HAL
open science

Offshoring and firm performance: self-selection, effects on performance, or both?

Joachim Wagner

To cite this version:

Joachim Wagner. Offshoring and firm performance: self-selection, effects on performance, or both?. Review of World Economics, 2010, 147 (2), pp.217-247. 10.1007/s10290-010-0078-2 . hal-00640228

HAL Id: hal-00640228
https://hal.science/hal-00640228v1

Submitted on 11 Nov 2011

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Offshoring and firm performance:

Self-selection, effects on performance, or both? *

Joachim Wagner

Leuphana University Lueneburg, and IZA, Bonn

wagner@leuphana.de

[Revision: October 6, 2010]

Abstract:

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 firm performance. Compared to non-offshoring firms, firms that relocated activities were larger and more productive, and had a higher share of exports in total sales. These differences existed the year before some firms started to relocate, and this points to self-selection of "better" firms into offshoring. To investigate the causal effects of offshoring, six different variants of a matching approach are used. Contrary to what is often argued we find no evidence for a large negative causal effect of offshoring on employment in Germany.

Keywords: Offshoring, Germany, enterprise panel data

JEL Classification: F23

*Acknowledgement: All computations were carried out inside the research data centre of the Statistical Office in Halle. I thank Michael Rößner for running the Stata do-files and checking the output for violation of privacy. Many thanks to Nils Braakmann, Ingo Geishecker, Holger Görg, Aoife Hanley, Christian Pfeifer, Andreas Stephan and participants in the 4th ISGEP workshop in Valencia, October 1-2, 2009, the Economics Research Seminar at Leuphana University Lüneburg, October 21, 2009 and the Erich-Schneider Seminar at CAU Kiel, February 1, 2010, for helpful comments on an earlier version. Comments from two anonymous referees lead to a complete rewriting of the working paper version that circulates as Wagner (2009). The data used in this study are confidential but not exclusive; see Zühlke et al. (2004) for the rules to access the data inside the research data centre. To facilitate replication and extensions the Stata do-files used are available from the author on request.

"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 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. As is often the case with catchwords, offshoring means different things to different people. In this paper I follow Olsen (2006, p. 6f.) and use offshoring to describe 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 (see also Feenstra 2010, p. 5f.). 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.

This kind of offshoring often leads to what Grossman and Rossi-Hansberg (2006, 2008) named international "trade in tasks" that is different from trade in complete goods, and it is this trade in tasks that is at the core of many theoretical models that discuss the issue of offshoring. In this empirical study, offshoring is measured as relocation of

production of a manufacturing firm abroad either inhouse (to a foreign affiliate) or through arms-length-trade (by buying intermediates from a non-affiliated foreign firm). Since this measure of offshoring includes horizontal foreign direct investment (where former exports are replaced by final goods production abroad to serve foreign markets) it is related to but not identical to the theoretical concept of offshoring as trade in tasks. A more correct expression might be "relocation abroad". Both expressions – offshoring and relocation abroad - will be used interchangeably in 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.[1] 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

[1] 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).

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.

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.[2] 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.[3]

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:

---

[2] Geishecker et al. (2008, p. 152) state that "academic research which analyses the phenomenon of outsourcing empirically is only in its infancy". Similarly, Olsen (2006, p. 9) points out that "surprisingly little rigorous empirical research has been done on its economic impacts."

[3] 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 et al. (2008) for Japan, Jabbour (2010) for France, Kurz (2006) for the United States and Morrison Paul and Yasar (2009) for Turkey.

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 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.).[4] 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[5] 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 et al. (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

[4] 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.

[5] 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 et al. (2005) and Addison et al. (2008), for the United Kingdom see Girma and Görg (2004), for Ireland Görg and Hanley (2004).

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 Geishecker et al. (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 (2006, p. 9) states that direct investigations of the impact of outsourcing on firm productivity are relatively few in number. Görg, Greenaway and Kneller (2008, p. 8) 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 et al. (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 Empoyment Research (IAB), 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 et al. (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.

Moser et al. (2009) discuss various channels through which offshoring may impact employment.[6] First, there is the direct job loss through downsizing. Second, cost reduction and increased competitiveness on both the national and international markets compared to non-offshoring competitors might lead to an increase in employment. Third, and discussed for the first time in this paper, there may be negative effects on the employment of other producers in Germany if domestic intermediate inputs that were bought by the offshoring firm are now replaced by intermediate inputs bought on a foreign market. This indirect effect might be an important source of job loss in Germany.[7]

Moser et al. (2009, p. 3) find a statistically and economically significant positive employment effect of an increase in the foreign intermediate input share in total inputs (i.e. offshoring) on the domestic plant. Offshoring plants increase their average labour productivity, and their domestic and foreign market share compared to "twin"-firms that do not engage in offshoring.

While the study by Moser et al. (2009) is for sure an important contribution to the empirical literature it is somewhat 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 measure of offshoring is different from the measure used in this paper. As stated above at the very beginning of this paper, offshoring is defined here as the

[6] I thank an anonymous referee for pointing out some flaws in my summary of the paper by Moser et al. (2009) in an earlier version of the present paper (see Wagner 2009).

[7] The consequences of these indirect effects for the matching approach used here in this paper to investigate the causal effects of offshoring will be discussed in section 3.3 below.

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 et al. (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 in this paper (but by Moser et al. 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 et al. (2009). One contribution of the paper is the application of an alternative measure of offshoring that has not been used in investigations for Germany before.

Given the large degree of heterogeneity in firm behaviour with respect to outsourcing (Olsen 2006, p. 15) the lack of empirical studies using longitudinal data at the enterprise level to investigate the causes and the 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]

---

[8] A case in point is the IAB establishment panel used by Moser et al. (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 (2010) 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.

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 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, the present paper matches them 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 built 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 - 2003 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.

[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.

[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.

Therefore, it is not possible to distinguish between international outsourcing (relocation abroad between firms) and international insourcing (relocation abroad within the firm).[13] Furthermore, 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 2000 - 2004 (to compare the performance of offshoring and non-offshoring firms).

There were large differences in labour productivity and other dimensions of firm performance between firms in East and West Germany 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

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

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 study:

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;[14] 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

[14] Note that value added per employee cannot be used as a measure of productivity because information on value added is only available for a small subsample of the enterprises.

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 - 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.[15]

[15] 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.

The big picture, then, is that compared to non-offshoring firms those firms that started offshoring in the years 2001 - 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.

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 required.

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 et al. 1999).

Here, firms that started offshoring in 2001 - 2003 are matched with “twins” from the large group of firms that never relocated activities abroad before 2006. Matching is performed by propensity score matching.[16]

The use of propensity score matching for the estimation of the effect of offshoring (the treatment) on firm performance assumes that the treatment is in a sense exogenous.[17] This assumption is referred to as unconfoundedness, selection on observables or conditional independence assumption (CIA) in the literature. It implies that differences between firms with and without offshoring with the same values for the covariates are due to offshoring. The covariates should include all variables that influence the assignment into the treatment (the decision of a firm to offshore) and the outcome (the dimension of firm performance). Evidently, this is a strong assumption, and there is no way

[16] 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.

[17] The discussion of propensity score matching closely follows Caliendo and Kopeinig (2008).

to test whether this assumption is justified or not in an application. Using all information available in the data to estimate the propensity score I assume that this assumption holds.

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, labour productivity, wage per employee, share of exports in total sales, 3-digit industry dummy variables (all measured in 2000) plus the growth of the outcome variable between 1997 and 2000. The choice of the selection variables included in the probit regression is in part data driven, and all variables that can be expected to be related to the probability to start offshoring that are available in the data set are included. Size can be expected to be positively related to offshoring because larger firms in general tend to be more internationally orientated in various ways, and to control for possible non-linearity the size variable is included as a squared and a cubic term, too. Descriptive results reported in table 2 indicate that productivity, human capital intensity, and exports tend to be higher in firms that start offshoring. The lagged value of the outcome variable is included to control at least partly for unobserved firm characteristics that are important for the performance dimension under investigation. The complete set of 3-digit industry dummy variables is expected to control for differences in the difficulty of offshoring between industries due to differences in technology.

The results of the probit estimates used in the matching approach are reported in table 11 in the Appendix. As can be seen size is related positively to starting to offshore (but there is no indication of a non-linear relationship here), and the same holds for the share of exports in total sales indicating that experience as an exporter on foreign markets makes offshoring more probable. Neither sales per employee, nor wage per employee, nor the lagged values of the performance variables are significant.

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 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 2000 - 2004 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. 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 1 nearest neighbour the 2 and the 3 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 values for the bandwith (0.01, 0.03 and 0.05) is used.

The use of propensity score matching to estimate the ATT requires one more assumption (besides conditional independence, common support condition, and the balancing property, all discussed above) to hold, namely the stable unit treatment value (SUTVA) assumption (see e. g. Fröhlich (2003, p. 8f.) and Morgan and Winship (2007, p. 37ff.)). It states that the potential outcome of one unit is unaffected by potential changes in

the treatment exposure of any other unit. In economics, this is sometimes referred to as a "no-macro-effect" or partial equilibrium assumption. In the context of this paper it means that the decision of one firm to start offshoring does not have any impact of the performance of other firms. This SUTVA assumption might be violated here. As pointed out by Moser et al. (2009) when a firm decides to offshore there may be negative effects on other producers in Germany if domestic intermediate inputs that were bought by the offshoring firm are now replaced by intermediate inputs bought on a foreign market, or if the offshoring firm becomes more productive and more competitive compared to non-offshoring firms. Some of the non-offshoring firms that are negatively affected may appear in the control group. While this might well be the case, I assume here that the bias from violation of the SUTVA is rather small because the number of firms that start offshoring is small and the probability that a firm in the sample used to construct the control group is severely hit by this decision is rather small, too.[18]

The first step in the empirical investigation of the effects of offshoring on firm performance is a test for the presence of a causal effect of offshoring on change in employment in the firm. The hypothesis stated 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 negative, but given that the period under investigation covers four years from 2000 to 2004 the average annual effect on employment growth can be considered to be rather small. Furthermore, according to the *t*-values reported the ATT are not statically different from zero.[19]

[18] See Moser et al. (2009) for a discussion of the SUTVA in the context of offshoring and how violation of this assumption affects the interpretation of the ATT.

[19] Both the *t*-value reported by PSMATCH2 (that does not take into account that the propensity score is estimated) and a *t*-value based on bootstrapped values of the standard deviation of the propensity score with 100 replications is given in table 3 (and the other tables reporting results of a matching approach). Abadie

[Table 3 near here]

Results might be heavily influenced by a small number of firms with extreme values of the outcome variable. 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.

Results for the trimmed sample are reported in the lower panel of table 3. Compared to the results for the whole sample the estimated ATT has about the same (and rather small) negative size, and the causal effect is statistically significant at a usual error level of five percent for two of the three variants of kernel matching. This finding of a small negative causal effect of offshoring on employment is not in line with Hypothesis 3.

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 sign of the ATT varies over the different matching methods

---

and Imbens (2008) show that bootstrapping is not appropriate for nearest neighbour matching estimators. This, however, is not true for kernel matching. Therefore, the decision about whether or not the ATT should be considered to be statistically different from zero is based on the bootstrapped standard errors of the estimations using the kernel matching approaches.

applied. Furthermore, the point estimates are tiny, and they are never statistically different from zero. Therefore, we can conclude that the results do not support Hypothesis 4.

[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).[20] The hypothesis stated in section 1 is:

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

While the sign of the ATT for the sample as a whole (reported in the upper panel of table 5) depends on the matching method used, the size is very small and the point estimates can never be considered to be 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, but still small and not statistically different from zero at a conventional error level of five percent. These results are not in line with Hypothesis 5.[21]

[Table 5 near here]

[20] Note that labour productivity cannot be measured as value added per employee because information on value added is only available for a small subset of enterprises in the data used. The error due to the use of sales per employee, however, is presumably small, because the differences- in-differences method controls for cross-sectional differences in production depth.

[21] A related result is reported in a recent study by Temouri et al. (2010) 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 - 2006, their results show that the evidence relating outward FDI to productivity growth at home is generally positive but quite small.

4. Robustness check

In the empirical investigation performed so far the treatment group is made-up of firms that started offshoring in 2001 - 2003. If larger firms often started offshoring before 2001 no inference is possible from this analysis on the causal effects of offshoring as a whole. To see whether the findings are robust and valid for the causal effects of offshoring as a whole, the definition of the treatment group is changed. Offshoring firms are now defined as firms that report offshoring activities between 2001 and 2003 irrespective of whether there have been any offshoring projects before.[22] The control group is made-up again by firms that did not report any offshoring activities before 2006.

Results are reported in tables 6 to 10. The big picture regarding differences between West German enterprises with offshoring in 2001 - 2003 and without offshoring before 2006 reported in table 6 (for 2004) and table 7 (for 2000) is rather similar to the one we see in table 1 and table 2 for first-time offshoring firms compared to non-offshoring firms. In 2004 offshoring firms were larger, more productive, more human capital intensive, and more export intensive than non-offshoring firms. Note that the average size of the offshoring firms reported in table 6 is much larger than the average size of first-time offshoring firms reported in table 1, pointing to the fact that many larger firms already started to offshore before 2001. According to table 7 these differences between the enterprises from the treatment group and the control group existed already in 2000, pointing to self-selection of “better” firms into offshoring activities.

[Table 6 and Table 7 near here]

The point estimates for the causal effect of offshoring on employment growth reported in table 8 are smaller than the effects reported in table 3 for the whole sample,

[22] I thank an anonymous referee for suggesting this robustness check. The results of the probit estimates used in the matching approach are reported in table 12 in the Appendix.

but insignificant according to the t-values. For the trimmed sample we get again different results. The point estimates are statistically significant at an error level of one percent for the new definition of the treatment group. However, the estimated effects are small from an economic point of view. This finding of a small negative causal effect of offshoring on employment is the same as the one reported above for the treatment group of first-time offshoring firms, and it is again not in line with Hypothesis 3.

[Table 8 near here]

Results reported in table 9 for the causal effect of offshoring on the growth of wage per employee are only slightly different from the results reported for first-time offshoring firms in table 4. The point estimates for the ATT is always positive, but it is tiny and never statistically significantly different from zero at a conventional error level. Therefore, we can conclude that the results again do not support Hypothesis 4.

[Table 9 near here]

While the results for the estimated causal effect of offshoring on employment growth and wage growth do not depend on the definition of the treatment group used in section3 and in the robustness check in this section this is different for the effects on growth of labour productivity. According to table 5 for the trimmed sample at least the point estimate of the effect is positive but small, and the effect is not statistically different from zero at an error level of five percent. If the treatment group includes firms that did offshore before 2001 it can be seen from table 10 that the causal effect of offshoring on productivity growth

is positive and statistically significant. These results are in line with Hypothesis 5. The effect, however, is not very large from an economic point of view.

[Table 10 near here]

The bottom line, then, is that from the matching approach we have evidence that offshoring has a negative but only small causal impact on employment in offshoring firms. We do not find evidence for a causal effect on the wage per employee, the proxy variable for human capital intensity. While these results are stable over the two definitions of the treatment group applied here, this is not the case with regard to productivity growth. Looking at first-time offshorers in 2001 - 2003 there is no evidence for a causal effect of offshoring. When the treatment group includes firms with offshoring activities before 2001 we find a positive and statistically significant causal effect, but this effect is rather small.

5. 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 - 2003 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 - 2003 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 2000 - 2004 when some firms were relocating firms and the others were not. From the matching approach we have evidence that offshoring has a negative but only small causal impact on employment in offshoring firms. We do not find evidence for a causal effect on the wage per employee, the proxy variable for human capital intensity. While these results are stable over the two definitions of the treatment group applied here, this is not the case with regard to productivity growth. Looking at first-time offshorers in 2001 - 2003 there is no evidence for a causal effect of offshoring. When the treatment group includes firms with offshoring activities before 2001 we find a positive and statistically significant causal effect, but this effect is rather small.

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

References

Abadie, Alberto and Guido W. Imbens (2008), On the Failure of the Bootstrap for Matching Estimators. *Econometrica* 76(6), 1537-1557.

Addison, John T., Lutz Bellmann, André Pahnke and Paulino Teixeira (2008), A Note on the Determinants and Consequences of Outsourcing Using German Data. Institute for the Study of Labor IZA DP No. 3608, July.

Antràs, Pol and Elhanan Helpman (2004), Global Sourcing. *Journal of Political Economy* 112(3), 552-580.

Bachmann, Ronald and Sebastian Braun (2008), The Impact of International Outsourcing on Labour Market Dynamics in Germany. Ruhr Economic Papers #53, July.

Buch, Claudia, Monika Schnitzer, Christian Arndt, Iris Kesternich, Anselm Mattes, Christian Mugele and Harald Strotmann (2007), Analyse der Beweggründe, der Ursachen und der Auswirkungen des sogenannten Offshoring auf Arbeitsplätze und Wirtschaftsstruktur in Deutschland. Tübingen und München: Institut für Angewandte Wirtschaftsforschung IAW und Seminar für Komparative Wirtschaftsforschung der LMU.

Caliendo, Marco and Sabine Kopeinig (2008), Some practical guidance for the implementation of propensity score matching. *Journal of Economic Surveys* 22 (1), 31-72.

Conover, W. J. (1999), Practical Nonparametric Statistics. Third edition. New York etc.: John Wiley.

Crinó, Rosario (2009), Offshoring, Multinationals and Labour Market: A Review of the Empirical Literature. *Journal of Economic Surveys* 23(2), 197-249.

DIHK (2005), Going International. Erfolgsfaktoren im Auslandsgeschäft. Erfahrungen, Lösungen und Perspektiven. Berlin: DIHK.

Farinas, José C. and Ana Martín-Marcos (2010), Foreign sourcing and productivity: evidence at the firm level. *The World Economy* 33(3), 482-506.

Feenstra, Robert C. (2010), Offshoring in the Global Economy. Microeconomic Structure and Macroeconomic Implications. Cambridge, Massachusetts, and London, England: MIT Press.

Fischer, Gabriele, Florian Janik, Dana Müller and Alexandra Schmucker (2009), The IAB Establishment Panel – Things Users Should Know. *Schmollers Jahrbuch / Journal of Applied Social Science Studies* 129(1), 133-148.

Fröhlich, Markus (2003), Programme Evaluation and Treatment Choice. Berlin etc.: Springer.

Geishecker, Ingo (2005), International Outsourcing and German Manufacturing Wages. *Schmollers Jahrbuch / Journal of Applied Social Science Studies* 125(1), 87-95.

Geishecker, Ingo (2006), Does Outsourcing to Central and Eastern Europe Really Threaten Manual Workers' Jobs in Germany? *The World Economy* 29(5), 559-583.

Geishecker, Ingo (2008), The impact of International Outsourcing in Individual Employment Security: A Micro-Level Analysis. *Labour Economics* 15(3), 291-314.

Geishecker, Ingo and Holger Görg (2005), Do unskilled workers always lose from fragmentation? *North American Journal of Economics and Finance* 16(1), 81-92.

Geishecker, Ingo and Holger Görg (2008), Winners and losers: a micro-level analysis of international outsourcing and wages. *Canadian Journal of Economics* 41(1), 243-270.

Geishecker, Ingo, Holger Görg and Sara Maioli (2008), The Labour Market Impact of International Outsourcing. In: David Greenaway, Richard Upward and Peter Wright (Ed.), Globalisation and Labour Market Adjustment. Houdmills, Basingstoke, Hampshire: Palgrave Macmillan, p. 152-173.

Girma, Sourafel and Holger Görg (2004), Outsourcing, Foreign Ownership, and Productivity: Evidence from UK Establishment-level Data. *Review of International Economics* 12(5), 817-832.

Görg, Holger and Aoife Hanley (2004), Does Outsourcing Increase Profitability? *Economic and Social Review* 35(3), 267-288.

Görg, Holger, David Greenaway and Richard Kneller (2008), The Economic Impact of Offshoring. GEP Research Report, Leverhulme Centre for Research on Globalisation and Economic Policy, University of Nottingham, June.

Görg, Holger, Aoife Hanley and Eric Strobl (2008), Productivity effects of international outsourcing: evidence from plant-level data. *Canadian Journal of Economics* 41(2), 670-688.

Görzig, Bernd, Adrianna Kaminiarz and Andreas Stephan (2005), Wie wirkt sich Outsourcing auf den Unternehmenserfolg aus? Neue Evidenz. *Schmollers Jahrbuch / Journal of Applied Social Science Studies* 125(4), 489-507.

Grossman, Gene M. and Elhanan Helpman (2005), Outsourcing in a Global Economy. *Review of Economic Studies* 72(1), 135-159.

Grossman, Gene M. and Esteban Rossi-Hansberg (2006), The Rise of Offshoring: It's not Wine for Cloth Anymore. In: *The New Economic Geography: Effects and Policy Implications.* Jackson Hole Conference Volume, Federal Reserve Bank of Kansas City, p. 59-102.

Grossman, Gene M. and Esteban Rossi-Hansberg (2008), Trading Tasks: A Simple Theory of Offshoring. *American Economic Review* 98 (5), 1978-1997.

Heckman, James J., Robert J. LaLonde and Jeffrey A. Smith (1999), The economics and econometrics of active labor market programs. In: Ashenfelter, O. C. and David Card (Eds.), *Handbook of Labor Economics, Vol. 3A*, Amsterdam: North-Holland, 1865-2097.

Institut für Demoskopie Allensbach (2006), Globalisierung – Die meisten sehen mehr Risiken als Chancen. *allensbacher berichte* Nr. 11/2006.

Ito, Banri, Ryuhei Wakasugi and Eiichi Tomiura (2008), Offshoring and Productivity: Evidence from Japanese Firm-level Data. RIETI Discussion Paper Series 08-E-028.

Jabbour, Liza (2010), Offshoring and Firm's Performance: Evidence from the French Manufacturing Industry. *The World Economy* 33(3), 507-524.

Kinkel, Steffen, Gunter Lay and Spomenka Maloca (2004), Produktionsverlagerungen ins Ausland und Rückverlagerungen. Karlsruhe: Fraunhofer-Institut für Systemtechnik und Innovationsforschung ISI.

Kinkel, Steffen and Spomenka Maloca (2008), Produktionsverlagerungen rückläufig Ausmaß und Motive von Produktionsverlagerungen und Rückverlagerungen im deutschen Verarbeitenden Gewerbe. Karlsruhe: Fraunhofer-Institut für Systemtechnik und Innovationsforschung ISI, Januar.

Kinkel, Steffen and Spomenka Maloca (2009), Ausmaß und Motive von Produktionsverlagerungen und Rückverlagerungen im deutschen Verarbeitenden Gewerbe. In Steffen Kinkel (Hrsg.), Erfolgsfaktor Standortplanung. Berlin und Heidelberg: Springer. S. 23-34.

Konold, Michael (2007), New Possibilities for Economic Research through Integration of Establishment-level Panel Data of German Official Statistics. *Schmollers Jahrbuch / Journal of Applied Social Science Studies* 127(2), 321-334.

Kurz, Christopher Johann (2006), Outstanding Outsourcers: A firm- and Plant-Level Analysis of Production Sharing. Finance and Economics Discussion Series, Divisions of Research & Statistics and Monetary Affairs, Federal Reserve Board, Washington, D.C., Staff Working Paper 2006-04.

Leuven, Edwin and Barbara Sianesi. 2003. “PSMATCH2: Stata module to perform full Mahalanobis and propensity score matching, common support graphing, and covariate imbalance testing”. (Version 3.0.0) Downloadable from: http://ideas.repec.org/c/boc/bocode/s432001.htm.

Lipponer, Alexander (2003), Deutsche Bundesbank’s FDI micro database. *Schmollers Jahrbuch / Journal of Applied Social Science Studies* 123(1), 593-600.

Marin, Dalia (2006), A new international division of labor in Europe: Outsourcing and offshoring to Eastern Europe. *Journal of the European Economic Association* 4(2-3), 612-622.

Morgan, Stephen L. And Christopher Winship (2007), Counterfactuals and Causal Inference. Methods and Principles for Social Research. Cambridge etc.: Cambridge University Press.

Morrison Paul, Caterine J. and Mahmut Yasar (2009), Outsourcing, productivity, and input composition at the plant level. *Canadian Journal of Economics* 42(2), 422-439.

Moser, Christoph, Dieter Urban and Beatrice Weder di Mauro (2009), Offshoring, Firm Performance and Establishment-Level Employment: Identifying Productivity and Downsizing Effects. Centre for Economic Policy Research CEPR Discussion Paper No. 7455, September.

Neureiter, Marcus and Peter Nunnenkamp (2010), Outsourcing Motives, Location Choice and Labour Market Implications: An Empirical Analysis for European Countries. *Kyklos* 63(2), 206-230.

Olsen, Karsten Bjerring (2006), Productivity Impacts of Offshoring and Outsourcing: a Review. OECD Directorate for Science, Technology and Industry STI Working Paper 2006/1.

Schöller, Deborah (2007a), Service Offshoring and the Deman for Less-Skilled Labor: Evidence from Germany. Hohenheimer Diskussionsbeiträge Nr. 287.

Schöller, Deborah (2007b), Service-Offshoring: Eine Herausforderung für die Beschäftigung in Deutschland? *Wirtschaftsdienst* 87(4), 249-257.

Statistisches Bundesamt (2008), Verlagerung wirtschaftlicher Aktivitäten. Erste Ergebnisse, Wiesbaden: Statistisches Bundesamt.

Statistisches Bundesamt (2009), Pressekonferenz „Verflechtung deutscher Unternehmen mit dem Ausland“ am 17. Februar 2009 in Berlin, Statement von Präsident Roderich Egeler, Wiesbaden: Statistisches Bundesamt.

Temouri, Yama, Nigel L. Driffield and Dolores Anón Higón (2010), German Outward FDI and Firm Performance. *Applied Economics Quarterly* 56 (1), 31 – 50.

Wagner, Joachim (2002), The causal effect of exports on firm size and labor productivity: First evidence from a matching approach. *Economics Letters* 77(2), 287-292.

Wagner, Joachim (2006), Exports, foreign direct investment, and productivity: evidence from German firm level data. *Applied Economics Letters* 13(6), 347-349.

Wagner, Joachim (2007a), Exports and Productivity: A Survey of the Evidence from Firm-level Data. *The World Economy* 30(1), 60-82.

Wagner, Joachim (2007b), Exports and Productivity in Germany. *Applied Economics Quarterly* 53(4), 353-373.

Wagner, Joachim (2009), Offshoring and firm performance: Self-selection, effects on performance, or both? Institute for the Study of Labor IZA DP No. 4605, December.

Zühlke, Sylvia, Markus Zwick, Sebastian Scharnhorst und Thomas Wende (2004), The research data centres of the Federal Statististical Office and the statistical offices of the Länder. *Schmollers Jahrbuch / Journal of Applied Social Science Studies* 124(4): 567-578.

Zwania, Jacek (2008), Verlagerung wirtschaftlicher Aktivitäten. Theoretischer Hintergrund zur Erhebung. *Wirtschaft und Statistik* 6/2008, 477-482.

Table 1: Differences between West German enterprises with first-time offshoring in 2001 - 2003 and without offshoring before 2006 – 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 first-time offshoring in 2001 - 2003 and without offshoring before 2006 – 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

Treatment	First-time offshoring in 2001 - 2003
Outcome	Employment growth (percentage) 2000 - 2004
Treatment group	Enterprises without offshoring before 2001 but with offshoring in 2001 - 2003
Control group	Enterprises without offshoring before 2006

A Full sample

Propensity score matching[a]	Number of firms	Treated	Control	ATT	*t*-value	bootstrapped *t*-value	balancing property
One nearest neighbour	160	-0.93	1.54	-2.47	-0.85	-0.63	yes
Two nearest neighbours	160	-0.93	3.80	-4.73	-1.74	-1.21	yes
Three nearest neighbours	160	-0.93	3.66	-4.59	-1.81	-1.47	yes
Kernel matching (bwith = 0.01)	160	-0.93	2.48	-3.41	-1.43	-1.31	yes
Kernel matching (bwith = 0.03)	160	-0.93	2.44	-3.37	-1.45	-1.29	yes
Kernel matching (bwith = 0.05)	160	-0.93	2.44	-3.37	-1.46	-1.32	yes

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

Propensity score matching[a]	Number of firms	Treated	Control	ATT	*t*-value	bootstrapped *t*-value	balancing property
One nearest neighbour	152	-1.27	2.95	-4.22	-1.86	-1.41	yes
Two nearest neighbours	152	-1.27	2.47	-3.74	-1.79	-1.46	yes
Three nearest neighbours	152	-1.27	2.68	-3.95	-2.00	-1.68	yes
Kernel matching (bwith = 0.01)	150	-1.08	2.51	-3.59	-1.99	-1.67	yes
Kernel matching (bwith = 0.03)	152	-1.27	2.54	-3.81	-2.14	-2.03	yes
Kernel matching (bwith = 0.05)	152	-1.27	2.59	-3.86	-2.18	-1.98	yes

[a] Propensity score matching is done using PSMATCH2 and Stata 10.1. The common support condition is imposed. ATT is the average treatment effect on the treated; bootstrapped *t*-values are based on 100 replications. Kernel matching uses the Epanechnikov kernel.

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

Treatment	First-time offshoring in 2001 - 2003
Outcome	Growth of wage per employee (percentage) 2000 - 2004
Treatment group	Enterprises without offshoring before 2001 but with offshoring in 2001 - 2003
Control group	Enterprises without offshoring before 2006

A Full sample

Propensity score matching[a]	Number of firms	Treated	Control	ATT	*t*-value	bootstrapped *t*-value	balancing property
One nearest neighbour	159	7.84	8.35	-0.52	-0.36	-0.28	yes
Two nearest neighbours	159	7.84	8.02	-0.19	-0.15	-0.12	yes
Three nearest neighbours	159	7.84	7.81	0.03	0.02	0.02	yes
Kernel matching (bwith = 0.01)	158	7.88	8.85	-0.97	-0.91	-0.99	yes
Kernel matching (bwith = 0.03)	158	7.88	8.86	-0.99	-0.94	-1.06	yes
Kernel matching (bwith = 0.05)	159	7.84	8.82	-0.98	-0.96	-0.94	yes

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

Propensity score matching[a]	Number of firms	Treated	Control	ATT	*t*-value	bootstrapped *t*-value	balancing property
One nearest neighbour	150	8.30	8.07	0.23	0.22	0.16	yes
Two nearest neighbours	150	8.30	8.22	0.08	0.09	0.07	yes
Three nearest neighbours	150	8.30	8.13	0.17	0.20	0.15	yes
Kernel matching (bwith = 0.01)	149	8.35	8.41	-0.07	-0.08	-0.08	yes
Kernel matching (bwith = 0.03)	149	8.35	8.87	-0.52	-0.69	-0.63	yes
Kernel matching (bwith = 0.05)	149	8.35	8.75	-0.40	-0.53	-0.51	yes

[a] Propensity score matching is done using PSMATCH2 and Stata 10.1. The common support condition is imposed. ATT is the average treatment effect on the treated; bootstrapped *t*-values are based on 100 replications. Kernel matching uses the Epanechnikov kernel.

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

Treatment	First-time offshoring in 2001 - 2003
Outcome	Growth of labour productivity (percentage) 2000 - 2004
Treatment group	Enterprises without offshoring before 2001 but with offshoring in 2001 - 2003
Control group	Enterprises without offshoring before 2006

A Full sample

Propensity score matching[a]	Number of firms	Treated	Control	ATT	*t*-value	bootstrapped *t*-value	balancing property
One nearest neighbour	160	14.19	12.09	2.10	0.42	0.53	yes
Two nearest neighbours	160	14.19	11.23	2.96	0.82	0.55	yes
Three nearest neighbours	160	14.19	16.21	-2.02	-0.57	-0.40	yes
Kernel matching (bwith = 0.01)	159	14.09	13.07	1.02	0.35	0.29	yes
Kernel matching (bwith = 0.03)	160	14.19	14.69	-0.50	-0.18	-0.17	yes
Kernel matching (bwith = 0.05)	160	14.19	13.52	0.67	0.25	0.17	yes

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

Propensity score matching[a]	Number of firms	Treated	Control	ATT	*t*-value	bootstrapped *t*-value	balancing property
One nearest neighbour	152	13.72	10.82	2.89	1.14	1.01	no
Two nearest neighbours	152	13.72	9.44	4.28	1.89	1.46	yes
Three nearest neighbours	152	13.72	10.56	3.16	1.44	1.26	yes
Kernel matching (bwith = 0.01)	152	13.72	10.21	3.51	1.75	1.76	yes
Kernel matching (bwith = 0.03)	152	13.72	10.30	3.41	1.72	1.72	yes
Kernel matching (bwith = 0.05)							

[a] Propensity score matching is done using PSMATCH2 and Stata 10.1. The common support condition is imposed. ATT is the average treatment effect on the treated; bootstrapped t-values are based on 100 replications. Kernel matching uses the Epanechnikov kernel.

Table 6: Differences between West German enterprises with offshoring in 2001 - 2003 and without offshoring before 2006 – 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)	1,177.40 (6,868.84)	0.057	0.000	0.000	1.000
Sales per employee (€)	186,384.9 (168,057.9)	191,505.1 (116,981.2)	0.490	0.001	0.001	0.668
Wage per employee (€)	35,319.12 (8,619.53)	36,584.08 (8,064.16)	0.007	0.029	0.015	0.979
Share of exports in total sales (%)	30.58 (25.18)	43.28 (22.96)	0.000	0.000	0.000	1.000
Number of firms	2,029	361				

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

Table 7: Differences between West German enterprises with offshoring in 2001 - 2003 and without offshoring before 2006 – 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	468.79 (3,937.66)	1,244.26 (7,502.55)	0.056	0.000	0.000	1.000
Sales per employee (€)	169,403.4 (169,638.9)	168,049.1 (96,907.4)	0.831	0.011	0.006	0.751
Wage per employee (€)	32,759.56 (7,747.13)	33,659.13 (7,301.10)	0.033	0.092	0.046	0.982
Share of exports in total sales (%)	27.19 (24.07)	38.75 (22.64)	0.000	0.000	0.000	0.995
Number of firms	2,029	361				

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

Table 8: The causal effect of offshoring on employment growth in West German manufacturing enterprises – Results from a matching approach

Treatment	Offshoring in 2001 - 2003
Outcome	Employment growth (percentage) 2000 - 2004
Treatment group	Enterprises with offshoring in 2001 - 2003
Control group	Enterprises without offshoring before 2006

A Full sample

Propensity score matching[a]	Number of firms	Treated	Control	ATT	*t*-value	bootstrapped *t*-value	balancing property
One nearest neighbour	360	0.66	2.73	-2.07	-0.65	-0.73	yes
Two nearest neighbours	360	0.66	2.50	-1.84	-0.63	-0.66	yes
Three nearest neighbours	360	0.66	2.73	-2.07	-0.73	-0.65	yes
Kernel matching (bwith = 0.01)	357	0.88	2.50	-1.62	-0.58	-0.62	yes
Kernel matching (bwith = 0.03)	359	0.62	3.13	-2.51	-0.91	-0.83	yes
Kernel matching (bwith = 0.05)	360	0.66	3.11	-2.46	-0.90	-0.77	yes

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

Propensity score matching[a]	Number of firms	Treated	Control	ATT	*t*-value	bootstrapped *t*-value	balancing property
One nearest neighbour	340	-1.77	2.75	-4.51	-2.73	-2.61	yes
Two nearest neighbours	340	-1.77	1.96	-3.73	-2.52	-2.16	yes
Three nearest neighbours	340	-1.77	1.61	-3.38	-2.38	-2.13	yes
Kernel matching (bwith = 0.01)	331	-1.57	2.24	-3.81	-2.87	-2.98	yes
Kernel matching (bwith = 0.03)	340	-1.77	2.20	-3.96	-3.06	-3.40	yes
Kernel matching (bwith = 0.05)	340	-1.77	2.39	-4.16	-3.28	-3.16	yes

[a] Propensity score matching is done using PSMATCH2 and Stata 10.1. The common support condition is imposed. ATT is the average treatment effect on the treated; bootstrapped *t*-values are based on 100 replications. Kernel matching uses the Epanechnikov kernel.

Table 9: The causal effect of offshoring on growth of wage per employee in West German manufacturing enterprises – Results from a matching approach

Treatment	Offshoring in 2001 - 2003
Outcome	Growth of wage per employee (percentage) 2000 - 2004
Treatment group	Enterprises with offshoring in 2001 - 2003
Control group	Enterprises without offshoring before 2006

A Full sample

Propensity score matching[a]	Number of firms	Treated	Control	ATT	*t*-value	bootstrapped *t*-value	balancing property
One nearest neighbour	359	9.49	9.16	0.33	0.30	0.26	yes
Two nearest neighbours	359	9.49	8.45	1.04	1.04	0.94	yes
Three nearest neighbours	359	9.49	8.50	0.99	1.05	1.01	yes
Kernel matching (bwith = 0.01)	355	9.48	8.50	0.98	1.06	1.14	yes
Kernel matching (bwith = 0.03)	358	9.48	8.53	0.95	1.09	1.07	yes
Kernel matching (bwith = 0.05)	359	9.49	8.62	0.87	1.01	1.10	yes

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

Propensity score matching[a]	Number of firms	Treated	Control	ATT	*t*-value	bootstrapped *t*-value	balancing property
One nearest neighbour	338	9.46	8.32	1.14	1.33	1.21	yes
Two nearest neighbours	338	9.46	8.41	1.05	1.44	1.15	yes
Three nearest neighbours	338	9.46	8.11	1.35	1.96	1.54	yes
Kernel matching (bwith = 0.01)	329	9.38	8.50	0.88	1.40	1.37	yes
Kernel matching (bwith = 0.03)	338	9.46	8.51	0.95	1.55	1.54	yes
Kernel matching (bwith = 0.05)	338	9.46	8.53	0.93	1.54	1.41	yes

[a] Propensity score matching is done using PSMATCH2 and Stata 10.1. The common support condition is imposed. ATT is the average treatment effect on the treated; bootstrapped *t*-values are based on 100 replications. Kernel matching uses the Epanechnikov kernel.

Table 10: The causal effect of offshoring on growth of labour productivity in West German manufacturing enterprises – Results from a matching approach

Treatment	Offshoring in 2001 - 2003
Outcome	Growth of labour productivity (percentage) 2000 - 2004
Treatment group	Enterprises with offshoring in 2001 - 2003
Control group	Enterprises without offshoring before 2006

A Full sample

Propensity score matching[a]	Number of firms	Treated	Control	ATT	*t*-value	bootstrapped *t*-value	balancing property
One nearest neighbour	360	16.97	12.00	4.97	1.26	1.33	yes
Two nearest neighbours	360	16.97	11.70	5.27	1.75	1.54	yes
Three nearest neighbours	360	16.97	11.54	5.43	1.98	1.38	yes
Kernel matching (bwith = 0.01)	359	16.96	11.82	5.14	2.01	1.74	yes
Kernel matching (bwith = 0.03)	359	16.96	11.29	5.67	2.31	2.25	yes
Kernel matching (bwith = 0.05)	360	16.97	11.17	5.79	2.40	2.08	yes

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

Propensity score matching[a]	Number of firms	Treated	Control	ATT	*t*-value	bootstrapped *t*-value	balancing property
One nearest neighbour	339	15.06	7.32	7.74	4.10	3.49	yes
Two nearest neighbours	339	15.06	9.17	5.87	3.47	2.79	yes
Three nearest neighbours	339	15.06	9.22	5.85	3.63	3.56	yes
Kernel matching (bwith = 0.01)	329	14.76	9.63	5.14	3.43	2.76	yes
Kernel matching (bwith = 0.03)	338	15.05	9.34	5.71	3.87	3.56	yes
Kernel matching (bwith = 0.05)	339	15.06	9.54	5.53	3.80	3.56	yes

[a] Propensity score matching is done using PSMATCH2 and Stata 10.1. The common support condition is imposed. ATT is the average treatment effect on the treated; bootstrapped *t*-values are based on 100 replications. Kernel matching uses the Epanechnikov kernel.

Appendix Table 11: Probit-regressions used to estimate the propensity score used in section 3[a]

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 2000	0.00018	0.051	0.0002	0.004	0.00018	0.049
Number of employees 2000 (squared)	-4.26e-9	0.640	-5.42e-9	0.062	-4.33e-9	0.634
Number or employees 2000 (cubic)	5.73e-15	0.974	2.91e-14	0.127	6.53e-15	0.970
Sales per employee 2000 (€)	6.33e-7	0.115	5.77e-7	0.151	6.20e-07	0.128
Wage per employee 2000 (€)	6.25e-6	0.403	8.36e-6	0.265	6.80e-6	0.358
Share of exports in total sales 2000 (%)	0.0070	0.001	0.0071	0.001	0.0070	0.001
Growth of number of employees 1997 - 2000 (%)	-0.0007	0.573				
Growth of wage per employee 1997 - 2000 (%)			-0.0012	0.616		
Growth of sales per employee 1997 – 2000 (%)					-0.00004	0.937
Number of firms	1,779		1,767		1,779	
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 2000	0.0002	0.009	0.00018	0.060	0.00017	0.019
Number of employees 2000 (squared)	-5.37e-9	0.076	-3.86e-9	0.675	-4.69e-9	0.112
Number or employees 2000 (cubic)	2.91e-14	0.140	-1.97e-5	0.991	2.50e-14	0.194
Sales per employee 2000 (€)	1.13e-6	0.018	5.26e-7	0.207	6.44e-7	0.148
Wage per employee 2000 (€)	5.32e-6	0.505	7.67e-6	0.350	4.61e-6	0.563
Share of exports in total sales 2000 (%)	0.0073	0.002	0.0073	0.001	0.0082	0.000
Growth of number of employees 1997 - 2000 (%)	-0.0005	0.662				
Growth of wage per employee 1997 - 2000 (%)			-0.0022	0.448		
Growth of sales per employee 1997 – 2000 (%)					0.0001	0.881
Number of firms	1,657		1,667		1,660	

[a] 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 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. *ß* is the estimated regression coefficient, *p* is the prob-value.

Appendix Table 12: Probit-regressions used to estimate the propensity score used in section 4[a]

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 2000	0.0002	0.000	0.0002	0.000	0.0002	0.000
Number of employees 2000 (squared)	-4.26e-9	0.000	-4.27e-9	0.000	-4.28e-9	0.000
Number or employees 2000 (cubic)	2.06e-14	0.003	2.07e-14	0.003	2.07e-14	0.003
Sales per employee 2000 (€)	5.26e-7	0.143	4.75e-7	0.187	4.47e-7	0.218
Wage per employee 2000 (€)	3.57e-6	0.550	4.66e-6	0.434	4.66e-6	0.432
Share of exports in total sales 2000 (%)	0.0091	0.000	0.0091	0.000	0.0091	0.000
Growth of number of employees 1997 - 2000 (%)	-0.0012	0.285				
Growth of wage per employee 1997 - 2000 (%)			0.0004	0.681		
Growth of sales per employee 1997 – 2000 (%)					0.0003	0.324
Number of firms	2,181		2,180		2,181	
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 2000	0.0002	0.000	0.0002	0.000	0.0002	0.000
Number of employees 2000 (squared)	-4.47e-9	0.000	-4.22e-9	0.001	-3.91e-9	0.001
Number or employees 2000 (cubic)	2.18e-14	0.003	2.04e-14	0.004	1.88e-14	0.008
Sales per employee 2000 (€)	8.56e-7	0.044	5.39e-7	0.144	4.29e-7	0.279
Wage per employee 2000 (€)	3.50e-6	0.584	3.30e-6	0.609	5.07e-6	0.425
Share of exports in total sales 2000 (%)	0.0095	0.000	0.0090	0.000	0.0096	0.000
Growth of number of employees 1997 - 2000 (%)	-0.0009	0.407				
Growth of wage per employee 1997 - 2000 (%)			0.0003	0.773		
Growth of sales per employee 1997 – 2000 (%)					0.0005	0.204
Number of firms	2,041		2,047		2,059	

[a] Endogenous variable:1 if the firm is an offshoring firm in 2001 – 2003, 0 if the firm did not offshore until 2006. 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. *ß* is the estimated regression coefficient, *p* is the prob-value.