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ABSTRACT

Offshoring and Firm Performance: Self-Selection, Effects on Performance, or Both?*

This paper uses unique new data for German manufacturing enterprises from matched regular surveys and a special purpose survey to investigate the causal effect of relocation of activities to a foreign country on various dimensions of firm performance. Enterprises that relocated activities abroad in the period 2001-03 for the first time are compared to firms that did not relocate activities abroad before 2006. The comparison is performed for both 2004 (to document differences between the two groups of firms after some of them started to relocate abroad) and for 2000 (when none of them did relocate abroad). It turns out that, compared to non-offshoring firms, firms that relocated activities were larger and more productive, and had a higher share of exports in total sales. All these differences existed in 2000, the year before some firms started to relocate, and this points to self-selection of "better" firms into offshoring. This finding is in line with results from recent theoretical models and with results from other countries. To investigate the causal effects of relocation across borders on firm performance, six different variants of a matching approach of firms that did and did not start to relocate abroad in 2001-03 were performed based on a propensity score estimated using firm characteristics in 2000 and the change in the performance variable between 1997 and 2000. The performance of both groups was compared for 2004-06 when some firms were relocating firms and the others were not. Broadly in line with hypotheses derived from the literature there is no evidence that offshoring has a negative causal impact on employment in offshoring firms. The effect is positive and large for productivity, and weak evidence for a positive effect on the wage per employee, the proxy variable for human capital intensity used, is found. Contrary to what is often argued, therefore, we find no evidence for a negative causal effect of offshoring on employment in Germany or on other core dimensions of firm performance.

JEL Classification: F23

Keywords: offshoring, Germany, enterprise panel data

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"We live in an age of outsourcing. Firms seem to be subcontracting an ever expanding set of activities, ranging from product design to assembly, from research and development to marketing, distribution and after-sales service. Some firms have gone so far as to be become 'virtual' manufacturers, owning designs for many products but making almost nothing themselves."

Grossman and Helpman (2005), p. 135

1. Motivation

Offshoring – the relocation of activities formerly performed in a domestic firm to a firm located in a foreign country[1] - is one of today's catchwords. Putting it into Google lead to some 2,040,000 results in 0.22 seconds on August 14, 2009, the day I started writing this paper. Most of the time (at least, in Germany) offshoring is used with a negative connotation, pointing to jobs lost due to relocating production from the high-wage country Germany to countries where labour is cheaper.[2] A case in point is a note that appeared the day before, on August 13, 2009, in the local newspaper,

[1] In this paper I follow Olsen (2006, p. 6f.) and define offshoring as the relocation of processes to any foreign country without distinguishing whether the provider is external or affiliated with the firm, while outsourcing is defined as the relocation of processes to external providers regardless of the provider's location within the home country or in a foreign country. Offshoring, therefore, includes international outsourcing (to a non-affiliated firm) and international insourcing (to an affiliated firm). Similarly, Görg, Greenaway and Kneller (2008, p. 3) define outsourcing as a process whereby an activity which was previously undertaken in-house is contracted to another supplier, and this could be supply of intermediate inputs or services. When this process occurs across national frontiers, this is called offshore outsourcing or, for short, offshoring. Offshoring leads to what Grossman and Rossi-Hansberg (2006, 2008) named international "trade in tasks" that is different from trade in complete goods.

[2] In a representative survey of the German population (aged at least 16 years) performed in June 2006 78 percent associated "globalization" with relocation of jobs abroad, and 61 percent with a loss of jobs at home; see Institut für Demoskopie Allensbach (2006).

telling that in a small city nearby an enterprise reduces the number of employees by 70 (of 175) because it relocates part of its production to Poland to save costs.[3]

Obviously, however, a negative causal impact of offshoring on domestic employment is not necessary. Grossman and Rossi-Hansberg (2006, p. 61f.) argue that when some tasks performed by a certain type of labour can be more easily offshored, the firms that gain the most are those that use this type of labour intensively. Profitability of these firms will rise, and this will lead to an incentive to expand relative to firms that rely most heavily on other types of labour. The increase in labour demand by these firms will in part fall on local workers who perform tasks that cannot easily be offshored. At the level of the offshoring firm, therefore, there might be a positive impact if the competitiveness of the production remaining in Germany is strengthened and productivity increases. At the macro level an increase in the international division of labour and specialisation on products where the home country has a comparative advantage might foster growth. Furthermore, it is often questionable whether the employment effects that are observed in conjunction with offshoring can be considered to be caused by offshoring. Often production that is relocated is no longer profitable in the home country, and the employees would lose their jobs even if the firm does not engage in offshoring.

The sign and the size of the effect of offshoring on employment at both the level of the firm and the level of the economy as a whole, therefore, can only be revealed by empirical studies. For similar reasons, the same holds for the impact of offshoring on other dimensions of economic performance, including productivity growth and growth in human capital intensity.

[3] See “Produktion in Uelzen zu teuer – Bürobedarf-Konzern Esselte Leitz enlässt 70 Mitarbeiter“ in Landeszeitung für die Lüneburger Heide, 13. 8. 2009, p. 19.

Given the large interest in offshoring in public discussions and the need for empirical research to uncover its consequences, the lack of stylized facts based on a large body of sound econometric studies comes as a surprise.[4] There is, however, both theoretical reasoning and empirical evidence that can be used to guide an empirical investigation on the causes and consequences of offshoring in German manufacturing enterprises.[5]

First of all, there is evidence that offshoring firms differ systematically from non-offshoring firms. In a comprehensive survey of the literature Görg, Greenaway and Kneller (2008, p. 34) ask "whether, among a random sample of firms we would expect all to engage in offshoring or whether it is only a certain group of firms that do so". According to the authors the "short answer to this is: only a certain group – and we would expect this to comprise the 'better' firms in any sample." Görg, Greenaway and Kneller (2008, p. 35) summarize empirical evidence from a number of studies which is in line with this big picture. This leads to a first hypothesis:

H1: Offshoring firms are "better" than non-offshoring firms – they are larger, more productive, more human capital intensive, and have a higher share of exports in total sales.

If firms that relocated parts of their activities abroad are "better" than non-offshoring firms at a point in time this might be caused by self-selection of "better" firms into offshoring. Self-selection would be in line with recent developments in

[4] Geishecker, Görg and Maioli (2008, p. 152) state that "academic research which analyses the phenomenon of outsourcing empirically is only in its infancy". Similarly, Olsen (2008, p. 9) points out that "surprisingly little rigorous empirical research has been done on its economic impacts."

[5] A related literature uses firm level data to investigate the causes and consequences of foreign sourcing, defined as the import of intermediate inputs. Recent contributions include Farinas and Martín-Marcos (2010) for Spain, Görg, Hanley and Strobl (2008) for Ireland, Ito, Wkasugi and Tomiura (2008) for Japan, Jabbour (2010) for France, Kurz (2006) for the U.S., and Morrison Paul and Yasar (2009) for Turkey.

economic theory of international firm activities. Offshoring involves substantial sunk costs related to searching for a foreign partner, doing market research, fixing contractual arrangements etc. Therefore, only the larger, more productive, more human capital intensive firms with a higher share of exports in total sales will be able to overcome these sunk cost barriers and successfully start to offshore (see Antràs and Helpman (2004) and Görg, Greenaway and Kneller (2008, p. 34f.).[6] This leads to a second hypothesis:

H2: Offshoring firms were "better" than non-offshoring firms already before they started offshoring – they were larger, more productive, more human capital intensive, and had a higher share of exports in total sales compared to firms that did not start offshoring in the future. Better firms self-select into offshoring.

The main focus of most empirical studies on the consequences of offshoring[7] is on labour market issues (i.e., the level and the skill composition of employment, and the level and the structure of wages). This literature is surveyed in Geishecker, Görg and Maioli (2008) and Crinò (2009). Summarizing, Görg, Greenaway and Kneller (2008, p. 6) argue that although some studies have identified small negative employment effects of offshoring, the consensus that seems to be emerging is that employment effects are either broadly neutral or result in a small net gain. Similarly, Crinò (2009, p. 234) states that the results of the empirical studies suggest that the overall labour market effect of offshoring is rather modest. However, low-skilled workers in particular feel the pressure from international outsourcing (see

[6] The same argument holds for sunk costs related to exporting and foreign direct investment; see Wagner (2007a) for a survey of the literature and Wagner (2006, 2007b) for studies with German firm level data.

[7] A related literature investigates empirically the consequences of outsourcing, defined as the relocation of activities between firms without distinguishing whether the provider is located in a foreign country or not. Studies with German firm level data include Görzig, Kaminiarz and Stephan (2005) and Addison et al. (2008), for the UK see Girma and Görg (2004), for Ireland Görg and Hanley (2004).

Geishecker, Görg and Maioli (2008, p. 169) and Crinò (2009, p. 234)). This leads to a third and a fourth hypothesis:

H3: Employment effects are either broadly neutral or result in a small net gain in offshoring firms.

H4: The skill composition in offshoring firms changes in favour of high-skill employees.

Studies focusing on other dimensions of firm performance are rare. We have some evidence, however, for productivity. Olsen (2008, 9) states that direct investigations of the impact of outsourcing on firm productivity are relatively few in number. Görg, Greenaway and Kneller (2008, p8) summarize the findings by stating that for manufacturing firms offshoring results in higher labour productivity. This leads to a fifth hypothesis:

H5: For manufacturing firms offshoring results in higher labour productivity.

What do we know about the validity of these five hypotheses for Germany? Empirical studies on the causes and on the causal effects of offshoring on the performance of enterprises in Germany, a leading actor in the world markets for goods and services, are rare:

Kinkel, Lay and Maloca (2004) use data from a small sample of firms collected in 2003 to look at the extent, the determinants, and the employment effects of relocation of production (see also Kinkel and Maloca 2008, 2009). The studies are descriptive only, and no causal effects of offshoring on firm performance are looked at.

Geishecker and Görg (2005) combine individual level data from the German socio-economic panel SOEP and industry-level information on imported inputs from input-output tables to investigate the effects of international fragmentation of production on individual wages (see also Geishecker (2005), Geishecker and Görg

(2008)) and on individual employment security (Geishecker 2008). Bachmann and Braun (2008) use a similar approach based on individual level data from the IABS, a sample provided by the Institute for Employment Studies, combined with industry-level data on imports of intermediate products. By construction all these studies cannot uncover any causal effect of outsourcing on enterprises, and the same holds for studies by Geishecker (2006) and Schöller (2007a, 2007b) based on industry level data.

Marin (2006) is a study on the extent and determinants of relocation to Eastern Europe, based on a survey of German and Austrian enterprises that invested in east-European countries between 1990 and 2001. The consequences of offshoring, however, are not considered in this study.

Buch et al. (2007) use firm level data from the "Going International" – survey performed in 2005 (see DIHK 2005) to investigate the causes and employment consequences of offshoring. Furthermore, they analyse a question from the 2004 wave of the IAB establishment panel (see Fischer et al. 2009) that deals with planned relocation to the new EU member countries, and they use micro data on foreign direct investments from the MiDi data base of the German central bank (see Lipponer 2003) aggregated at the regional level (federal states) and the level of broad industries. The focus is on the determinants of offshoring and on the employment effects of foreign direct investment at the regional and sectoral level. The causal effects of offshoring on firm performance are not investigated in this study.

The only study using German firm level data to investigate the causal effects of offshoring that I am aware of is a recent paper by Moser, Urban and Weder di Mauro (2009). The authors use data from the IAB establishment panel (described in Fischer et al. 2009) for 1998 to 2004 to identify causal effects of offshoring on employment. They measure offshoring as qualitative increase in the share of

intermediate inputs of an establishment received from abroad. Their variable *offshoring* takes the value of one if the establishment experienced an increase in imported intermediate goods and zero otherwise. The data allow to measure qualitatively such an increase as an establishment's increase in its share of intermediate goods from abroad from 'not at all' to 'partly' or from 'partly' to 'predominantly' between business years. The most important findings of this study are a positive employment effect of offshoring on the domestic plant and an increase in average labour productivity compared to plants that did not offshore.

While the study by Moser, Urban and Weder di Mauro (2009) is for sure an important contribution to the empirical literature it is severely limited by its data-driven focus on measuring offshoring by an increase in the share of intermediate inputs of an establishment received from abroad only. This definition of offshoring is completely different from the definition usually used in the literature on offshoring. As stated above at the very beginning of this paper, offshoring is usually defined as the relocation of activities formerly performed in a domestic firm to a firm located in a foreign country. This relocation might take the form of substitution of intermediate products formerly produced in the firm in Germany by imported intermediate inputs, and this increases the share of intermediate inputs of an establishment received from abroad and indicates offshoring in the sense of Moser, Urban and Weder di Mauro (2009). On the one hand, however, substitution of intermediate inputs formerly bought from suppliers located in Germany by imported inputs is not considered as offshoring according to the definition used here in this paper (but by Moser, Urban and Weder di Mauro (2009)). On the other hand, relocation of activities from a firm in Germany to a foreign country that does not lead to an increase in the import of intermediates (like producing and selling a good in a foreign country instead of producing it in Germany and exporting it) is not counted as offshoring by Moser,

Urban and Weder di Mauro (2009). Therefore, the results reported by Moser, Urban and Weder di Mauro (2009) do not reveal evidence on the causal effect of offshoring (defined in the usual way) in Germany.

Given the large degree of heterogeneity in firm behaviour with respect to outsourcing (Olsen 2008, p. 15) the lack of empirical studies using longitudinal data at the enterprise level to investigate the causes and the causal effects of offshoring on various dimensions of firm performance hinders an understanding of offshoring that could better inform public debates and discussion about policy measures (not only, but also in Germany). This paper contributes to the literature by using unique new data for German manufacturing enterprises from matched regular surveys and a special purpose survey conducted by the federal statistical office to investigate the causal effects of relocation of activities to a foreign country on various dimensions of firm performance.

The rest of the paper is organized as follows. Section 2 introduces the data used in this study. Section 3 presents the results of the empirical investigation. Section 4 concludes.

2. Data

One reason for the absence of empirical studies on the causes and consequences of outsourcing using German firm level data is that information on this important dimension of firm behaviour is missing in the regular surveys conducted by official statistics. Furthermore, it is only touched upon in a limited way in smaller scale

surveys performed by other institutions.[8] Fortunately, however, the German federal statistical office conducted a so-called special purpose survey (*Erhebung für besondere Zwecke*, see §7 of the federal statistics law BStatG) on relocation of economic activities (*Verlagerung wirtschaftlicher Aktivitäten*) in 2006 (see Zwania (2008)).[9] A representative sample of enterprises with at least 100 employees was asked about the reasons to relocate production inside Germany and across the German border, the role of barriers to relocate, the extent of relocation in the past and plans for the near future, the regions they relocated to, the partners in the relocation process, and the consequences of relocation for the firm. For the first time information on these topics is available for a large sample of firms from a survey performed by official statistics, and descriptive results offer a number of new interesting facts on these important (and in part highly controversial) topics (see Statistisches Bundesamt (2008)).[10]

However, the research potential of the data from the relocation survey as such is limited. First of all, it is a cross section survey only, and this hinders any dynamic or causal analyses.[11] Second, many questions ask for a subjective assessment by the

[8] A case in point is the IAB establishment panel used by Moser, Urban and Weder di Mauro (2009).in their study discussed in section 1 above. See also the samples used in other studies based on firm level data from Germany summarized there.

[9] Participation in a special purpose surveys is voluntary, and the sample is limited to 20.000 units. A prerequisite for this kind of survey is either a pressing need for data in the process of preparing or substantiating a planned decision by a high government agency, or the clarification of a methodological question in statistics.

[10] Note that identical surveys have been conducted under the auspices of Eurostat in 11 other countries (Czech Republic, Denmark, Finland, Ireland, Italy, the Netherlands, Norway, Portugal, Slovenia, Sweden, and the United Kingdom); see Neureiter and Nunnenkamp (2009) for an empirical study using aggregate published data from these surveys to investigate the relation between modes of international sourcing and the competitiveness of firms.

[11] This has been pointed out by Roderich Egeler, the president of the German federal statistical office, when he presented results of the survey on relocation of economic activities at a press conference in Berlin on February 17, 2009. See Statistisches Bundesamt (2009), p. 10.

interviewee, and it is an open question whether this person is willing and able to give a correct answer. To enhance the research potential of these data considerably, they were matched to a panel data set that has information from a regular survey from official statistics, the monthly report for establishments in manufacturing industries.[12]

The monthly report for establishments in manufacturing industries covers all local production units that have at least 20 employees or that belong to an enterprise with a total of at least 20 employees. Information from the monthly surveys is either summed up for a year, or average values based on monthly figures are computed, and a panel data set is build from annual data. Furthermore, the information collected at the establishment level has been aggregated at the enterprise level. A detailed description of the information in these data is given in Konold (2007).

Data from the relocation survey were used to identify enterprises that relocated production abroad in the period 2001-03 for the first time. The questionnaire asks whether firms relocated activities in Germany or abroad before 2001, between 2001 and 2003, between 2004 and 2006, or are planning such activities for 2007 to 2008. Firms that stated that they did not relocate abroad before 2001 but did relocate abroad between 2001 and 2003 are considered to be first-time offshoring firms in this study. Note that the questionnaire does not ask whether relocation abroad happened within the boundary of the firm (i.e. to a foreign subsidiary of the German firm) or to an independent foreign firm. Therefore, it is not possible to distinguish between international outsourcing (relocation abroad between firms) and international insourcing (relocation abroad within the firm).[13] Furthermore,

[12] Matching is technically feasible by using the enterprise number from the special purpose survey that is identical to the enterprise number used in regular surveys, and it is legal according to §13a BStatG.

[13] See Olsen (2006, p. 7) for this terminology and an illustrative matrix of insourcing, outsourcing and offshoring.

no information is collected on the size or intensity of the offshoring activities between 2001 and 2003.

The first-time offshoring firms are compared to non-offshoring firms defined as firms that did not relocate production abroad before 2006. This comparison is based on data from the monthly report, and it is performed for both 2004 (to document differences between the two groups of firms after some of them started to relocate abroad), for 2000 (when none of them did relocate abroad), and for 2004 to 2006 (to compare the performance of offshoring and non-offshoring firms).

There were large differences in labour productivity and other dimensions of firm performance in the period under investigation. Therefore, any empirical investigation should be performed for enterprises from both parts of Germany separately. However, when the sample was split into enterprises located in West Germany and in East Germany it turned out that only 18 East German enterprises were first-time offshoring firms. Any results for this small group of firms were classified as confidential by the statistical office. Therefore, this study has to be limited to enterprises from West Germany.

By construction, the sample of first-time offshoring firms and non-offshoring firms used in this study is biased in two ways. First of all, given that the firms were asked in 2006 only firms that survived until 2006 are sampled, and both offshoring and non-offshoring firms that exited between 2001 and 2006 are not covered in the sample. This implies that firms that closed down before 2006 can not be included in the calculations of any causes or effects of offshoring. The direction and the size of any survivor bias is an open question here. Second, only enterprises with at least 100 employees in 2006 were sampled in the relocation survey, and all results, therefore, are for larger firms only. However, it can be argued that offshoring might well be considered to be a rare event among smaller enterprises.

3. Offshoring and firm performance: Empirical results

3.1 Ex-post differences between offshoring and non-offshoring firms

The empirical investigation starts with a comparison of first-time offshoring firms and non-offshoring firms in 2004, the year after all first-time offshoring firms started to relocate abroad, to test the first of the five hypotheses looked at in this paper.

H1: Offshoring firms are "better" than non-offshoring firms – they are larger, more productive, more human capital intensive, and have a higher share of exports in total sales.

Firm size is measured by the number of employees; productivity is defined as labour productivity measured by sales per employee; human capital intensity is measured by wage per employee; and export intensity is the share of exports in total sales. All data are based on information collected in the monthly report of establishments in manufacturing industries. Given that this report is a census of all manufacturing enterprises with at least 20 employees, all enterprises from the survey on relocation of economic activities (that covers a sample of all enterprises with at least 100 employees only) are covered by the monthly report. The sample used here is restricted to enterprises that were active already in 1997, ten years before the survey on relocation was performed. The reason for this selection of firms is that for the analysis of the causal effects of offshoring on firm performance information on the change in the performance of the firms between 1997 and 2000 (in the period before some of the firms started offshoring) is needed. Information on 2,029 enterprises without offshoring before 2006 and on 160 firms that started offshoring activities in 2001 to 2003 is available. A comparison of mean values for the two groups of firms reported in table 1 shows that compared to non-offhoring firms offshoring firms are

larger, more productive, more human capital intensive, and have a higher share of exports in total sales. These differences in means are, however, only statistically different from zero at a conventional error level of five percent or less for the share of exports in total sales.

[Table 1 near here]

If one looks at differences in the mean value for both groups only, one focuses on just one moment of the distribution of a characteristic. A stricter test that considers all moments is a test for stochastic dominance of the distribution for first-time offshoring firms over the distribution for non-offshoring firms. More formally, let F and G denote the cumulative distribution functions of productivity for exporters and non-exporters. If $F(x) - G(x) = 0$, the two distributions do not differ, while first order stochastic dominance of F relative to G means that $F(z) - G(z)$ must be less or equal zero for all values of z, with strict inequality for some z. Whether this holds or not is tested non-parametrically by adopting the Kolmogorov-Smirnov test (see Conover 1999, p. 456ff.). The Kolmogorov-Smirnov test indicates that the two distributions do differ at an error level of five percent for all characteristics but the wage per employee, and that the distribution for first-time offshoring firms first-order stochastically dominates the distribution for non-offshoring firms.[14]

The big picture, then, is that compared to non-offshoring firms those firms that started offshoring in the years 2001 to 2003 were in 2004 larger and more productive, and had a higher share of exports in total sales. These findings are in line with hypothesis 1.

[14] Farinas and Martín-Marcos (2010) use this approach to look at differences between firms that engage in foreign sourcing – i.e. that import intermediate inputs – and firms that do not.

3.2 Ex-ante differences between offshoring and non-offshoring firms

The fact that firms that started offshoring in 2001 to 2003 were different (and in a sense “better”) than non-offshoring firms in 2004 does not have any implications for the direction of causality between firm characteristics and offshoring. For example, this does not point to positive growth effects of offshoring - it might well be the case that there is self-selection of larger firms into offshoring, and the same holds for any other firm characteristic considered here. As discussed in section 1 above this would be in line with recent developments in economic theory of international firm activities, and with the second hypothesis to be tested in this study.

H2: Offshoring firms were “better” than non-offshoring firms already before they started offshoring – they were larger, more productive, more human capital intensive, and had a higher share of exports in total sales compared to firms that did not start offshoring in the future. Better firms self-select into offshoring.

If there is self-selection of this type we expect to find significant differences in firm characteristics between future offshore-starters and future non-starters in the year before some of them begin offshoring. This is tested empirically by comparing firms from the two groups in 2000 when none of them was offshoring but some of them were about to start to offshore in the period to come.

Results reported in table 2 indicate that the differences that were found in 2004 existed already in 2000, the year before some firms started to relocate. While the differences in means are, like in 2004, only statistically different from zero at an error level of five percent or less for the share of exports in total sales, the null hypothesis of equality of distributions of the firm characteristics can be rejected for all characteristics but the wage per employee (albeit at an error level of nine percent

only in the case of labour productivity), and the Kolmogorov-Smirnov test points out that the differences in characteristics are favourable for firms with offshoring. In line with hypothesis 2 this points to self-selection of “better” firms into offshoring.

[Table 2 near here]

3.3 Causal effects of offshoring on firm performance

If firms that start to offshore differ from firms that do not offshore it is not appropriate to consider any difference in performance between offshoring and non-offshoring firms to be caused by offshoring. Therefore, it is not appropriate to investigate the consequences of offshoring by comparing the performance of both groups of firms over the years after some of them started to relocate activities abroad. Instead, an alternative approach to test for effects of starting to offshore is applied next.

To motivate this approach, consider the following situation: Assume that a study reports that firms that started offshoring have substantially faster growth of employment in the following years than firms that keep producing in the home country only. Does this point to a causal effect of starting to offshore on employment? The answer is, obviously, no: If larger and faster growing firms self-select into offshoring, and if, therefore, today’s offshore-starters are 'better' than today’s non-offshoring firms (and have been so in the recent past), we would expect that they should, on average, perform better in the future even if they do not start to offshore today. However, we cannot observe whether they would really do so because they do start to offshore today. We simply have no data for the counterfactual situation. So how can we be sure that the better performance of offshore-starters compared to non-offshorers is caused by offshoring (or not)?

This closely resembles a situation familiar from the evaluation of active labour market programs (or any other form of treatment of units): If participants, or treated units, are not selected randomly from a population but are selected or self-select according to certain criteria, the effect of a treatment cannot be evaluated by comparing the average performance of the treated and the non-treated. However, given that each unit (plant, or person, etc.) either participated or not, we have no information about its performance in the counterfactual situation. A way out is to construct a control group in such a way that every treated unit is matched to an untreated unit that has been as similar as possible (ideally, identical) at the time before the treatment. Differences between the two groups (the treated, and the matched non-treated) after the treatment can then be attributed to the treatment (for a comprehensive discussion, see Heckman, LaLonde and Smith 1999).

Here, firms that started offshoring in 2001 to 2003 are matched with "twins" from the large group of firms that never relocated activities abroad before 2006. Matching is performed by nearest neighbour propensity score matching. The propensity score is estimated from a probit regression of a dummy variable indicating whether or not an enterprise was a first-time offshorer in 2001 – 2003 on the number of employees (also included in squares and cubic), labour productivity, wage per employee, share of exports in total sales, 2-digit industry dummy variables (all measured in 2000) plus the growth of the outcome variable between 1997 to 2000.[15] The balancing property (that requires an absence of statistically significant differences between the treatment group and the control group in the covariates after matching) is tested, and it is satisfied. The difference in means of the variables used to compute the propensity score is never statistically significant between the starters and the matched non-starters. The common support condition (that requires that the

[15] The results of the probit estimates used in the matching are reported in table 1 in the appendix.

propensity score of a treated observation is neither higher than the maximum nor less than the minimum propensity score of the controls) is imposed by dropping offshore starters (treated observations) whose propensity score is higher than the maximum or lower than the minimum propensity score of the non-offshorers (the controls). Matching uses Stata 10.1 and the PSMATCH2 command (version 3.0.0), see Leuven and Sianesi (2003).

Using matched pairs of enterprises the difference in firm performance over the period 2004 to 2006 between starters and matched non-offshorers is computed. This difference is the so-called average treatment effect on the treated, or ATT, the estimated effect of starting to offshore on the respective dimension of firm performance (see Caliendo and Kopeinig (2008) for a comprehensive introduction to propensity score matching and Wagner (2002) for a discussion of this method in the context of the effect of exports on productivity growth). Because it is well known that results from propensity score matching may critically depend on details of the matching algorithm applied alternative methods were used in a robustness check. First, besides the one nearest neighbour the two and the three nearest neighbours from the control group were used to compute the ATT. Second, a kernel matching approach was applied, too. Here, a neighbourhood for each treated observation (first-time offshoring firm) is defined, and the counterfactual is constructed using all observations from the control group (firms without offshoring before 2006) within the neighbourhood, assigning higher weights to observations that are closer to the treated firm. An Epanechnikov-kernel with three different value for the bandwith (0.01, 0.03 asnd 0.05) is used.

To start with, we test for the presence or not of a causal effect of offshoring on change in employment in the firm. The hypothesis derived in section 1 is

H3: Employment effects are either broadly neutral or result in a small net gain in offshoring firms.

Empirical results are reported in the upper panel of table 3. The ATT is positive, and it is extremely large from an economic point of view. The large value of the average rate of growth of employment for the firms that started offshoring might be due to a small number of firms with extremely high values. Unfortunately it is not possible to document (and to investigate further) the highest or lowest values of the rate of growth because these are values for individual firms that cannot be revealed to an investigator due to data protection rules. A way out is to trim the sample by dropping extreme observations of the outcome variable, and then to compare the results from the whole and the trimmed sample. This approach is applied here (and in the investigation of the other hypotheses below), and the top and bottom three percent of the distribution of the outcome variable for the treatment group and the control group were dropped in a robustness check.

[Table 3 near here]

Results for the trimmed sample are reported in the lower panel of table 3. Compared to the results for the whole sample the average rate of employment growth for the first-time offshoring firms is now much lower, and it is negative. For the control group of firms that did not offshore before 2006 this average growth rate is positive or negative, depending on the matching algorithm used. The ATT is negative for all six matching methods applied. However, the effect is not statistically different

from zero at a usual error level according to the t-test.[16] This finding of no causal effect of offshoring on employment is in line with hypothesis 3.[17]

Next, the presence or not of a causal effect of offshoring on the growth of the wage per employee (to proxy a change in the skill composition of the workforce) is tested. The hypothesis stated in section 1 is

H4: The skill composition in offshoring firms changes in favour of high-skill employees.

Results are reported in table 4 for the whole sample (upper panel) and the trimmed sample (lower panel). The ATT is positive for both samples and all matching methods applied, and it is quite large from an economic point of view. The effect, however, is statistically significant at a conventional level for nearest neighbour matching using the whole sample only. Therefore, we can conclude that the results do not contradict hypothesis 4, but are weakly in line with it.

[Table 4 near here]

The next hypothesis to be tested is related to the causal effect of offshoring on the growth of labour productivity (measured as the growth of sales per employee). The hypothesis stated in section 1 is

H5: For manufacturing firms offshoring results in higher labour productivity.

[16] Contrary to a widely used approach in the literature the test for the statistical significance of the ATT in this paper is not based on a bootstrap; see Abadie and Imbens (2008) for a discussion of the failure of the bootstrap for nearest neighbour matching estimators.

[17] A related results is reported by Temouri and Driffield (2009). Using a panel of multinationals based in Germany they show that the expansion of employment abroad does not occur at the detriment of employment at home.

The ATT for the sample as a whole (reported in the upper panel of table 5) depends very much on the matching method used. It is even negative for the two nearest neighbours approach (due to an unusually large value of the average growth of labour productivity for the firms from the control group). According to the t-values reported, however, the ATT is never statistically significantly different from zero. Results for the trimmed sample (reported in the lower panel of table 5) are much more stable across the different matching methods. The ATT is always positive, and large from an economic point of view; the t-values indicate that it is significantly different from zero at an error level of 10 percent or better for four out of six variants. These results are broadly in line with hypothesis 5.[18]

[Table 5 near here]

From the matching approach, therefore, we have no evidence that offshoring has a negative causal impact on employment in offshoring firms. This finding is in line with results from studies for other countries, and with hypothesis 3. The effect is positive and large for productivity. This effect is again in line with results from the international literature, and with hypothesis 5. Weak evidence only for a positive effect on the wage per employee, the proxy variable for human capital intensity used, is found.

[18] A related result is reported in a recent study by Temouri, Driffield and Higón (2009) on the link between productivity effects and outward FDI of German firms. By presenting productivity growth effects across low and high cost locations over the period 1997 to 2006, their results show that the evidence relating outward FDI to productivity growth at home is generally positive but quite small.

4. Conclusions

This study uses combined data from matched regular surveys and a special purpose survey on relocation to investigate the causal effect of relocation of activities abroad on various performance dimensions of firms from West German manufacturing industries. Data from the relocation survey were used to identify enterprises that relocated activities abroad in the period 2001-03 for the first time. These firms are compared to firms that did not relocate any activities outside Germany before 2006. The comparison is performed for both 2004 (to document differences between the two groups of firms after some of them started to relocate abroad) and for 2000 (when none of them did relocate abroad). It turns out that, compared to non-relocating firms, relocating firms are larger and more productive, more human capital intensive, and have a higher share of exports in total sales. All these differences existed in 2000, the year before some firms started to relocate, and this points to self-selection of "better" firms into offshoring. This finding is in line with results from recent theoretical models and with results for other countries.

To investigate the causal effects of relocation across borders on firm performance, six different variants of a matching approach of firms that did and did not start to relocate abroad in 2001-03 were performed based on a propensity score estimated using firm characteristics in 2000 and the change in the performance variable between 1997 and 2000. The performance of both groups was compared for 2004-06 when some firms were relocating firms and the others were not. Broadly in line with hypotheses derived from the literature there is no evidence that offshoring has a negative causal impact on employment in offshoring firms. The effect is positive and large for productivity, and weak evidence for a positive effect on the wage per employee, the proxy variable for human capital intensity used, is found.

The take-home message, therefore, is: Contrary to what is often argued we find no evidence for a negative causal effect of offshoring on employment in Germany or on other core dimensions of firm performance. Hopefully, these results will inform future public debates and discussion about policy measures with regard to offshoring, and globalization in general.

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Table 1: Differences between West German enterprises with and without first-time offshoring in 2001-03 – Results for 2004

	Enterprises without offshoring Mean (Standard deviation)	Enterprises with offshoring Mean (Standard deviation)	t-test on mean difference (p-value)	Kolmogorov-Smirnov-test (p-values) H0: equality of distributions for enterprises with and without offshoring	 H0: differences favourable for firms without offshoring	 H0: differences favourable for firms with offshoring
Number of employees	465.34 (4,004.47)	588.66 (1,949.92)	0.489	0.000	0.000	0.988
Sales per employee (€)	186,384.9 (186,057.9)	199,245.4 (143,523.6)	0.288	0.044	0.022	0.984
Wage per employee (€)	35,319.12 (8,619.53)	36,491.97 (7,728.41)	0.069	0.260	0.130	0.960
Share of exports in total sales (%)	30.58 (25.18)	41.70 (24.70)	0.000	0.000	0.000	0.998
Number of firms	2,029	160				

Note: The t-test on mean difference assumes unequal variances for enterprises with and without offshoring

Table 2: Differences between West German enterprises with and without first-time offshoring in 2001-03 – Results for 2000

	Enterprises without offshoring Mean (Standard deviation)	Enterprises with offshoring Mean (Standard deviation)	t-test on mean difference (p-value)	Kolmogorov-Smirnov-test (p-values) H0: equality of distributions for enterprises with and without offshoring	 H0: differences favourable for firms without offshoring	 H0: differences favourable for firms with offshoring
Number of employees	469.80 (3,916.52)	679.01 (2,303.20)	0.298	0.000	0.000	0.999
Sales per employee (€)	170,341.7 (174,486.8)	179,031.0 (118,831.2)	0.391	0.088	0.044	0.930
Wage per employee (€)	32,808.42 (8,043.52)	33,887.95 (7,860.07)	0.095	0.270	0.135	0.988
Share of exports in total sales (%)	27.12 (24.05)	36.53 (23.26)	0.000	0.000	0.000	0.987
Number of firms	2,054	162				

Note: The t-test on mean difference assumes unequal variances for enterprises with and without offshoring.

Table 3: The causal effect of offshoring on employment growth in West German manufacturing enterprises – Results from a matching approach[1]

Treatment	First-time offshoring in 2001 - 2003
Outcome	Employment growth (percentage) 2004 - 2006
Treatment group	Enterprises without offshoring before 2001 but with offshoring in 2001 - 2003
Control group	Enterprises without offshoring before 2006

A Full sample

Matching method	Number of firms	Treated	Control	ATT	t-value	balancing property
One nearest neighbour	156	55.08	-1.02	56.11	0.98	yes
Two nearest neighbours	156	55.08	-0.96	56.04	0.98	yes
Three nearest neighbours	156	55.08	-0.97	56.05	0.98	yes
Kernel matching (bwith = 0.01)	154	55.87	-0.68	56.55	0.98	yes
Kernel matching (bwith = 0.03)	156	55.08	-0.69	55.78	0.98	yes
Kernel matching (bwith = 0.05)	156	55.08	-0.67	55.75	0.98	yes

B Sample without top/bottom three percent of the distribution of the outcome variable for the treatment group and the control group

Matching method	Number of firms	Treated	Control	ATT	t-value	balancing property
One nearest neighbour	148	-1.31	0.99	-2.30	-1.47	yes
Two nearest neighbours	148	-1.31	0.51	-1.82	-1.32	yes
Three nearest neighbours	148	-1.31	0.30	-1.60	-1.23	yes
Kernel matching (bwith = 0.01)	147	-1.26	-0.61	-0.65	-0.52	yes
Kernel matching (bwith = 0.03)	148	-1.31	-0.57	-0.74	-0.61	yes
Kernel matching (bwith = 0.05)	148	-1.31	-0.45	-0.86	-0.71	yes

[1] Propensity-score matching is done using PSMATCH2 and Stata 10.1. ATT is the average treatment effect on the treated; see text.

Table 4: The causal effect of offshoring on growth of wage per employee in West German manufacturing enterprises – Results from a matching approach[1]

Treatment	First-time offshoring in 2001 - 2003
Outcome	Growth of wage per employee (percentage) 2004 - 2006
Treatment group	Enterprises without offshoring before 2001 but with offshoring in 2001 - 2003
Control group	Enterprises without offshoring before 2006

A Full sample

Matching method	Number of firms	Treated	Control	ATT	t-value	balancing property
One nearest neighbour	155	4.80	2.34	2.46	2.12	yes
Two nearest neighbours	155	4.80	3.17	1.63	1.56	yes
Three nearest neighbours	155	4.80	3.24	1.56	1.54	yes
Kernel matching (bwith = 0.01)	152	4.81	2.96	1.85	1.90	yes
Kernel matching (bwith = 0.03)	154	4.82	3.07	1.76	1.85	yes
Kernel matching (bwith = 0.05)	155	4.80	3.15	1.65	1.79	yes

B Sample without top/bottom three percent of the distribution of the outcome variable for the treatment group and the control group

Matching method	Number of firms	Treated	Control	ATT	t-value	balancing property
One nearest neighbour	147	4.35	3.12	1.23	1.57	yes
Two nearest neighbours	147	4.35	3.13	1.21	1.77	yes
Three nearest neighbours	147	4.35	3.39	0.95	1.48	yes
Kernel matching (bwith = 0.01)	141	4.27	3.37	0.90	1.53	yes
Kernel matching (bwith = 0.03)	147	4.35	3.38	0.97	1.69	yes
Kernel matching (bwith = 0.05)	147	4.35	3.35	1.00	1.78	yes

[1] Propensity-score matching is done using PSMATCH2 and Stata 10.1. ATT is the average treatment effect on the treated; see text.

Table 5: The causal effect of offshoring on growth of labour productivity in West German manufacturing enterprises – Results from a matching approach[1]

Treatment	First-time offshoring in 2001 - 2003
Outcome	Growth of labour productivity (percentage) 2004 - 2006
Treatment group	Enterprises without offshoring before 2001 but with offshoring in 2001 - 2003
Control group	Enterprises without offshoring before 2006

A Full sample

Matching method	Number of firms	Treated	Control	ATT	t-value	balancing property
One nearest neighbour	155	17.03	14.02	3.01	0.88	yes
Two nearest neighbours	155	17.03	17.12	-0.10	-0.03	yes
Three nearest neighbours	155	17.03	16.00	1.03	0.36	yes
Kernel matching (bwith = 0.01)	152	17.01	13.39	3.62	0.87	yes
Kernel matching (bwith = 0.03)	155	17.03	14.32	2.71	0.69	yes
Kernel matching (bwith = 0.05)	155	17.03	14.87	2.16	0.60	yes

B Sample without top/bottom three percent of the distribution of the outcome variable for the treatment group and the control group

Matching method	Number of firms	Treated	Control	ATT	t-value	balancing property
One nearest neighbour	147	16.55	13.82	2.73	1.27	yes
Two nearest neighbours	147	16.55	12.82	3.73	1.97	yes
Three nearest neighbours	147	16.55	13.48	3.07	1.69	yes
Kernel matching (bwith = 0.01)	147	16.55	13.00	3.55	2.07	yes
Kernel matching (bwith = 0.03)	147	16.55	13.59	2.96	1.75	yes
Kernel matching (bwith = 0.05)	147	16.55	13.97	2.58	1.54	yes

[1] Propensity-score matching is done using PSMATCH2 and Stata 10.1. ATT is the average treatment effect on the treated; see text.

Appendix Table A.1: Probit-regressions used to estimate the propensity score[1]

Outcome variable	Growth of number of employees		Growth of wage per employee		Growth of sales per employee	
A Full sample	ß	p	ß	p	ß	p
Number of employees	1.87e-4	0.045	2.88e-5	0.002	2.92e-5	0.001
Number of employees (squared)	-4.72e-9	0.603	-8.29e-10	0.050	-8.44e-10	0.037
Number or employees (cubic)	1.38e-14	0.937	4.44e-15	0.244	4.57e-15	0.084
Sales per employee (Euro)	5.71e-07	0.165	7.08e-8	0.170	7.44e-8	0.167
Wage per employee (Euro)	6.01e-6	0.427	5.74e-7	0.566	3.78e-7	0.700
Share of exports in total sales (%)	0.008	0.001	9.00e-4	0.003	9.10e-4	0.002
Growth of number of employees (%)	-4.73e-4	0.648				
Growth of wage per employee (%)			-2.85e-4	0.423		
Growth of sales per employee (%)					-2.76e-5	0.729
Number of firms	1746		1821		1819	
B Sample without top/bottom three percent of the distribution of the outcome variable for the treatment group and the control group						
Number of employees	2.13e-4	0.003	2.05e-4	0.004	1.89e-4	0.045
Number of employees (squared)	-6.13e-9	0.045	-6.05e-9	0.135	-5.21e-9	0.569
Number or employees (cubic)	3.31e-14	0.096	3.25e-14	0.575	2.22e-14	0.900
Sales per employee (Euro)	5.86e-7	0.162	6.75e-7	0.162	4.81e-7	0.277
Wage per employee (Euro)	2.94e-6	0.707	4.24e-6	0.605	5.48e-6	0.503
Share of exports in total sales (%)	0.008	0.000	0.008	0.001	0.009	0.000
Growth of number of employees (%)	-4.55e-4	0.654				
Growth of wage per employee (%)			-0.004	0.287		
Growth of sales per employee (%)					-6.38e-5	0.908
Number of firms	1642		1621		1624	

[1] Endogenous variable:1 if the firm is a first time offshoring firm in 2001 – 2003, 0 if the firm did not offshore until 2006. All variables in the Probit-regressions are for 2000 (levels) and 1997 – 2000 (growth rates). All regressions also include a full set of 3-digit industry dummies (excluding industries without any offshoring firm) and a constant; full results are available on request.