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Is Offshoring Linked to Offshoring Potentials?

Evidence from German Linked-Employer-Employee Data

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Is Offshoring Linked to Offshoring Potential?

Evidence from German Linked Employer-Employee Data[1]

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October 27, 2014

Abstract

This paper analyses the link between offshoring in German plants and the offshoring potential of their employees. We use information on the offshoring potential of jobs from representative task data and merge it with linked employer-employee data, for which information on different modes of offshoring behaviour is available. We empirically identify individual and plant-level determinants of offshoring activity and additionally analyse how offshoring potential influences the realisation of offshoring by German plants. Depending on the measure for actual offshoring, we mostly find a negative link: firms are less likely to outsource or offshore parts of their production processes if their outsourcing and offshoring potential is high. This indicates that existing measures of offshoring potential can indeed be interpreted as not-yet realised offshoring, or offshoring that cannot be realised, e.g. due to trade barriers.

JEL-Classification: F14, F16

Keywords: Outsourcing, Offshoring, Trade in Tasks

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1 Introduction

The last decades have seen an extraordinary rise in international trade. Nowadays, the term "trade" does not only refer to trade in final products, but increasingly includes trade in intermediate inputs along the production chain. Typically, labour intensive inputs are imported from low-wage countries, a process typically referred to as offshoring.[3] In addition, the process of offshoring increasingly happens for smaller and smaller parts of the production process, i.e. single tasks instead of whole goods, production chains or even plants (so called *trade in tasks*, see Grossman and Rossi-Hansberg 2008, Acemoglu and Autor 2011, Autor 2013, or Baldwin and Robert-Nicoud 2014).

On the one hand, the literature on offshoring typically identifies the determinants of offshoring behaviour of firms, or the effects of offshoring on firm performance (see Crinò 2009, or Wagner 2011, for an overview). Typical questions are: Why do firms offshore? Which firms engage in offshoring? On the other hand, there is a discussion on what type of jobs are being offshored and how many may be offshored in the future. Not all jobs are equally tradable, and the economic literature has identified a set of characteristics that may allow the estimation of the offshoring potential of jobs. Earlier studies have used only subjective measures or a selective number of characteristics to estimate the extent of job offshoreability (see, e.g. Blinder 2009 for the U.S. or Schrader and Laaser 2009 for Germany). More recent studies focus on different, maybe more objective measures (Becker and Muendler 2012, Blinder and Krueger 2013), or a larger set of characteristics (Brändle and Koch 2014). There are several studies trying to quantify the potential for offshoring (e.g. Blinder 2009). What is missing is an analysis of the link between the offshoring potential of jobs and actual offshoring behaviour of firms.

The main contribution of the present work is to complement existing lines of research by linking actual offshoring behaviour to offshoring potential. If offshoring potential is a predictor for future offshoring, we would expect plants with a high offshoring potential to relocate those tasks in the future and having done so less in the past. However, it may be the case that offshoring plants have a more offshoreable task set in general. Then, the relationship between offshoring potential and actual offshoring would be positive. We analyse this relationship empirically by combining information on the offshoring potential of the employees of a plant with plant-level determinants of actual offshoring behaviour.

The main dataset for our analysis is the German LIAB, a linked employer-employee dataset. It combines a representative panel survey of German plants with information on the employees working in them. In the LIAB, different information on offshoring behaviour is selectively included in several waves of the data (see, Addison et al. 2011 or Sirries et al. 2012). We match information on offshoring potential based on a large set of characteristics drawn from the German BIBB/BAuA employment survey. The information is differentiated between the outsourcing potential and the offshoring potential of jobs, aggregated, and then linked to the LIAB on a 3-digit level of occupations. Using this approach we can estimate a plant-level offshoreability index, depending on the occupations of the employees working in a plant. We take a retrospective approach because we fully observe the offshoreability of the current workforce, but only whether offshoring has happened during the last or

[3] Of course, offshoring is not contingent on the inputs being labour intensive, or on the destination country being low-wage. For a discussion of various definitions of offshoring and outsourcing, see Wagner (2011). Offshoring in this sense does not care about organizational decisions, while outsourcing defines the production of intermediate imports outside the firm boundaries, i.e. through the market, and does not care about the location of production, i.e. at home or abroad. Therefore, offshoring may be more broadly characterized as encompassing international outsourcing and foreign direct investment.

last two years, depending on the measure. Our investigation proceeds in analysing whether plants with higher offshoring potential have a higher probability to having offshored parts of their production processes, after controlling for relevant firm characteristics.

The empirical results of the paper reveal that, in addition to the usually applied determinants of offshoring behaviour of firms, the two indicators of offshoring and outsourcing potential significantly affect the probability of having outsourced or offshored. The average outsourcing potential of jobs in a plant decreases the likelihood that a plant engages in (international) outsourcing, depending on the measure used. As regards the offshoring potential of the employee stock in a plant, we find that this measure is also negatively linked to actual offshoring behaviour of German plants, especially for those measures, where we know for sure that outsourcing has taken place internationally.[4] Therefore, we think that the information on offshoring behaviour in the LIAB is well suited to investigate the topic: offshoring potential has a stronger influence in plants that are internationally active. We conclude that we can interpret offshoring potential as not-yet realised offshoring, or offshoring that cannot be undertaken, e.g. because of trade barriers.

Section 2 gives a short summary of the relevant strands of the literature and shows the missing link between offshoring potential and actual offshoring. The data is described in Section 3 along with a documentation of the matching process between the BIBB/BAuA and the LIAB data and the empirical method. Section 4 displays the main empirical results concerning the determinants of offshoring behaviour as well as some robustness checks. Section 5 concludes.

2 Literature Review and Hypothesis

2.1 The Offshoring Decision

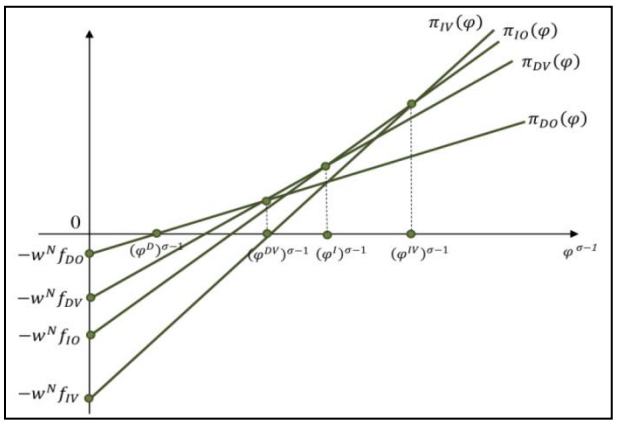
As a definition, we label a firm's decision to relocate the production of intermediate inputs to a foreign country as offshoring. Since offshoring make take place within the firm boundaries or at arm's length (cf. Antras and Helpman, 2004), we distinguish offshore outsourcing (from an independent supplier) from intra-firm sourcing (from a vertically integrated supplier). This is in line with more recent contributions in the literature, such as Federico (2012) or Kohler and Smolka (2014), which analyse the choice of firms between integration and outsourcing in the home country or abroad.

The decision to offshore parts of the production process may be a simple cost versus benefits assessment. Higher benefits from offshoring emerge, for example, when the cost differentials between the home country and the offshoring location exist, which implies efficiency gains. Other possible gains come from higher quality or more variety from producing abroad. Offshoring might also have possible effects on production or labour costs at home, for example through a positive effect on the labour supply (Grossmann and Rossi-Hansberg 2008) or a negative effect on the employees' bargaining power (Skaksen 2004).

Costs from offshoring are usually modelled to include fix costs, e.g. of setting up a plant, variable costs, e.g. transportation and communication costs, and frictions, e.g. hold-up problems or strikes from the local workforce (for an overview see Antras and Yeaple 2013). As a result, offshoring models predict a sorting of firms into offshoring along the distribution of firm productivity, see Figure 2.1.

[4] In the other cases, we do not exactly know whether outsourcing has taken place internationally, but it could have.

Figure 2.1: Sorting into Organizational Modes



Source: Antras and Yeaple (2013), Fig. 10, based on Antras and Helpman (2004).

More productive firms (higher $\varphi^{\sigma-1}$ along the x-axis) are said to be able to overcome the fix costs of offshoring more easily and benefit to a larger degree from efficiency gains. In the set of models Antras and Yeaple (2013) characterise, profits for highly productive firms are largest when they produce internationally, but inside the firm boundary, i.e. FDI ($\pi_{IV}(\varphi)$ is larger than for the other modes of production), then comes international outsourcing ($\pi_{IO}(\varphi)$), then domestic integration ($\pi_{DV}(\varphi)$), then domestic outsourcing ($\pi_{DO}(\varphi)$). Hence, there is a clear positive relationship between productivity and the offshoring decision in these models, while the relationship between productivity and outsourcing may be non-linear.[5]

2.2 Empirical Determinants of Actual Offshoring

The empirical literature has indeed found that offshoring firms differ systematically from non-offshoring firms. Görg et al. (2008) conclude in their literature survey that offshoring firms are larger, more human capital intensive, and have a higher share of exports in total sales, i.e. they are more internationally active on other fields as well. There is an ongoing discussion, similar to the one on exports, on whether the relationship between offshoring and productivity is a causal effect or a selection effect (see, e.g. Kohler and Smolka 2014 for the most recent empirical contribution). For a review of the international literature on the economic consequences of offshoring see Crinò (2009).

For Germany, micro-level evidence on the determinants of actual offshoring is existent, but sparse. This has in part to do with the lack of suitable offshoring measures, which is also a problem in other countries, such that most evidence uses sector-level data on offshoring (see, for a discussion, Eppinger 2014 and for recent evidence Schwörer 2013). Wagner (2012) offers, among other topics, a review of recent studies on the relationship between imports (the use of foreign intermediates) and firm performance, especially productivity. The argumentation is similar to the one concerning the relationship between exports and productivity. International links should be positively correlated with productivity because (a) only productive firms can bear the fixed costs of importing (self-selection effect), (b) importing firms become more productive as imports are cheaper or of better quality (cost effect), and (c) importing firms may learn from importing. A positive link between importing and productivity is confirmed in the majority of studies analysed. However, according to Wagner (2012),

[5] This sorting pattern depends crucially on fixed cost ranking. Especially for middle two categories, this remains unclear. E.g. Kohler and Smolka (2012) find evidence from Spain on reverse patterns.

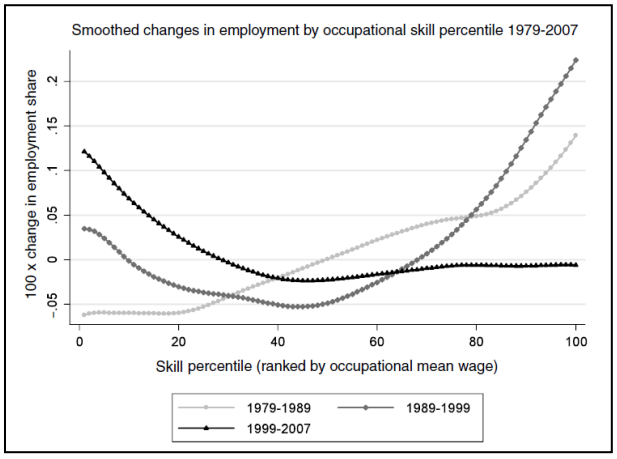
evidence on the relationship between importing and other characteristics is scarce and inconclusive. Serti et al. (2010) use Italian data and find that failing to control for importing activities may bias estimations of exporter wage premia upwards. Using the plant-level data from the IAB Establishment Panel in 2002-2004, Addison et al. (2011) analyse the determinants and employment consequences of two possible measures of offshoring: an increase in the share of intermediate inputs and the existence of reorganizational measures that involve an increase in buying intermediate inputs. These measures, however, do not necessarily account for international outsourcing. The results are mixed. Both measures are not correlated to the same covariates and they do not have a significant effect on employment growth and plant survival in the future in most specifications.

The issue of causality of offshoring and firm performance is discussed, among others, in Wagner (2011) using German official register data and a special purpose survey on relocation activities. Offshoring causes sunk costs that can only be paid by more productive firms in the first place, such that there is self-selection of such firms into offshoring. Then, offshoring increases productivity via lower costs and higher quality of inputs. Using descriptive statistics and matching techniques, he finds that firms that started offshoring between 2001 and2003 were already larger, more productive, paid higher wages and exported more in the year 2000. Therefore, these variables should be included in an analysis on the determinants of offshoring.

2.3 Determinants of Offshoring Potential

The starting point of the discussion about the empirical assessment of offshoring potential of tasks, jobs, or economic activities has been skill-biased technological change. In industrialised countries, especially low-skill jobs are typically paid more than their comparable counterparts in developing countries, such that a wage-differential exists that can make it profitable for firms to relocate these activities. However, the recent literature has found that it is not primarily skill that determines which jobs are being offshored, but other characteristics, for example the routineness or interactivity of a job (see, for an overview Acemoglu and Autor 2011). Indeed the relationship between an occupations' skill level and employment growth has changed over the last decades, giving rise to what nowadays is called job polarisation, i.e. the disappearance of medium-skilled jobs.

Figure 2.2: Job Polarization



Source: Acemoglu and Autor (2011), HB of LabEco, Fig. 10, based on Autor and Dorn (2009).

Figure 2.2 shows this relationship. It compares the relative employment changes of U.S. occupational groups between 1979 and 2007. Occupations are ranked by the skill level, i.e. the mean wage. It can be seen that since 1989 and especially since 1999 low-wage, i.e. low-skill occupations gain in

employment shares relative to mid-wage occupations. High-wage occupations have gained employment share until 1999. In other words, there is no linear relationship between skill and employment changes (cf. educational up-skilling) any longer.

Several possible determinants of offshoring and outsourcing potential of jobs and activities, which may or may not be related to skill, have been identified in the literature:

Communication intensities and interactivity requirements make it more difficult to offshore a job (Blinder 2009; Leamer and Storper 2001). High demands for interaction and context, e.g. face-to-face communication with customers or requirements to cultural proximity (e.g. skills in languages or law) are identified in the literature. Bardhan and Kroll (2003) find common characteristics for jobs that are internationally tradable: they do not require personal contact, they have high information requirements, working processes are linked to the internet, or jobs are characterized by low social networking requirements. Similarly, van Welsum and Reif (2005) find evidence that outsourcing potential crucially depends on social contact and the use of computers. Interactivity is added to the determinants of job offshoreability by Becker et al. (2013). They establish a link to internationalization, adding 'interactive' and 'non-interactive' tasks to the already mentioned 'routine' and 'non-routine' tasks. They find that offshoring is accompanied by significant shifts to non-routine and interactive tasks in the home country.

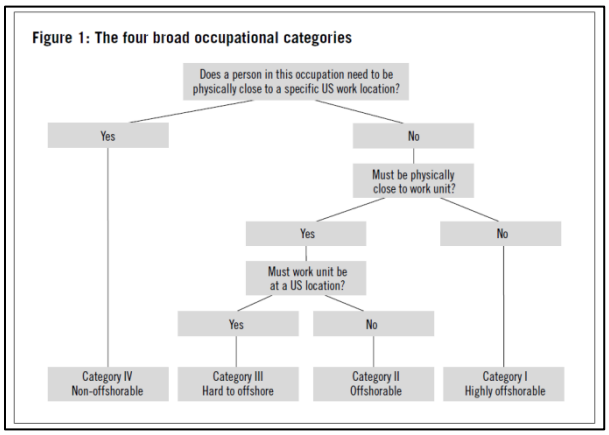
Routineness of tasks is the most commonly used measure of offshoring potential (cf. Autor et al. 2003, Spitz-Oener 2006). Based on the BIBB/BAuA employment survey, Spitz-Oener (2006) examines the changes in job contents and tasks due to technological development. She introduces a classification of tasks into five categories: 'non-routine analytic', 'non-routine interactive', 'routine cognitive', 'routine manual', and 'non-routine-manual'. Quite similarly, Oldenski (2012) finds high (negative) correlations between relocation and the complexity of tasks and Autor et al. (2003) theoretically and empirically confirm that "routine tasks" (i.e. limited and well-defined sets of cognitive and manual activities) can more easily be substituted by "computer capital", whereas "non-routine tasks" (i.e. "problem-solving and complex communication activities"), are rather being complemented or supported than substituted by computer capital (see also below). Costinot et al. (2011) assume that complex (non-routine) tasks may cause frictions in the production process that cannot be resolved ex ante. According to Antras (2003) and Barba-Navaretti and Venables (2004), both offshoring and outsourcing potential of goods or services increase with their standardization or codifiability. The term codifiability thereby refers directly to whether it is possible to describe a certain activity in a way that it can be performed by another company, either located in the home country or abroad.

Jensen and Kletzer (2006), and later in a revised version Jensen und Kletzer (2010), use geographic restrictions on so-called "occupational requirements": They assume that, for instance, activities involving intensely modern information and communication techniques are characterized by high offshoring potential. These techniques are, to a certain degree, standardized, or at least codifiable, and the physical distance between supplier and customer is only of minor importance. They employ a creative methodology that uses geographical concentration in the US to estimate how 'tradable' each occupation was in 2000.

Generally spoken, increasing needs to interact personally are supposed to be a barrier to offshoring, whereas the impact on outsourcing is not that clear-cut. If, for instance, interaction requires high levels of trust, outsourcing is less probable; however, trust must not always be confined to intra-firm cooperation. Cultural linkages might similarly hinder offshoring of an economic activity, but might have no influence on organizational dislocation on the national level, as, for instance, the cultural background of firms or people does not differ in many respects in the home country.

Hence, the literature on outsourcing and offshoring potential has identified a number of possible job characteristics that may determine whether it is possible to relocate a job abroad. However, in their empirical assessments, most studies focus on only one or a few of them, or use rather subjective measures. An example is the categorization of Blinder (2009). He assigns the O*Net job occupations to four different categories according to their likeliness of being offshored by using job descriptions, tasks and work activities, see Figure 2.3.

Figure 2.3: A Measure of Locational Ties and Offshoring Potential



Source: Blinder (2009: 54).

For example, non-offshoreable jobs require being at a specific work location in the U.S. In hard-to-offshore jobs the worker has to be physically close to his or her work unit, which must be in the U.S. Among all occupations, 59 (8.2 Mio. workers) are classified as highly offshoreable, 151 occupations (20.7 Mio workers) are classified as offshoreable, 74 occupations (8.8 Mio workers) are classified as hard to offshore, and 533 occupations (92.6 Mio. workers) are classified as non-offshoreable. A similar methodology is available for German occupations at the 3-digit KldB[6] level (cf. Schrader and Laaser 2009). However, the measure is relatively broad and subjective.[7] Instead of looking at an actual work environment, it assumes all jobs of a specific occupation to perform exactly the same tasks. This critique is not new, in fact Blinder and Krueger (2013), therefore, use and compare three different survey methods: self-reflection (easy vs. distinguished), professional coding based on the nature of their work, (occupation and tasks performed).

Comprehensive measures of job offshorability and outsourceability that uses a wide number of job characteristics and a data-driven, objective weighting method are generated by Brändle and Koch (2014). They use four waves of the BIBB/BAuA employment surveys, where information on most of the characteristics listed above, and also some new ones is supplied. Applying a principal component analysis, they provide two indicators that measure both the offshoring (cross-country geographical relocation) and outsourcing potential (organizational relocation) at the level of jobs, occupations, tasks, or industries. For this paper, we use their index, see Section 3.2.

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6 The KldB 88 ("Klassifizierung der Berufe") is a classification of professions quite common in German datasets and literature. Contrary to the International Standard Classification of Occupations (ISCO), it is based on the actual type of professional activity, and not on skill levels.

7 Blinder (2009: 55) himself states that he assigns an "admittedly subjective" two-digit index number of offshoreability to each occupation.

2.4 Links between Offshoring and Offshoring Potential

From this literature survey, it has so far become clear that a number of papers have dealt with the (micro-) determinants of offshoring behaviour and that a number of alternative measures exist which estimate the offshoring potential of jobs. A missing link, however, is evidence on the relationship between the two.

Obviously, a more easily offshoreable workforce should be associated with lower offshoring costs and hence higher offshoring at the plant level. For example, routine jobs can be more easily offshored because the new workers need less training and supervision, or less skilled workers can be employed, resulting in higher wage differentials. However, the question arises then, why firms do not exploit these potential efficiency gains. Indeed, there may exist other barriers that prevent firms from offshoring.[8] If these barriers are also positively linked to the offshoring potential of jobs, then the relationship between offshoring potential and actual offshoring becomes ambiguous.

Productivity may be country-specific, such that a firm can only produce efficiently in Germany, but not in an offshore location. Family-owned firm, for instance, may only be highly productive in the home country as they have a social responsibility for their local workforce. Also, the complementarities within the firm may matter. If there are some easily offshoreable workers, but they need to work together with non-offshoreable workers, they can neither be offshored easily. Furthermore, a mere offshoring threat may reduce wages in a setting of collective bargaining, while offshoring may increase wages for the workforce at home (Bhagwati 2004, Skaksen 2004). If this is the case, it can be profitable to keep offshoreable workers in the home country to reduce the overall wage bill.

There is evidence suggesting that offshoring has an effect on the offshoreability of the workforce. Becker et al. (2013) use plant-level data on German MNE together with task information to study the onshore employment composition effects of (in-house) offshoring. They identify a significant shift towards more non-routine and more interactive tasks for the affected employees. Hogrefe (2013) empirically analyses how offshoring influences relative labour demand, not differentiated by skill, but between routine and non-routine tasks. Theoretically, workers should sort themselves into occupations depending on wages (higher for non-routine) and disutility from effort (higher for low-talent workers), similarly to Liu and Trefler (2009). Using industry-level data on offshoring, employment and wages (BA employment panel), and the share of routine tasks in occupations (BIBB/BAuA survey, similar to Spitz-Oener 2006), he finds that offshoring reduces the employment and cost shares of routine tasks, controlling for output, capital and skill groups. Also, according to Becker and Muendler (2012), there has been a shift towards less offshoreable activities since the 1980s. As changes occur mostly within sectors and occupations, offshoring should be negatively linked to offshoreability. Finally, Eppinger (2014) finds a negative relationship between services imports and industry-level offshoreability measures similar to ours. He suggests that most likely trade barriers exist that prevent the offshoring of offshoreable jobs.

[8] These could be non-tariff trade barriers that only affect certain sectors or occupations.

3 Data and Empirical Method

3.1 Data on Offshoring: the LIAB

To investigate the relationship between actual offshoring and offshoring potential, our primary data source is the LIAB dataset from the Institute for Employment Research (IAB) in Nuremberg, more precisely the LIAB cross-sectional Model 2 1993-2010. It is a linked employer-employee dataset with rich information based on a representative annual plant-level survey (the IAB Establishment Panel, EP). Additionally, personal data is amended from the Integrated Employment Biographies (IEB) from almost all employees working in these plants.[9] Personal information is drawn from official registers from the labour administration and social security records and is of very high quality. We use personal information on all individuals employed on a social security basis in a plant surveyed in the IAB EP and aged between 15 and 65, excluding home workers and working family members, as well as individuals earning less than 450 euros a month.

The IAB Establishment Panel is a representative sample of about 1 % of German plants that is stratified over industries and firm size classes. Hence, large plants are overrepresented, such that the data covers about 7 % of all German employees. The survey is based on the population of all plants in Germany with at least one employee subject to social security. The survey is conducted in personal interviews with senior staff or personnel managers, has a high response rate, and low panel attrition. The questionnaire focusses on the plants' personnel structure, development and policy, and offers extensive information on firm characteristics.[10] We restrict our data to information from 1996 onwards, where East German plants join the survey, to plants from manufacturing and service industries (excluding public administration), and to plants with at least five employees.[11]

Most importantly, from our perspective, the LIAB dataset contains a set of variables, namely responses to different questions directed at plant managers or high personnel staff on outsourcing and offshoring. Unfortunately, items on offshoring are not included in every wave, and different items are asked across waves. Table 3.1 gives an overview on information on offshoring in the data, including the shares of plants which engage in outsourcing or offshoring in each year and the total number of positive observations (plant year combinations). The questionnaire texts are presented in Table A.1 in the Appendix.

[9] For an overview of the data see Jacobebbinghaus and Seth (2010).

[10] For an overview of the data see Ellguth et al. (2014).

[11] We access the data through remote-data access and guest visits at the Research Data Centre (Forschungsdatenzentrum, FDZ) at the IAB.

Table 3.1: Different Measures on Outsourcing and Offshoring Behaviour in the Data

Year	Increased inputs	Increased Inputs through outsourcing	Increased Inputs through offshoring	Any Part of the Plant closed/ outsourced/ separated	Parts outsourced	Parts outsourced in foreign country	Foreign direct investments	Additional buying of intermediate inputs
1996				9.50%	4.82%			
1997				8.34%	3.94%			
1998				6.07%	3.04%			41.43%
1999				6.72%	3.40%			
2000				5.57%	2.72%			14.30%
2001				5.64%	2.57%			12.89%
2002				5.57%	2.37%			
2003				5.23%	2.11%			
2004				5.10%	2.32%			9.56%
2005				4.75%	2.09%			
2006				3.79%	1.84%		3.97%	
2007				4.22%	1.49%	0.57%		11.93%
2008	13.33%	12.68%	2.48%	3.15%	1.57%			
2009				3.12%	1.48%			
2010				3.76%	1.40%	0.26%		8.03%
Total relative	13.33%	12.68%	2.48%	5.13%	2.32%	0.06%	3.97%	12.95%
Total no. of (positive) Cases	1,301	1,237	242	6,957	3,123	77	308	6,834

Source: LIAB QM 9310, Wave 1996 to 2010, own calculations.

The first set of variables (increased inputs) particularly suits the investigation of actual outsourcing and offshoring as it precisely follows the definition. Furthermore, the questions distinguish between outsourcing at home and offshoring abroad, which is important for the distinction of potential effects of offshoring potential and outsourcing potential. Also, the question is asked in a way that it only identifies an *increase* in imported intermediates, such that level effects, which are particularly affected by selection of (large, productive) plants into offshoring, do not play a role here. The drawback of this information is that it is only available for one wave of the survey (2008).

An alternative set of variables, which is available for all of the survey waves, is the information whether a plant has closed, outsourced, or separated any parts of production during the last year. This item does not really focus on the reasons behind a closure or a separation, and can be interpreted as a comprehensive measure that captures all of these potential events. We can also focus on those plants that have outsourced a part of the production. This could be both nationally or internationally. Only in two of the most recent waves, 2007 and 2010, the destination of the outsourced parts of the plant is asked: here, we focus on those plants that state that they have outsourced internationally.

Additionally, in 2006, one item asks whether the plant has engaged in foreign direct investment during the last year. This variable captures the part of offshoring that is performed inside the firm boundaries (vertical FDI), but may also capture takeovers of foreign competitors (horizontal FDI). Note that for this item only a few observations are available. A last set of potential variables focusses on reorganisation measures in the plant and is asked about every third year (1998, 2000, 2001, 2004, 2007, and 2010). One of the items captures the increased purchase of intermediate inputs as one form of reorganisational modes.

Some of the variables in this study have already been used in the empirical trade literature, e.g. in Addison et al. (2011) for reorganizational modes, in Sirries et al. (2012) for a number of variables, or in Arndt et al. (2012) for FDI.

To account for confounding factors both influencing actual offshoring and offshoring potential in the workforce, we control for a large number of further covariates. Addison et al. (2011) provide a number

of plant-level characteristics that should be controlled for. Table A2 gives on overview on the control variables used. We include sector dummies, year dummies (where possible), a dummy variable for West Germany, firm size classes, an indicator whether the observation is a single-plant firm, a headquarter or an intermediate body, a public ownership dummy, information on collective bargaining, firm age, exporter status, and whether the plant is affiliated with the public sector. We also control for firm-level productivity, which can be measured as sales less intermediates per employee. However, information on intermediate inputs is missing non-randomly for about 30 % of the observations, which would lead to a bias due to sample selection. Further control variables have been tested, but largely been found not to influence the offshoring decision by firms. Note also that we do not know the destination country for the offshoring location, such that estimating a gravity equation, similarly to Eppinger (2014) or Head and Ries (2009) is not feasible here.

3.2 Data on Offshoring Potential: the BIBB/BAuA Employment Surveys

As there is no information on outsourcing and offshoring potential in the LIAB, we rely on other data to construct these measures. We use several cross-sections of the German Qualification and Career Survey of Employees (BIBB/BAuA Survey),[12] which has also been used by other researchers on the topic (e.g. Spitz-Oener 2006, Becker et al. 2012). We follow the approach of Brändle and Koch (2014), who use a large number of job characteristics to explain outsourcing potential and offshoring potential of individuals' jobs. By means of a principal component analysis, they generate variance-maximising indices, which can be aggregated on the occupation, regional, task, or industry level.

The BIBB/BAuA employment survey contains very detailed information on job characteristics of each employee, which are believed to be of relevance for the outsourcing potential and offshoring potential of jobs. Brändle and Koch (2014) have operationalised a large number of these characteristics:[13]

- Codifiability: Every step of the execution of tasks / activities is stipulated in detail.
- Routineness: The operational cycles of work are exactly and constantly repeating.
- Multitasking: Sum of different tasks performed, relative the average number of tasks performed in that year.
- Complementarity: Number of complementary tasks performed, relative to all tasks performed.
- Information and Communication Technologies: Daily work involves working with computers or other ICT devices.
- Interactivity: Daily work involves direct contact with clients or patients; daily work involves convincing others; daily works involves negotiating agreements.
- Locational Ties: Defined on the basis of 3-digit professions according to Blinder (2006) and Schrader and Laaser (2009).
- Cultural Linkage, Law: Daily work requires specific knowledge of law and justice.
- Cultural Linkage, Writing Skills: Daily work requires specific knowledge of writing skills.
- Cultural Linkage, Language Skills: Daily work requires skills in one or more foreign languages.

[12] The surveys are carried out by the German Federal Institute for Vocational Training (BIBB), the Research Institute of the Federal Employment Service (IAB), the Federal Institute for Occupational Safety and Health (BAuA) and the Federal Ministry of Education and Research. See Hall et al. (2014), for an overview on the data.

[13] Especially, they have managed to smooth the information over time, as the different cross-sections of the data are not fully consistent (see Table A1 of their paper).

- New Scopes: Daily work involves addressing new and / or unforeseen problems and challenges or testing new procedures or processes.

For each individual, they generate an index based on the characteristics listed above. As some of the characteristics are correlated or measure similar aspects of a job's outsourcing and offshoring potential, one cannot simply add them up, but needs a weighting procedure. Brändle and Koch (2014) use a principal component analysis, a mathematical procedure that uses an orthogonal transformation of the data to reduce the set of possibly correlated determinants into a smaller set of linearly uncorrelated components that maximises the explained variance in the data.

Table 3.2: PCA Results

	Outsourceability			Offshoreability		
Characteristic	Hypotheses	Comp1	Comp2	Hypotheses	Comp1	Comp2
Codifiability	(+)	-0.28	**0.66**	(+)	-0.27	**0.61**
Routines	(+)	**-0.31**	**0.62**	(+)	-0.29	**0.58**
Number of Tasks	(-)	**0.42**	0.26	(0)		
Complementarity	(-)	**0.46**	0.17	(-)	**0.43**	0.02
ICT Use	(+)	**0.32**	0.12	(+)	**0.40**	**0.31**
Interactivity	(-)	**0.40**	0.22	(-)	**0.36**	0.00
Locational Ties	(0)			(-)	-0.21	**-0.36**
Law Knowledge	(0)			(-)	0.27	0.02
Writing Skills	(0)			(-)	**0.38**	0.19
Language Skills	(0)			(-)	**0.33**	0.17
New Scopes at Work	(-)	**0.42**	0.15	(0)		

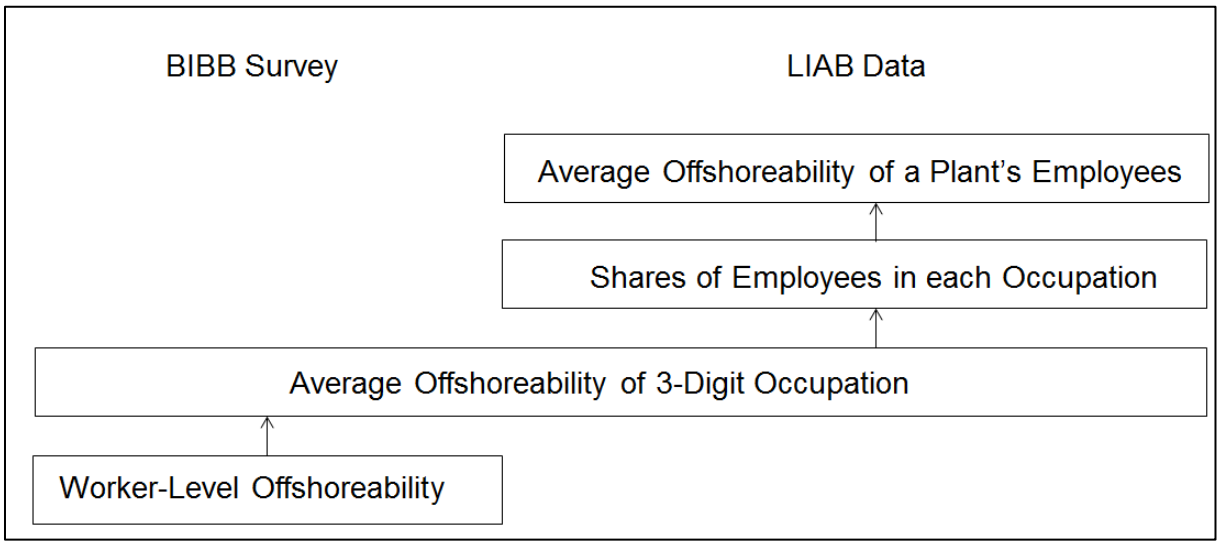
Note: Coefficients larger than 0.3 are marked bold. Theoretical hypothesis are in parentheses: (+) / (0) / (-) the job characteristic should have a positive / no / negative correlation with outsourcing or offshoring potential. Eigenvalues are > 1. The Kaiser-Meyer-Olkin measures and squared multiple correlations of variables are well behaved. Source: BIBB Survey 1992, 1999, 2006, 2012; calculations by Brändle and Koch (2014).

Table 3.2 presents an overview of the PCA loadings (weights) to see how the relevant job characteristics enter the first two linear components of the data. We follow Brändle and Koch (2014) and use the negative of the first component from the outsourcing potential estimation and the second component of the offshoring potential estimation as the respective indicators, as they best fit the theoretical hypothesis based from the literature.

For our investigation we merge the information of outsourcing and offshoring potential to the LIAB on the occupational level, following Figure 3.1. We first aggregate the job indicators from the BIBB/BAuA employment survey to the KldB-1988 3-digit level of occupations, which is available for both datasets. We then merge this occupation-level information to the LIAB data. Hence, each individual gets assigned an offshoring and outsourcing potential based on her or his occupation.[14]

[14] This procedure exploits the between-occupation differences in outsourcing and offshoring potential. Brändle and Koch (2014) as well as Boockmann (2014), who uses a different merging approach, have shown that the larger share of variation in the offshoring and outsourcing potential is between rather than within occupations.

Figure 3.1: Merging Procedure



Source: Own representation.

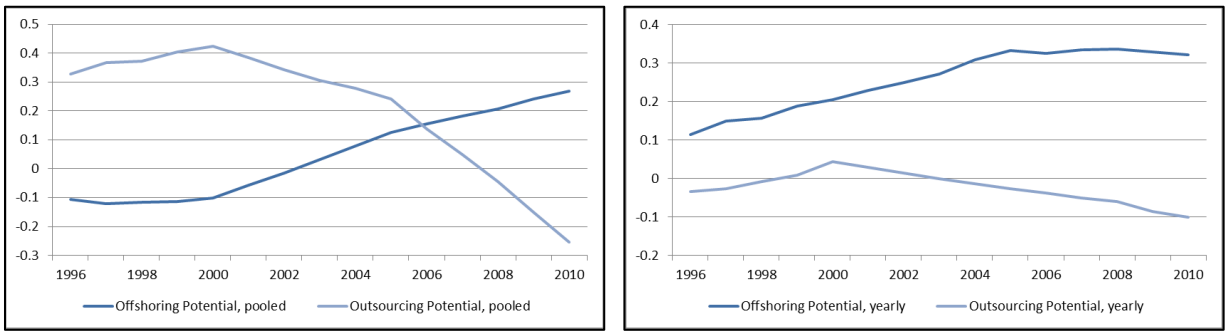
As our level of analysis is the plant, we then aggregate the individual-level data on the plant level. Hence, each plant gets assigned a value of offshoring and outsourcing potential that is based on the individuals it employs and their occupations.[15]

As regards variation over time, there are two potential margins on which the indicators of offshoring and outsourcing potential can change: coefficients and characteristics. First, one can use a pooled PCA over all waves of the BIBB/BAuA survey, implicitly assuming that the coefficients, i.e. the relationship between job characteristics and the resulting offshoring and outsourcing potential, do not change. Hence, variation over time comes from changes in job characteristics, or, on the plant level, from changes in the composition of the workforce's occupations. Second, the PCAs can be estimated for each of the waves separately, such that changes can occur on both margins. While the first model restricts variation over time, it can be interpreted as capturing the long-term determinants of offshoreability. The second model allows for a feedback effect, i.e. changes in the influence of certain job characteristics over time.[16] In our empirical analysis, we use the long-term determinants of offshoreability.

[15] For example, if a plant employs three accountants, ten legal representatives, two watchmen, and a translator, the offshoring potential of the plant would be (3×0.81+10 ×(-0.48)+ 2 ×(-0.72)+1 ×0.10= 0.61), which is of course an arbitrary number, but which can be compared to other plants, with other employees, and over time.

[16] For example, the use of ICT can have a strong relationship to offshoring potential early in the time period, but over time the share of jobs that use a computer in Germany rises, such that ICT is of less importance in later waves.

Figure 3.2: Offshoring Potential and Outsourcing Potential over Time



Source: LIAB QM 1996-2010 and BIBB/BAuA Employment Survey 1991, 1998, 2006, and 2012, own calculations.

Figure 3.2 presents the variation of offshoring and outsourcing potential over time in the LIAB data. Note that, because the BIBB/BAuA survey is not carried out yearly, we have imputed the time periods between the existing waves by convex combinations.[17] The interpretation of the indicators does only make sense in relative terms. The left panel uses the pooled PCA version and shows that the job characteristics change in such a way that jobs become less outsourceable, but more offshoreable over time. At the beginning of the observation period, jobs are more prone to being outsourced than to being offshored. It changes in 2006, where jobs become more offshoreable than outsourceable. This suggests that during that time, more outsourcing than offshoring has taken place. On the right panel of Figure 3.2, we have used yearly PCAs to allow for changes in coefficients. Here, also job offshoreability rises and job outsourceability declines over time. However, jobs are always more prone to offshoring than to outsourcing. Hence, allowing for changes in coefficients over time reduces the outsourceability of jobs, suggesting that individual job characteristics react stronger to outsourcing. While we have used both types of indicators in our analysis, we present the estimates of the pooled version.

3.3 Econometric Specification

For our econometric analysis, we use a simple binary response model (logit or probit) or, for easier interpretation, linear probability models. Our dependent variables Y_{it} are mostly asked retrospectively, such that we might want to use explanatory variables with one or two lags (see Table A1). This would, however, seriously affect our (already small) numbers of observations, as we conditioned on plants that stay in the data for at least two years. Hence, we estimate the probability that a plant has offshored parts of the production process within the last year(s) based on sets of contemporaneous characteristics, such that they capture the exposure to offshoring and outsourcing potential based on the workforce employed in a plant after offshoring has taken place. In other words, we measure the remaining or long-term offshoring or outsourcing potential of plants that have been engaged in offshoring or outsourcing versus plants that have not.[18]

Our model takes the form:

$$F(Y_{it})^{-1} = \beta_1 + \beta_2 \text{outs}_{\text{it}} + \beta_3 \text{offsh}_{\text{it}} + \boldsymbol{\gamma}\, \mathbf{X_{it}} + \delta\, \text{year}_{\text{t}} + \varepsilon_{\text{it}}$$

[17] For example, offshoring potential in 2000 is computed by 0.75 × offshoring potential in 1998 + 0.25 × offshoring potential in 2006 and so on.

[18] As an alternative, measuring outsourcing and offshoring potential before the outsourcing or offshoring takes place, would capture an out-of equilibrium situation, where the plants feel they need to adjust their levels of outsourceability and offshoreability to a lower level.

The vector $\boldsymbol{X_{ti}}$ contains confounding factors at the plant level,[19] while year_t are time dummy variables, where possible, and ε_{it} is the error term. We also include sector dummy variables into the model. As regards the interpretation of the coefficients of interest, the raw coefficients do not tell much, but need to be corrected by the standard deviation, which then allows for a reasonable interpretation on the probability to having offshored parts of the production. This model assumes that the two dimensions outsourcing potential and offshoring potential can be interpreted ceteris paribus.

4 Empirical Results

4.1 Offshoring Potential and Actual Offshoring Behaviour

Table 4.1 shows an overview of correlations between offshoring and outsourcing potential and different modes of actual offshoring behaviour from an unconditional regression analysis. We present coefficients from a linear probability model for easier computation, while probit estimates and marginal effects have been computed, but find similar results.[20]

We find that for the first three variables (1-3) and the last (8), both outsourcing and offshoring potential are positively linked to actual offshoring. For the relocation variables (4-6) and FDI (7), we find negative correlations between outsourcing potential and the dependent variable, while offshoring potential is also positively correlated with all dependent variables except the broad definition of offshoring (4). These results can be used as a first check whether the merger of offshoring and outsourcing potential from the task data is successful, in that it generates indices which have explanatory power.

Table 4.1: Offshoring Behaviour and Offshoring Potential, Unconditional Results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Increased inputs	Increased Inputs through outsourcing	Increased Inputs through offshoring	Any Part of the Plant closed/ outsourced/ separated	Parts outsourced	Parts outsourced in foreign country	Foreign direct investments	Additional buying of intermediate inputs
Outsourcing Potential	0.0244***	0.0232***	0.0056**	-0.0092***	-0.0050***	-0.0003**	-0.0114***	0.0345***
	(0.0063)	(0.0062)	(0.0026)	(0.0012)	(0.0008)	-0.0001	-0.0041	-0.0025
Offshoring Potential	0.0835***	0.0725***	0.0394***	-0.0012	0.0053***	0.0014***	0.0843***	0.0620***
	(0.0090)	(0.0088)	(0.0033)	(0.0021)	(0.0013)	-0.0002	-0.0061	-0.0039
Constant	0.1170***	0.1126***	0.0169***	0.0532***	0.0239***	0.0006***	0.0288***	0.1191***
	(0.0036)	(0.0036)	(0.0012)	(0.0009)	(0.0006)	-0.0001	-0.0018	-0.0017
Observations	9.746	9.739	9.739	135.483	134.495	129,290	7,761	52,718
Plants (No. of Clusters)				34.053	33.934	33.433		25.939
F-Statistics	57.11	46.40	71.96	27.70	28.09	21.47	98.69	202.37
R^2	0.01	0.01	0.01	0.00	0.00	0	0.02	0.01

Note: Robust or cluster-robust standard errors in parentheses: p<0.10, ** p<0.05, *** p<0.01. Source: LIAB QM 9310, BIBB Surveys 1992, 1999, 2006, 2012, own calculations.

[19] They can also be plant-level averages of individual characteristics of the employees in the plant.

[20] In these and further regressions we use pooled estimations and cluster-robust standard errors on the plant level where possible, i.e. where we have multiple observations over time, and robust standard errors anywhere else.

From these results, no clear picture emerges, except that there is significant correlation between outsourcing and offshoring potential and actual offshoring behaviour. The correlations are mostly positive, such that we would expect that plants which have a more offshoreable and outsourceable workforce feature a higher probability of having offshored parts of the production. However, these results may be due to selection and/or other observable differences between the plants that offshore and the ones that do not.

Therefore, Table 4.2 presents the results from similar regressions, but where we control for additional control variables on the firm level. For outsourcing potential, we now find mostly negative and significant coefficients. This means that firms with a less outsourceable workforce engage more often in outsourcing or offshoring.[21] For offshoring potential we find similar results, depending on the item asked. For the first three variables (1-3), increase in intermediate inputs, offshoring potential only has a negative effect on the dependent variable if the plant has been engaged in offshoring (3). This is perfectly in line with the hypotheses and the wording of the item asked. For the next three variables, relocation activities, we find mixed results. The broad definition (4) is negatively correlated with offshoring potential, but both measures explicitly indicate outsourcing instead of plant closings or separations (5). Similarly to this, we find positive correlations for international outsourcing (6), which are, however, very small. For FDI (7), we find no significant correlation, and for reorganisational activities in the form of additional buying of intermediate inputs, we find a negative and significant correlation. Hence, it seems to be cases that, for most measures, a high offshoring potential decreases the likelihood of offshoring activity. The effects are quantitatively sizeable. For example, in specification (3) a higher offshoring potential by one standard deviation decreases the likelihood of an increase in intermediate inputs to have occurred by 0.0129/0.38 = 3.4 percentage points or 3.4/2.48 = 137 %. The marginal effects are relatively large, because only few firms engage in offshoring. They should, therefore, not be taken at face value, but used to compare the different relative influence between the independent variables. The effect of offshoring potential is, for comparison, a larger effect than belonging to the public sector (-1.25 percentage points or -50 %), but a smaller effect than being an exporting plant (+5.27 percentage points or +212 %).

[21] The dependent variables measure very different things that are more or less closely tied to offshoring or outsourcing.

Table 4.2: Determinants Offshoring

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Increased inputs	Increased Inputs through outsourcing	Increased Inputs through offshoring	Any Part of the Plant closed/ outsourced/ separated	Parts outsourced	Parts outsourced in foreign country	Foreign direct investments	Additional buying of intermediate inputs
Outsourcing Potential	-0.0222***	-0.0195**	-0.0112***	-0.0155***	-0.0097***	0.0000	-0.0274***	-0.0193***
	(0.0079)	(0.0078)	(0.0036)	(0.0017)	(0.0011)	(0.0001)	(0.0058)	(0.0035)
Offshoring Potential	-0.0145	-0.0141	-0.0129**	-0.0052*	0.0035*	0.0005*	0.0035	-0.0214***
	(0.0145)	(0.0144)	(0.0052)	(0.0031)	(0.0020)	(0.0003)	(0.0085)	(0.0070)
Baseline: Single Plant Firm								
Headquarter	0.0118	0.0122	0.0043	0.0099***	0.0115***	0.0008**		0.0024
	(0.0103)	(0.0101)	(0.0052)	(0.0024)	(0.0017)	(0.0003)		(0.0053)
Branch Plant	0.0046	-0.0010	0.0035	0.0365***	0.0083***	-0.0003	0.1143***	0.0175***
	(0.0137)	(0.0133)	(0.0074)	(0.0035)	(0.0022)	(0.0003)	(0.0129)	(0.0068)
Public Sector	0.0250	0.0259	-0.0125***	0.0002	0.0071	-0.0008***	-0.0544***	-0.018
	(0.0238)	(0.0237)	(0.0031)	(0.0071)	(0.0055)	(0.0002)	(0.0137)	(0.0113)
Baseline: Individual Bargaining								
Firm-Level Contract	-0.0127	-0.0087	-0.0166**	0.0065**	0.0053***	-0.0005**	-0.0174	0.0133*
	(0.0148)	(0.0145)	(0.0067)	(0.0030)	(0.0020)	(0.0002)	(0.0113)	(0.0075)
Collective Bargaining Agreement	-0.0120	-0.0068	-0.0053	0.0086***	0.0059***	0.0002	-0.0071	0.0002
	(0.0082)	(0.0080)	(0.0040)	(0.0017)	(0.0010)	(0.0002)	(0.0050)	(0.0041)
Firm Age, censored at 1975	-0.0002	-0.0002	-0.0000	-0.0001	-0.0001	0.0000	0.0005*	-0.0001
	(0.0004)	(0.0004)	(0.0002)	(0.0001)	(0.0001)	(0.0000)	(0.0002)	(0.0002)
Export Activity	0.0509***	0.0421***	0.0527***	-0.0026	-0.0025*	0.0005*	0.0679***	0.0722***
	(0.0108)	(0.0106)	(0.0055)	(0.0020)	(0.0013)	(0.0003)	(0.0071)	(0.0053)
Foreign Ownership	-0.0408**	-0.0529***	0.0180	0.0174***	0.0092***	0.0013**	-0.0717***	0.0067
	(0.0159)	(0.0149)	(0.0112)	(0.0042)	(0.0030)	(0.0007)	(0.0150)	(0.0089)
Baseline: 1-19 Employees								
20-99 Employees	0.0385***	0.0388***	0.0023	0.0141***	0.0046***	-0.0003**	-0.0018	0.0391***
	(0.0082)	(0.0081)	(0.0029)	(0.0014)	(0.0008)	(0.0001)	(0.0033)	(0.0040)
100-199 Employees	0.0652***	0.0609***	0.0217***	0.0313***	0.0146***	-0.0001	0.0201**	0.0669***
	(0.0140)	(0.0137)	(0.0070)	(0.0029)	(0.0018)	(0.0003)	(0.0096)	(0.0070)
200-999 Employees	0.0694***	0.0639***	0.0291***	0.0580***	0.0333***	0.0006	0.0856***	0.0730***
	(0.0135)	(0.0132)	(0.0068)	(0.0033)	(0.0023)	(0.0004)	(0.0115)	(0.0068)
>1000 Employees	0.0813***	0.0864***	0.0454**	0.1030***	0.0606***	0.0017	0.2053***	0.1112***
	(0.0304)	(0.0302)	(0.0191)	(0.0087)	(0.0064)	(0.0011)	(0.0333)	(0.0142)
Baseline: Other Services								
Agriculture	0.0635***	0.0625***	0.0063**	0.0063	0.0062**	0.0005	0.0181***	0.0325***
	(0.0227)	(0.0227)	(0.0028)	(0.0047)	(0.0027)	(0.0004)	(0.0047)	(0.0110)
Mining, Energy, Recycling	0.0433***	0.0392***	0.0083*	0.0160***	0.0061**	-0.0000	0.0114	0.0353***
	(0.0153)	(0.0150)	(0.0049)	(0.0044)	(0.0028)	(0.0002)	(0.0083)	(0.0080)
Other Manufacturing	0.0763***	0.0719***	0.0167**	0.0015	0.0032	0.0005	0.0390***	0.0871***
	(0.0174)	(0.0170)	(0.0081)	(0.0038)	(0.0025)	(0.0004)	(0.0109)	(0.0089)
Metal Manufacturing	0.1907***	0.1752***	0.0623***	-0.0118***	-0.0014	0.0005	0.0581***	0.1346***
	(0.0161)	(0.0159)	(0.0073)	(0.0034)	(0.0022)	(0.0003)	(0.0095)	(0.0081)
Construction	0.1566***	0.1486***	0.0180***	-0.0051	-0.0004	0.0001	0.0292***	0.0532***
	(0.0172)	(0.0170)	(0.0048)	(0.0031)	(0.0019)	(0.0002)	(0.0059)	(0.0074)
Trade	0.0073	0.0062	0.0051	0.0031	0.0007	-0.0002	0.0005	0.0450***
	(0.0102)	(0.0100)	(0.0031)	(0.0032)	(0.0019)	(0.0002)	(0.0055)	(0.0062)
Logistics	0.0605***	0.0625***	0.0176**	0.0120***	0.0119***	0.0004	0.0173	0.0092
	(0.0179)	(0.0178)	(0.0071)	(0.0044)	(0.0031)	(0.0005)	(0.0108)	(0.0082)
Banking and Insurance	0.0019	0.0039	-0.0017	-0.0075	-0.0011	-0.0009***	-0.0081	0.0055
	(0.0237)	(0.0236)	(0.0054)	(0.0082)	(0.0060)	(0.0003)	(0.0135)	(0.0148)
Consulting Services	0.0735***	0.0718***	0.0138***	-0.0021	0.0006	0.0001	0.0139*	0.0001
	(0.0143)	(0.0142)	(0.0046)	(0.0034)	(0.0022)	(0.0002)	(0.0076)	(0.0063)
West Germany	0.0229***	0.0189**	0.0109***	-0.0036**	-0.0003	0.0003	0.0184***	0.0413***
	(0.0082)	(0.0081)	(0.0037)	(0.0018)	(0.0011)	(0.0002)	(0.0045)	(0.0043)
Year Dummy Variables	Not applicable	Not applicable	Not applicable	Yes	Yes	Yes	Not applicable	Yes
Constant	0.0119	0.0136	-0.0179***	0.0678***	0.0265***	-0.0004*	-0.0364***	-0.0432***
	(0.0103)	(0.0101)	(0.0037)	(0.0066)	(0.0045)	(0.0002)	(0.0052)	(0.0063)
Observations	8.491	8.485	8.485	105.258	104.776	101.150	6.667	42.990
Plants (No. of Clusters)				27.418	27.340	26.957		21.725
F-Statistics	19.36	17.24	10.10	32.97	20.24	1.67	16.03	94.90
R^2	0.06	0.05	0.07	0.03	0.02	0.01	0.18	0.10

Note: Robust or cluster-robust standard errors in parentheses: p<0.10, ** p<0.05, *** p<0.01. Source: LIAB QM 9310, BIBB Surveys 1992, 1999, 2006, 2012, own calculations.

For the control variables, we mostly find the expected results, which are also in line with the literature. Compared to single plant firms, headquarters and branch plants are more likely to engage in offshoring

activity. Public sector plants are less likely to conduct offshoring.[22] For collective bargaining, we find only mixed and mostly insignificant results. Firm age does not seem to influence offshoring decisions. However, plants in foreign ownership are usually more likely to engage in offshoring, with the exception of the FDI (7) and increased inputs measures (1-2). As regards firm size, we find that larger plants more often engage in offshoring. The dummy variable for West Germany indicates a larger probability of West German plants to conduct offshoring. For the variable indicating exporting status, we also find large and significant effects. However, this variable might be jointly determined with offshoring activity. Therefore, in Section 4.2 we also look only at exporting plants. The regression diagnostics suggest that the models are of relevant explanatory power.

4.2 Robustness Analysis

In this section, we further check for the robustness of our results. First of all, we include firm-level productivity in our model. It can be measured using labour productivity as sales less intermediates per employee. Doing so, however, reduces the number of observations by about 30 % and may be problematic as sales and especially the share of intermediate inputs have been shown to be missing non-randomly in the IAB EP. We, therefore, first present the results of a regression of a model without firm-level productivity on the restricted sample to check for sample selectivity in the upper part of Table 4.3. Then, we include firm-level labour productivity in the lower part of Table 4.3.

Table 4.3: Determinants of Offshoring, Productivity Sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Increased inputs	Increased Inputs through outsourcing	Increased Inputs through offshoring	Any Part of the Plant closed/ outsourced/ separated	Parts outsourced in home country	Parts outsourced in foreign country	Foreign direct investments	Additional buying of intermediate inputs
Small Sample								
Outsourcing Potential	-0.0312***	-0.0297***	-0.0126***	-0.0141***	-0.0087***	0.0001	-0.0304***	-0.0205***
	(0.0096)	(0.0095)	(0.0043)	(0.0019)	(0.0013)	(0.0002)	(0.0065)	(0.0042)
Offshoring Potential	-0.0273	-0.0267	-0.0145**	-0.0093***	0.0022	0.0005	-0.0018	-0.0277***
	(0.0173)	(0.0172)	(0.0063)	(0.0035)	(0.0022)	(0.0003)	(0.0094)	(0.0084)
Small Sample with Productivity								
Outsourcing Potential	-0.0251**	-0.0234**	-0.0123***	-0.0117***	-0.0066***	0.0001	-0.0269***	-0.0176***
	(0.0097)	(0.0096)	(0.0043)	(0.0019)	(0.0013)	(0.0002)	(0.0064)	(0.0043)
Offshoring Potential	-0.0397**	-0.0394**	-0.0151**	-0.0126***	-0.0008	0.0005	-0.006	-0.0317***
	(0.0179)	(0.0178)	(0.0064)	(0.0036)	(0.0022)	(0.0003)	(0.0096)	-0.0085
Log. Productivity per Employee	0.0183***	0.0188***	0.0009	0.0057***	0.0051***	-0.0000	0.0072***	0.0070***
	(0.0055)	(0.0054)	(0.0025)	(0.0010)	(0.0006)	(0.0001)	(0.0027)	-0.0023

Note: Robust or cluster-robust standard errors in parentheses: p<0.10, ** p<0.05, *** p<0.01. Control and Dummy Variables similar to Table 4.2; Source: LIAB QM 9310, BIBB Surveys 1992, 1999, 2006, 2012, own calculations.

It can be seen that both estimating on the smaller sample and including firm-level productivity affects the results. In the smaller sample, offshoring potential loses significance in specifications (5) and (6). The inclusion of firm-level productivity mostly increases the coefficients for offshoring potential and

[22] Note that these are not plants in public administration, but plants that are either publicly owned, have civil servants working in them or state, are not-for profit organisations or state to have a budget and not sales as their business volume.

also pushes into significance for specifications (1) and (2). Hence, the overall picture does not change: offshoring potential is negatively correlated with actual offshoring behaviour. Firm-level labour productivity per employee itself is positively correlated with actual offshoring behaviour. Hence, the findings from the literature that productive firms offshore more can be confirmed.[23]

Next, we look at certain subsamples of the data, to assess whether our results may be driven by certain groups of plants. Table 4.4 gives an overview of results from regressions similarly to the ones from Table 4.2, but only estimated for (a) West German plants, (b) manufacturing plants, (c) exporting plants, and (d) small and medium-sized plants. The table shows that for outsourcing potential, the results are very robust, except the first three specifications (increase of inputs) in exporting and small and medium-sized plants. In these plants, there is no significant correlation anymore. Hence, these effects may be driven by large plants, or by plants which do not engage in exports.

Table 4.4: Determinants of Offshoring, Subsamples

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Increased inputs	Increased Inputs through outsourcing	Increased Inputs through offshoring	Any Part of the Plant closed/ outsourced/ separated	Parts outsourced in home country	Parts outsourced in foreign country	Foreign direct investments	Additional buying of intermediate inputs
(a) Western Germany								
Outsourcing Potential	-0.0307***	-0.0248**	-0.0175***	-0.0149***	-0.0096***	0.0000	-0.0384***	-0.0216***
	(0.0100)	(0.0097)	(0.0048)	(0.0022)	(0.0015)	(0.0002)	(0.0078)	(0.0046)
Offshoring Potential	-0.026	-0.0202	-0.0182***	-0.0034	0.0041	0.0009**	0.0032	-0.0286***
	(0.0184)	(0.0182)	(0.0067)	(0.0042)	(0.0028)	(0.0004)	(0.0116)	(0.0092)
(b) Manufacturing								
Outsourcing Potential	-0.0341*	-0.0317*	-0.0206**	-0.0296***	-0.0160***	0.0003	-0.0439***	-0.0453***
	(0.0178)	(0.0172)	(0.0095)	(0.0030)	(0.0021)	(0.0003)	(0.0114)	(0.0071)
Offshoring Potential	-0.0478*	-0.0534**	-0.0274**	-0.0015	0.0066**	0.0006	0.0103	-0.0652***
	(0.0266)	(0.0262)	(0.0110)	(0.0042)	(0.0026)	(0.0005)	(0.0140)	(0.0120)
(c) Exporting Plants								
Outsourcing Potential	-0.0186	-0.0201	-0.0146	-0.0269***	-0.0164***	-0.0004	-0.0994***	-0.0357***
	(0.0213)	(0.0208)	(0.0134)	(0.0041)	(0.0028)	(0.0005)	(0.0198)	(0.0095)
Offshoring Potential	-0.0774*	-0.0766*	-0.0684***	0.0012	0.0026	0.0004	0.0445	-0.0825***
	(0.0414)	(0.0404)	(0.0260)	(0.0067)	(0.0043)	(0.0008)	(0.0306)	(0.0196)
(d) Small and Medium-Sized Plants								
Outsourcing Potential	-0.0113	-0.0095	-0.0059*	-0.0075***	-0.0038***	0.0000	-0.0160***	-0.0122***
	(0.0091)	(0.0089)	(0.0035)	(0.0015)	(0.0009)	(0.0001)	(0.0049)	(0.0039)
Offshoring Potential	-0.0106	-0.0125	-0.0066	-0.0043	0.0018	0.0001	0.0046	-0.0108
	(0.0163)	(0.0162)	(0.0051)	(0.0028)	(0.0016)	(0.0002)	(0.0067)	(0.0077)

Note: Robust or cluster-robust standard errors in parentheses: p<0.10, ** p<0.05, *** p<0.01. Control and Dummy Variables similar to Table 4.2; Source: LIAB QM 9310, BIBB Surveys 1992, 1999, 2006, 2012, own calculations.

For offshoring potential, we find similar, but somewhat weaker results for most of the subsamples. Especially for small- and medium-sized plants we do not find significant effects anymore. However, for exporting plants, we find very strong and significantly negative results, which are far larger than in the whole sample. Hence, we would interpret this in such a way that in otherwise internationally active plants the offshoring potential of the employees plays a larger role in determining whether to engage in offshoring.

A last robustness check includes, as an alternative measure of outsourcing and offshoring potential, the average job characteristics of the workforce in a plant. It is merged to the LIAB in a similar way as the offshoring and outsourcing potential indicators: For each 3-digit occupation, we calculate, for instance, the average use of ICT. Depending on the occupations of its workers, each plant then gets assigned an average value of ICT use. The job characteristics have the advantage that they may

[23] This may be viewed as empirical support for selection into offshoring, but the timing of our model could also allow for an interpretation of a positive effect from offshoring on productivity.

directly show which job attribute can increase the likelihood of a plant to engage in offshoring. However, due to the large number of job characteristics, there may be a multicollinearity problem.

Table 4.5: Determinants of Offshoring, Job Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Increased inputs	Increased Inputs through outsourcing	Increased Inputs through offshoring	Any Part of the Plant closed/ outsourced/ separated	Parts outsourced in home country	Parts outsourced in foreign country	Foreign direct investments	Additional buying of intermediate inputs
Blue-Collar Worker	-0.0237	-0.0733	0.0401	-0.0257**	-0.0149**	0.0037***	-0.0139	-0.0745***
	(0.0809)	(0.0795)	(0.0337)	(0.0107)	(0.0068)	(0.0010)	(0.0378)	(0.0258)
Codifiability	-0.1580***	-0.1635***	-0.0287*	-0.0227***	-0.0111**	0.0005	0.006	-0.0997***
	(0.0395)	(0.0391)	(0.0152)	(0.0066)	(0.0044)	(0.0006)	(0.0210)	(0.0153)
Complementarity	-0.2257***	-0.2524***	-0.0192	0.0008	0.0007	-0.0007	0.0327	0.0659***
	(0.0686)	(0.0672)	(0.0298)	(0.0057)	(0.0035)	(0.0005)	(0.0301)	(0.0148)
Financial Losses if Error	-0.0486	-0.0589	0.0205	0.001	-0.0033	0.0002	0.0032	-0.0455***
is made	(0.0445)	(0.0439)	(0.0174)	(0.0069)	(0.0047)	(0.0007)	(0.0209)	(0.0154)
ICT use	0.1802***	0.1782***	-0.0183	0.0173**	0.0183***	0.0018**	0.0193	-0.0147
	(0.0594)	(0.0589)	(0.0232)	(0.0079)	(0.0049)	(0.0008)	(0.0284)	(0.0186)
Interactivity	0.0542	0.0664	0.0384	-0.0178	-0.0233***	-0.0009	-0.0052	0.0052
	(0.1099)	(0.1088)	(0.0394)	(0.0110)	(0.0071)	(0.0008)	(0.0439)	(0.0228)
Required Knowledge	0.0281	0.0076	0.0437	-0.0340***	-0.0197***	-0.0005	0.0349	0.0650***
	(0.0650)	(0.0639)	(0.0274)	(0.0075)	(0.0050)	(0.0007)	(0.0301)	(0.0170)
Language Requirements	-0.0644	-0.0544	-0.0167	-0.0124	-0.0035	0.001	0.0519**	-0.0479**
	(0.0445)	(0.0438)	(0.0182)	(0.0081)	(0.0051)	(0.0009)	(0.0219)	(0.0187)
Knowledge of Law required	0.1419	0.1539	0.0677	-0.0524**	-0.0107	0.0021	-0.0253	-0.0506
	(0.1351)	(0.1332)	(0.0567)	(0.0243)	(0.0155)	(0.0017)	(0.0477)	(0.0528)
Locational Ties	0.034	0.0263	-0.0001	0.0069**	0.0033*	0.0008**	0.0138	-0.0089
	(0.0222)	(0.0218)	(0.0101)	(0.0029)	(0.0017)	(0.0003)	(0.0108)	(0.0068)
New Scopes	0.1217**	0.1246**	0.0008	0.0243**	0.0104*	0.0006	-0.0139	0.0002
	(0.0603)	(0.0593)	(0.0224)	(0.0102)	(0.0055)	(0.0006)	(0.0287)	(0.0221)
Pressure to Perform	-0.0028	-0.0089	0.0301	0.0002	0.0022	-0.0004	0.0007	0.1383***
	(0.0522)	(0.0516)	(0.0189)	(0.0084)	(0.0053)	(0.0008)	(0.0298)	(0.0184)
Multitasking	-0.0765**	-0.0839**	-0.0294*	0.0024	0.0031	0.0010*	-0.0084	-0.0973***
	(0.0376)	(0.0370)	(0.0158)	(0.0056)	(0.0034)	(0.0006)	(0.0195)	(0.0126)
Undesirable Working Cond.	0.0561	0.0728**	-0.0113	-0.0046	0.0066**	-0.0021***	-0.0320*	0.0388***
	(0.0347)	(0.0342)	(0.0140)	(0.0054)	(0.0030)	(0.0006)	(0.0181)	(0.0139)
Writing Skills	0.0961	0.1373	-0.0381	0.0454**	0.0544***	-0.0017	-0.1478***	-0.1626***
	(0.1420)	(0.1399)	(0.0559)	(0.0195)	(0.0148)	(0.0012)	(0.0537)	(0.0474)
Observations	8.491	8.485	8.485	105.258	104.776	101.150	6.667	42.990
Plants (No. of Clusters)				27.418	27.340	26.957		21.725
F-Statistics	15.57	14.51	6.57	25.84	15.85	1.25	10.47	67.92
R^2	0.07	0.06	0.07	0.03	0.02	0.01	0.18	0.10

Note: Robust or cluster-robust standard errors in parentheses: p<0.10, ** p<0.05, *** p<0.01. Control and Dummy Variables similar to Table 4.2; Source: LIAB QM 9310, BIBB Surveys 1992, 1999, 2006, 2012, own calculations.

It can be seen that most of the job characteristics are significantly correlated with one or the other dependent variable. Some of the results are in line with the hypotheses. For example: ICT use is usually positively correlated with offshoring behaviour and the complementarity of the workforces' tasks relates negatively to increasing input purchases. However, others have unexpected signs: having a workforce with more codifiable occupations decreases the likelihood of offshoring, while larger locational ties of the workforce's tasks increase the likelihood of relocating parts of the plant. Hence, we conclude that the alternative to our condensed indicators of offshoring and outsourcing potential does not make for an easy interpretation and may generate further methodological problems.

5 Conclusion

This study empirically analyses the link between offshoring potential and actual offshoring behaviour in German plants. We do so by linking information from German task data on outsourcing and offshoring potential of jobs to linked employer-employee data on actual offshoring behaviour by German plants. We use a broad measure of offshoring potential based on a large number of job characteristics that has been generated in a data-driven, variance-maximising way. We add, based on a merger on the occupational level, the average outsourcing and offshoring potential of a plant's workforce as an additional determinant in an estimation that explains its offshoring behaviour while controlling for typical firm-level and individual-level control variables. We employ a range of potential variables that measure outsourcing vs. offshoring behaviour of plants in different ways.

Our results suggest that there is a negative relationship between the offshoring potential of a plant's remaining workforce and its offshoring behaviour. This is true, even to a larger extent, for outsourcing potential and outsourcing behaviour. In other words, plants that have a more outsourceable or offshoreable workforce are less likely to having engaged in outsourcing or offshoring. The findings suggest that one may interpret offshoring potential as not-yet realised offshoring, or as existing barriers to offshoring.

The effects are stronger in larger and exporting plants, but hold for alternative measures of offshoring potential like in Spitz-Oener (2006), Blinder (2009), or Becker et al. (2013).[24] Also, we show that a compound index capturing several dimensions of offshorability, as proposed by Brändle and Koch (2014), is preferable over the inclusion of the underlying job characteristics in such estimation.

The contribution of the paper is that it combines rich information on offshoring potential of jobs from representative German task data to detailed information from German linked employer-employee data, a combination that has not been available so far. Also, this study constitutes the first attempt to analysing the link between offshoring and its potential at the micro-level, with the exception of Eppinger (2014). Most previous studies were concerned only with one of these phenomena and typically relied on industry-level information, such as shares of imported intermediates inputs from the WIOD.

Further research may focus on strengthening the theoretical link between offshoring potential and actual offshoring, which is rather weak. First attempts have been made by Skaksen (2004), but no empirical test of his model has yet been carried out. Germany could be an interesting case, as it still has strong collective bargaining coverage. Also, there may be other characteristics determining both offshoring potential and actual offshoring, which cannot be observed in the data. Unfortunately, the potential for a causal investigation is limited, as the measurement of offshoring behaviour in the LIAB data is not optimal. Further attention should also be paid to a potential non-linear relationship and firm heterogeneity in exploiting the offshoring potential.

[24] Results are available upon request.

6 References

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7 Appendix

Table A1: Questionnaire Items of Outsourcing and Offshoring Information

Increased Inputs	Did your company/your department contract out work, which was previously carried out by the company itself to other companies in the last financial year, i.e. 2007? *[Yes] [No]*
Increased Inputs through Outsourcing	Where is this work carried out now? *[At home] [Abroad] [Both at home and abroad]*
Increased Inputs through Offshoring	Where is this work carried out now? *[At home] [Abroad] [Both at home and abroad]*
Any Part of the Plant closed/ outsourced/ separated	Were any of the restructuring measures listed below taken by your establishment between 1 July [last year] and 30 June [this year]? *[were closed down] [were relocated to other company units] [were separated and continued as independent businesses] [none of these]*
Any Part of the Plant outsourced in Home Country	Were any of the restructuring measures listed below taken by your establishment between 1 July [last year] and 30 June [this year]? *[were relocated to other company units in Germany] [were relocated to other company units abroad][none of these]*
Any Part of the Plant outsourced in Foreign Country	Were any of the restructuring measures listed below taken by your establishment between 1 July [last year] and 30 June [this year]? *[were relocated to other company units in Germany] [were relocated to other company units abroad][none of these]*
Foreign Direct Investments	Has your company made foreign investments during the last two years? (2004 and 2005*) [Yes] [No]*
Additional Buying of Intermediates	Has one of the following changes taken place within your establishment/office in the last two years? *[More reliance on internal labour] [Expansion of purchase of products and services from external sources] [Restructuring of procurement and distribution channels and/or of customer relations] [Restructuring of departments or areas of activities] [Downward shifting of responsibilities and decisions] [Introduction of team work/ working groups with their own responsibilities] [Introduction of units/departments carrying out their own cost and result calculations] [Ecological measures in enterprise (e.g. eco, product and materials balances, eco audit)] [Improvement of quality management] [Others] [None]*

Source: IAB Establishment Panel.

Table A2: Overview of Variables Used

Variable	Observations	Mean	Std.Dev	Min	Max
Outsourcing Potential	136,436	0.20	0.57	-1.70	2.12
Offshoring Potential	136,361	0.06	0.38	-1.41	1.31
Log. Productivity per Employee	85,793	3.69	0.93	-8.71	9.94
Agriculture	136,505	0.03	0.16	0	1
Mining, Energy, Recycling	136,505	0.06	0.25	0	1
Other Manufacturing	136,505	0.10	0.30	0	1
Metal Manufacturing	136,505	0.16	0.37	0	1
Construction	136,505	0.10	0.30	0	1
Trade	136,505	0.14	0.35	0	1
Logistics	136,505	0.05	0.21	0	1
Banking and Insurance	136,505	0.03	0.18	0	1
Consulting Services	136,505	0.12	0.32	0	1
Other Services	136,505	0.21	0.40	0	1
West Germany	136,512	0.62	0.49	0	1
1-19 Employees	136,512	0.31	0.46	0	1
20-99 Employees	136,512	0.36	0.48	0	1
100-199 Employees	136,512	0.11	0.32	0	1
200-999 Employees	136,512	0.17	0.38	0	1
>1000 Employees	136,512	0.05	0.21	0	1
Single Firm	135,981	0.68	0.47	0	1
Headquarter	135,981	0.20	0.40	0	1
Branch Plant	135,981	0.13	0.33	0	1
Public Sector	136,512	0.15	0.35	0	1
Individual Wage Determination	136,001	0.40	0.49	0	1
Firm-Level Contract	136,001	0.09	0.29	0	1
Collective Bargaining Agreement	136,001	0.50	0.50	0	1
Firm Age, censored at 1975	136,512	15.80	9.97	0	35
Export Activity	113,737	0.29	0.45	0	1
Foreign Ownership	127,116	0.06	0.24	0	1

Source: LIAB QM 9310, own calculations.

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