshoring and productivity is complicated by the fact that firms may not only differ in the post-offshoring period but already before offshoring actually occurs. We apply a difference-in-difference (DiD) estimator to identify the causal effects of offshoring on productivity. Propensity score matching is used to create a valid control group of statistical twins for the treatment group and condition the DiD estimator.

Our evidence suggests that offshoring SMEs tend to be among the more productive ones ex ante. However, offshoring establishments lose this advantage over their non-offshoring counterparts. Even several years after offshoring has taken place non-offshoring establishments still keep an edge over offshoring ones. We cannot find similar evidence for larger companies. For the group of SMEs, this result provides some counterbalance to the widely held notion that offshoring may be an effective business strategy to maintain or gain a competitive edge over competitors.

2. Empirical strategy and data

Productivity after offshoring of firm i can be measured but, obviously, we cannot observe the counterfactual, i.e., the productivity of firm i if it had not offshored. Hence, the difference in productivity after offshoring cannot be measured for an *individual* firm. Yet, the average effect of treatment (offshoring) on the treated (the offshoring firms), in short the ATT, can be studied. In order to do this we have to identify firms that did not undergo the treatment (i.e., did not offshore), but are as similar as possible to the offshoring firms in all relevant pre-treatment characteristics. Rosenbaum and Rubin (1983) have shown that a valid control group (the missing counterfactual) can be found through propensity score matching (PSM) (Rosenbaum and Rubin, 1983). Formally, the propensity score is defined as $P(\mathrm{D}=1|\mathbf{X}) = P(\mathbf{X})$ with $\mathbf{X}$ denoting the vector of covariates. A probit model is used to calculate $P(\mathbf{X})$.

However, relying only on the PSM to estimate the effects of offshoring may result in misleading, or even wrong, conclusions (Smith and Todd 2005). We therefore use a difference-in-difference (DiD) matching estimator, conditioned on the PSM, that compares the change in outcome for the treatment group to the change in outcome for untreated statistical twin plants, where changes are measured relative to pre-treatment benchmarks. Thus, time-invariant pre-treatment differences between both groups are explicitly taken into consideration when identifying the treatment effect.

The DiD technique starts from the assumption that in the absence of treatment $E[Y_{0t} - Y_{0t'}|P(\boldsymbol{X}), D=1] = E[Y_{0t} - Y_{0t'}|P(\boldsymbol{X}), D=0]$, where the subscript “0” indicates “no treatment” and t (t') denotes the post-treatment (pre-treatment) period. Then, the ATT using the DiD approach can 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. Hence, the corresponding estimator can be written as

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

with w_{ij} denoting the weight attached to firm j from the control group (Heckman, Ichimura and Todd 1997). We use an Epanechnikov kernel function with the usual bandwidth of $h = 0.06$ to determine w_{ij}.

Our data source is the IAB Establishment Panel from the Institute for Employment Research in Germany (IAB), a rich data set based on a representative annual survey of approximately 16,000 establishments (see Ellguth, Kohaut and Müller 2013). Our data set permits an accurate identification of offshoring events and allows us to run our estimates without having to resort to proxy measures for offshoring.

We used the surveys from 1999 to 2014 to create a panel data set. In the 2007, 2008 and 2010 surveys (waves) additional questions were included that allow the unambiguous identification of offshoring activities (relocations abroad). The treatment group therefore consists of all plants that i) confirmed offshoring in the surveys, ii) had not undertaken offshoring before (to avoid biasing our results) and iii) participated in all surveys between 1999 and 2014. It comprises $n = 187$ plants. Also note that our data does not enable us to discriminate between offshoring to a firm that is legally independent of the offshoring firm and one that is not, such as a subsidiary. The control group comprises 519 plants and is sufficiently large to find very good twins for our treatment group (Tables A1 and A2 in the Appendix A).

3. Empirical results

We use labour productivity, defined as turnover divided by the number of employees (subject to social security contributions), as our productivity measure. The sample observations are aggregated into a pre- and a post-treatment period, using 2007 as the first (survey) year for which we can unambiguously identify offshoring activities as separation point.

Our evidence points to significant (1% level) pre-offshoring differences between the treatment and the control group (Table 1, column 3). The difference-in-difference estimation in the last column reports the estimated mean difference in the growth of labour productivity between the treatment and control groups after the treatment. The conclusion can be drawn that productivity growth in the control group after offshoring is higher (i.e., less weak) than in the treatment group.[1]

We cannot confirm these findings for large offshoring firms. In contrast to the SMEs, no evidence could be found for a significant difference in labour productivity growth across the pre- and post-treatment periods between offshoring and non-offshoring companies (Table 2, last column). Hence, offshoring does not have any systematically positive or negative effect on labour productivity for the group of large companies.

Table 1. Average annual growth of labour productivity for SMEs.

Pre-treatment (1999 – 2006)			**Post-treatment (2007 – 2014)**			
No relocation	**Offshoring**	**Diff**	**No relocation**	**Offshoring**	**Diff**	**Diff-in-Diff**
0.025	0.054	0.029***	-0.003	-0.031	-0.027***	-0.057***
		(0.007)			(0.007)	(0.010)

Notes: Average annual values for the pre-treatment and the post-treatment periods based on yearly data; n = 88 (common support). The S.E. is given in parentheses.

Table 2. Average annual growth of labour productivity for large companies.

Pre-treatment (1999 – 2006)			**Post-treatment (2007 – 2014)**			
No relocation	**Offshoring**	**Diff**	**No relocation**	**Offshoring**	**Diff**	**Diff-in-Diff**
0.021	0.055	0.034	0.017	-0.053	-0.070	-0.103
		(0.042)			(0.043)	(0.074)

Notes: Average annual values for the pre-treatment and the post-treatment periods based on yearly data; n = 36 (common support). The S.E. is given in parentheses.

[1] It can be suspected that the across-the-board decline in labour productivity which is observable for both SMEs and large companies in the 2007 – 2014 period is related to the financial crisis (see Adler et al. 2017 for a comprehensive report on productivity trends).

To check the robustness of our results, we use bootstrapping techniques to estimate the coefficients and standard errors in both steps, where we set the number of bootstrapping replications equal to 500. Our conclusions remain robust (results are available on request).

To address the potential problems of simultaneous causality and unobservable confounders, we have additionally implemented a double-robust estimator to control for (possible) misspecifications. The results of these (alternative) estimations show (very) similar coefficients and t-values and, therefore, are not reported here.

As an additional robustness check, we created sub-categories and focused on micro (less than 10 employees), small (between 10 and 49 employees) and medium-sized enterprises (between 50 and 249 employees). Our results remain significant for all three sub-groups (Table A3 in Appendix A). Lastly, we vary the size limit used to distinguish between SMEs and larger companies. We find that the results are significant and negative for firms with up to 200 employees (results available upon request). This result corresponds to the finding by Görg and Hanley (2004) whose estimate for the Irish electronics sector suggests that the size threshold for firms to benefit from materials outsourcing is 262 employees.[2]

4. Discussion

Our results provide further evidence for the challenges of offshoring that have also sparked the backshoring and reshoring debate (e.g., Johansson and Olhager, 2018). Whilst several paper find positive productivity effects of offshoring (e.g., Amiti and Wei 2009; Moser, Urban and Weder di Mauro 2015; Winkler 2010 for Germany), they do not discriminate between smaller and larger firms. Yet, managing a more fragmented production chain is a resource intensive task. This may be particularly difficult to accommodate for SMEs given their already more constrained resource base, not only financially but also regarding high skilled labour, knowledge, experience and management capacities (e.g., Acs et al. 1997; Hollenstein 2005). SME are more prone to make estimation errors due to hidden costs, i.e. unanticipated costs that arise in the implementation of strategic decisions that give rise to new organisational and operational complexities such as offshoring (Larsen et al, 2013). Grossman and Helpman (2002) offer a related argument. They point out that operating an international production chain is likely to be based on incomplete contracts that give rise to repeated renegotiations and potential hold-up problems. With a firm's bargaining power at least partly dependent on its size, SMEs will find themselves in a more difficult position than larger companies to deal with contingencies that require contractual adjustments. Moreover, the renegotiation of contracts is likely to occur in an environment characterized by different legal and bureaucratic regimes straining the more limited managerial capacities of SMEs even further. Mykhaylenko et al. (2017) also point to the managerial capacity as limiting factor in an increasingly complex organization as offshoring implies that physical and cultural distances have to be managed effectively.

In particular for offshoring SMEs, the redesign organizational processes and structures, informed by a clear orientation towards the expected benefit (e.g., cost saving, access to technology or raw materials), appears paramount to cope with new complexities and reduce the erosion of financial and managerial resources (see also Larsen et al., 2013 and Mykhaylenko et al., 2015).

[2] Mykhaylenko et al., 2015 caution that not all offshoring benefits cannot (immediately) be reliably measured. However, as we focus on the comparison of SMEs and larger companies using the same dataset, our diff-in-diff results will remain unaffected.

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Appendix A

Table A1. Matching results for SMEs.

Covariate	% reduction bias	t-test (unmatched)	t-test (matched)
Age	-12.3	-0.24	-0.20
Legal status	55.8	2.01	0.50
Turnover (in €)	59.6	2.27	0.70
Turnover in West Germany (in %)	33.8	1.31	0.76
Intermediate inputs (in %)	73.9	0.73	0.15
Investment (in €)	68.0	0.73	0.23
Employees	58.5	5.14	1.19
Foreign turnover (in %)	61.2	8.71	1.38
Skilled employees	60.3	5.82	1.18
R&D	62.7	9.02	1.56
Unmatched	**Pseudo R^2 =** 0.171	LR-test χ^2= 94.92	(p>chi²) (0.000)
Matched	**Pseudo R^2 =** 0.072	LR-test χ^2= 10.79	(t-stat) (0.822)

Notes: Results based on Kernel PSM under the common support restriction; n = 88.

Table A2. Matching results for large firms.

Covariate	% reduction bias	t-test (unmatched)	t-test (matched)
Age	-37.4	0.47	-0.18
Legal status	9.8	1.45	0.88
Turnover (in €)	76.0	-0.72	-0.29
Turnover in West Germany (in %)	88.3	1.15	0.10
Intermediate inputs (in %)	7.2	-1.51	-1.49
Investment (in €)	89.2	-0.86	-0.15
Employees	-51.4	-0.19	0.35
Foreign turnover (in %)	40.4	-1.32	-0.60
Skilled employees	41.8	-0.26	0.21
R&D			
Unmatched	**Pseudo R^2 =** 0.230	LR-test χ^2= 12.25	(p>chi²) (0.200)
Matched	**Pseudo R^2 =** 0.151	LR-test χ^2= 3.47	(p>chi²)) (0.943)

Notes: Results based on Kernel PSM under the common support restriction; n = 36.

Table A3. Growth of plant labour productivity for size-related subgroups of SMEs (Diff-in-Diff results).

	Micro (N=10)	**Small (N=31)**	**Medium-Sized (N=47)**
Kernel-Common Support	-0.062*** (0.010)	-0.032*** (0.011)	-0.061*** (0.013)
Bootstrapping	-0.044 (0.112)	-0.027 (0.040)	-0.045 (0.029)
Additional variable "R&D-Department"	-0.066*** (0.020)	-0.025*** (0.012)	-0.068*** (0.013)

Note: The S.E. is given in parentheses.