Do foreign workers reduce trade barriers? Microeconomic evidence

Martyn Andrews
University of Manchester

Thorsten Schank
Friedrich-Alexander Universität Erlangen-Nürnberg

Richard Upward*
University of Nottingham

July 14, 2010

Preliminary: please do not quote

Abstract

This paper provides evidence that the presence of foreign workers in plants increases the likelihood that those plants will export their output. This informs both the macro literature on trade costs and the micro literature on plants' export behaviour. Using a rich linked employer-employee dataset, we identify the nationality of each worker in a large sample of German plants, and relate this to the exporting behaviour of that plant. We find a significant effect of worker nationality on exporting which is not driven by the industrial, occupational or locational concentration of migrants. The effect is much stronger for senior occupations, who are more likely to have a role in exporting decisions by the plant. The relationship is also stronger when we consider exports to particular regions and workers from those regions.

*Corresponding Author. Email `richard.upward@nottingham.ac.uk`. School of Economics, University of Nottingham, Nottingham NG7 2RD UK. Much of the work for this paper was completed while Upward was visiting the Institut für Arbeitsmarkt und Berufsforschung.

1 Introduction

Anderson & van Wincoop (2004) conclude that trade barriers associated with national borders are large, but that policy barriers, in the form of tariff and non-tariff barriers, are only a small fraction of the total border effect. Instead, informal trade barriers are the largest component of the cost of trading goods across national borders. These barriers include language, cultural differences, information costs and contracting costs. Evidence on the importance of these informal trade barriers comes almost exclusively from studies of aggregate trade flows between countries.

A separate literature has used firm- or plant-level data to examine the factors which determine entry into export markets (e.g. Roberts & Tybout 1997, Bernard & Jensen 2004). The two key findings of this literature are, firstly, the importance of firm heterogeneity and, secondly, the role of sunk costs in causing persistence of exporting behaviour. These two findings interact because more productive firms are better able to overcome the sunk costs, and hence more likely to enter export markets. It also seems likely that firms differ in the size of the sunk costs they face. If informal trade barriers differ between firms, this would also explain why some firms export and others do not.

This paper examines whether foreign employees can provide one explanation why some firms export and others do not. Our basic hypothesis is that plants' foreign workers can reduce trade costs, because foreign workers help plants to overcome language, cultural and informational barriers to trade. Aggregate gravity models have established that migrant links can increase trade between countries. This paper shows that this mechanism operates, at least partly, via the employees of firms.[1]

Our data identify the nationality of each worker within a large representative panel of German plants, and also identify the exporting behaviour of those plants. We deal with the potential endogeneity of the plant's workforce by (a) controlling for observable characteristics such as plants' location, (b) by constructing instruments constructed at the local labour market level which exclude the plant's own workers, and (c) by using fixed effects methods which rely on the within-plant change in the proportion of foreigners.

The richness of the data allow us to go beyond simply examining whether plants with more foreign workers are more likely to export. We test a number of related hypotheses which shed more light on the mechanism by which foreign workers affect plants' exporting behaviour. First, we would expect that employees' influence on

[1] Alternative mechanisms include the idea that migrant networks encourage trade via consumers' preferences, or that trade is facilitated by agents who are external to firms.

their plants' exporting capabilities would be greater for more senior workers and workers who have a direct link to customers. Occupational information on each worker allow us to test this hypothesis. Second, we test whether plants are more likely to export to a particular destination if they employ foreign workers from that destination. Third, we investigate whether the strength of ties to a worker's home country increases the strength of the exporting effect. Fourth, we test whether the effect is stronger for plants in service sector industries which are more likely to export non-standard products.

We find consistent and robust evidence of a relationship between the proportion of foreign workers in a plant and the probability of exporting. A plant with a 10 percentage point higher proportion of foreign workers is 1 percentage point more likely to export. The effect is more than twice as large for foreign workers who do *not* originate from those Southern European countries which sent large numbers of (largely unskilled) manual workers to Germany in the 1950s and 1960s under the so-called *Gastarbeiter* programs. The effect is also much larger for workers in managerial positions within the plant.

The paper is organised as follows. We begin in Section 2 by briefly reviewing the two relevant literatures on trade costs and on firm exporting behaviour. Section 3 describes the data and presents some suggestive evidence that there is at least a correlation between the nationality of workers and their plants' exporting behaviour. Section 4 explains our econometric methods, which have to deal with the possible endogeneity of the workforce. Section 5 describes the results, and Section 6 concludes.

2 Literature review

Rauch & Casella (2003) argue that, "as tariffs and transportation costs have come down, research has increasingly focused on informal barriers to trade." These informal barriers include information, business contacts, language, contract enforcement and preferences. Of these barriers, at least the first three might potentially be mitigated by the presence of foreign workers in a firm.

At the aggregate level, there is considerable evidence of a link between trade flows and stocks of migrants. For example, Gould (1994) estimates a gravity model of trade between the US and $j = 1, \ldots, 47$ trading partners. The model includes measures of the number of immigrants from country j, the skill intensity of those immigrants, and their average length of stay. Gould finds significant import and

export effects, and also finds that only small numbers of migrants are required for the export effect, relative to import effects. He also argues that the information channel is less important for homogeneous goods where the price provides better information, and, consistent with this hypothesis, there are larger effects for less homogenous products.

Other related evidence comes from the effect of common languages on trade. Frankel (1997, p.74) includes a dummy variable for "common language" in a gravity model and finds that countries which share a common language trade about 55% more than they would otherwise.

Wagner *et al.* (2002) surveys the empirical literature with particular reference to the mechanisms which lie behind the effect of immigration and subsequent trade. The estimated elasticities lie in a very wide range, between 0.02 and 0.47 for exports and 0.01 and 0.41 for imports.

An issue in this literature is whether the import effect is larger or smaller than the export effect, since the import effect is likely to be driven by preferences, whereas the export effect is more likely to be evidence of informal trade barriers. Head & Ries (1998), for example, find elasticities to be much larger on imports than on exports, which perhaps suggests that preferences are more important than information. However, other studies such as Girma & Yu (2002) find the reverse: export effects are larger than import effects.

Almost all studies use aggregate gravity models at the country level. A few studies use data from within countries, including Wagner *et al.* (2002) who examine trade between Canadian provinces. The aggregate data cannot shed light on the precise mechanism, notwithstanding the debate on the size of the effect on imports and exports. Our contribution is to show that there is an effect which operates via the employees of plants.

There is also a set of stylised facts that have emerged about the exporting status of individual firms or plants. The key fact to have emerged from the empirical literature is that exporting and non-exporting firms co-exist in the same narrowly defined industry. Only a small proportion of plants export, a very small proportion of plants are responsible for the vast majority of all exports, and those firms that do export generally export only a small proportion of their output. See, for example, Bernard *et al.* (2007). Greenaway & Kneller (2007) stress that the key features of models which can explain exporting decisions by firms are the interaction of sunk costs and productivity heterogeneity. But Kneller & Pisu (2008) note that we know less about how trade costs or trade barriers affect individual firms, and this is

precisely what we shed light on in this paper.

We are aware of only one other paper which examines the relationship between the characteristics of individual workers and exporting behaviour. Molina & Muendler (2009) use linked employer-employee data for Brazil, and show that firms' hiring behaviour is an important predictor of their subsequent export performance. In particular, hiring workers who have themselves previously worked for exporters is a significant factor.

3 The data and descriptive statistics

The first datasource is the *Institut für Arbeitsmarkt- und Berufsforschung (IAB) Establishment Panel*, an annual survey of between approximately 4,000 and 10,000 plants located in West Germany (since 1993) and between 4,000 and 6,000 plants located in East Germany (since 1996). The sampling frame comprises all plants in Germany with at least one worker covered by the social security system as of 30 June in the year before the survey. The sample includes all industries, and currently covers approximately 1% of all plants in Germany and approximately 7% of workers because it is weighted towards larger plants.[2] Information is obtained by personal interviews with plant managers, and comprises about 80 questions per year on, for example, employment, bargaining arrangements, sales, exports, investment, wage bill, location, and industry.

The total original sample comprises 187,434 plant-years on 46,121 plants over the period 1993–2008. We drop plants whose industry is classified as: Public Administration, Membership Organisations and Private Households. We also drop plants which are classified as "not for profit", or whose legal form is classified as a public corporation. It might be argued that some plants in our sample produce non-tradable output, such as services which can only be delivered face-to-face. We therefore excluded industries where the average percentage of exports to output is less than 1%.[3] These exclusions reduce the sample to 108,557 plant-years and 27,440 plants.

Exports are recorded as a proportion of total sales in the previous calendar year. From 1998 onwards, managers were also asked to distinguish between exports to countries in the European Monetary Union. From 2004 onwards, exports are further

[2]Weights to ensure that the sample is representative are calculated by comparing the sample of plantss with the population of plants in the same Federal state, size and industry cell. The population of plants is obtained from a Federal Employment Agency database. A more detailed description of the data and the weighting procedure is described in Fischer *et al.* (2009).

[3]These sectors were: Construction, Hotels and restaurants, Education services and Health services. These plants contributed 32,713 observations, or 17% of the original sample.

distinguished between those to countries in the European Monetary Union and the new member states which joined the EU during the 2004 expansion. We drop the small number of observations which do not contain export information, reducing the sample to 103,131 plant-years and 26,682 plants.

The second source of data is the employment statistics register of the German Federal Office of Labour (*Beschäftigtenstatistik*), which covers all workers or trainees registered by the social insurance system.[4] The great majority of workers in private sector plants are included in the register.[5] Information on workers includes basic demographics, start and end dates of employment spells, occupation and industry, earnings, qualifications (school and post-school), and an establishment identification number which can be linked to the establishment identifier in the establishment panel.

We select all workers in the employment register who are employed by the surveyed establishments on June 30th each year. We exclude apprentices, part-time workers, homeworkers and those aged over 65 or under 16 from the sample. Because the information on exporting in the establishment panel refers to the previous calendar year, we use worker-level information from two years before the interview date. For example, the 2008 establishment survey provides information about exporting activity from January to December in 2007; this is linked to information on workers in establishments on June 30th 2006, so we can be sure that the worker information predates the exporting information.[6] From our sample of 103,131 plant-years, 85,711 (83%) can be linked to information on workers two years earlier. The remaining plants either did not exist two years earlier, or had no employees covered by social security at that point. The remaining 85,711 observations on 21,946 plants is our usable sample.

The employment register data records the nationality (citizenship) of workers. It seems likely that some workers who are recorded as being "foreign" by nationality have lived in Germany for some time, or may even have been born in Germany.[7]

[4] A detailed description of the employment data can be found in Bender *et al.* (2000).

[5] The establishment panel contains information on the number of employees and the number of employees covered by social security. In our sample of private sector plants 96% of employees are covered by social security.

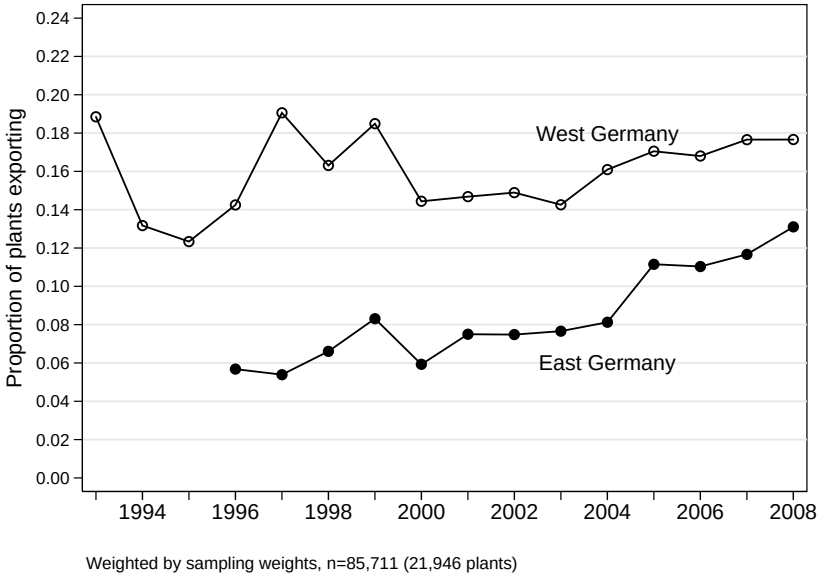
[6] Although 1993 is the first year of the establishment panel, the employment statistics register can be used to find workers in plants before 1993, so we do not lose observations by pre-dating the worker-level information in this way.

[7] German nationality is essentially based on parents' nationality, irrespective of place of birth. It has traditionally been quite difficult for non-Germans to acquire German nationality, requiring (amongst other conditions) a minimum of 15 years' residence. The amended Nationality Act of 2000 has made it slightly easier but still requires at least eight years' residence. Children born in Germany to non-German parents acquire German nationality at birth only if at least one parent has a permanent residence permit and has been living in Germany for at least eight years.

Because of this, we examine subsets of workers whose nationality is more likely to reflect links with other countries. A list of the most common nationalities working in plants in our sample is given in Table 14 in the Appendix. Note that Germany signed bilateral recruitment agreements with Italy, Greece, Turkey, Portugal and Yugoslavia in the 1950s and 1960s, and these are all important foreign nationalities in the German labour market.

Figure 1 shows the proportion of establishments in our sample which export any of their output over the sample period. A consistently higher proportion of plants export from West Germany, but the share of exporting plants in East Germany is increasing faster.[8]

Figure 1: *Proportion of establishments exporting*



Some basic characteristics of the establishments in our sample are given in Table 1, split by the exporting status of the establishment. Basic patterns are consistent with those found in the firm- or plant-level literature on exporting. Exporting plants in our data are larger, more likely to be foreign-owned, more profitable and are more likely to be in the manufacturing sector.

Table 2 compares the average characteristics of workers in plants by their export status. Exporting plants pay higher wages and their workers are slightly older and more experienced. Exporting plants do not simply employ more skilled workers.

[8] Wagner (2008) provides detailed evidence on the proportion of manufacturing plants exporting in East and West Germany, while Wagner (2004) discusses the increase in exports over the relevant time period.

Table 1: *Characteristics of establishments by exporting status, 1993–2008*[a]

	Zero exports	Exports <10%	Exports 10–50%	Exports >50%
No. of establishment-years	56,845	9,210	13,393	6,263
Average sales (€m, constant prices)	2.4	6.9	13.6	26.0
% of sales exported	0.0	5.6	28.7	76.3
Average employment	8.0	22.3	47.7	76.3
% foreign-owned	1.5	3.8	7.8	16.0
% with "good" profits[b]	29.7	29.8	33.6	41.2
% in manufacturing	19.8	33.7	41.2	39.7

[a] Weighted by sampling weights.
[b] Proportion responding "good" or "very good" to the question: "Please give your assessment of the profit situation of your business in the last fiscal year."

They employ a higher proportion of workers with university degrees, but they also employ a higher proportion of workers with the lowest qualification level. Similarly, exporting plants employ a larger proportion of basic manual workers but also a larger proportion of engineers, technicians and qualified business occupations. This will in part reflect the sectoral composition of exporting and non-exporting plants, which we will control for in our regression analysis.

The last line of Table 2 provides the first indication that the proportion of foreign workers differs between exporting and non-exporting plants. The average proportion of foreign workers in exporting plants increases with each exporting category. 11% of the workforce in plants which export more than half their output are foreign, compared to only 4% in plants which do not export. Of course, there might be other characteristics of exporting plants which are correlated with their employment of foreigners. One possibility is that plants are located in regions with lower exporting costs, and those regions also have higher proportions of foreign workers, for example cities or districts close to foreign borders. In our regression analysis we therefore control for regional and local area effects.

Another explanation for the fact that exporting plants employ more foreign workers might be that exporting plants employ more foreigners because foreign workers happen to be concentrated in industries and occupations which are export intensive. For example, foreign workers in Germany might be concentrated in low-skill manual occupations which are intensively required by exporting plants. This might be particularly the case for *Gastarbeiter*. In our regression analysis we therefore also consider the occupational structure of employment and the effect of considering

Table 2: *Characteristics of workers by establishment's export status, 1993-2007*[a]

	Zero exports	Exports <10%	Exports 10–50%	Exports >50%
No. of worker-years	3,658,651	1,224,582	5,013,862	4,358,536
Average daily wage (€, 2000 prices)	90.0	116.5	114.3	116.9
Average age (years)	37.4	39.0	39.6	40.4
Average tenure (years)	4.4	5.2	5.3	5.0
% no apprenticeship or Abitur	8.3	11.5	13.8	12.8
% apprenticeship or Abitur	86.7	81.3	76.2	74.5
% university degree	5.0	7.1	10.0	12.6
% basic manual occupation[b]	11.1	14.1	17.5	15.0
% qualified manual occupation	18.2	21.3	16.4	16.0
% engineers and technicians	7.6	8.6	12.1	13.6
% basic service occupation	10.8	11.0	11.0	11.7
% qualified service occupation	6.2	1.0	0.5	0.1
% semi-professional	0.4	0.3	0.4	0.1
% professional	1.5	1.8	2.1	0.8
% basic business occupation	15.1	9.3	6.3	3.5
% qualified business occupation	23.8	27.0	29.3	33.8
% manager	5.2	5.5	4.6	5.3
% foreign national	4.0	4.8	6.7	11.1

[a] Weighted by sampling weights.
[b] See Table 15 for a description of occupational codes used.

foreign workers from non-*Gastarbeiter* countries.

A stronger test of the hypothesis that foreign workers actually lower exporting transaction costs is to examine the proportion of foreign workers by occupation. Because we have data on individual workers we can identify whether foreign workers are in senior occupational positions. We would expect that workers in senior positions will have more effect on exporting than those working in production or in less-skilled occupations. This is illustrated in Table 3. The table shows that the increase in the share of foreign workers in exporting plants is greater for workers with higher levels of education and for workers in managerial, business and engineering occupations. For example, 8.3% of managers in export-intensive plants are foreign, compared to 1.4% of managers in non-exporting plants. The ratio of these shares (6.04) is much higher than the equivalent ratio for manual and service occupations.

One final piece of descriptive evidence which suggests that there is some causal relationship comes from the patterns of hiring and exporting over time. Molina & Muendler (2009) show that plants' hiring behaviour at $t-1$ is systematically related to their exporting decisions in period t. We examine this by categorising plants into three groups: those that start exporting during the sample period, those that

Table 3: *Workers' nationality by occupation[a] and establishments' export status, 1993–2007[b]*

	Zero exports	Exports <10%	Exports 10–50%	Exports >50%	Ratio (4)/(1)
% foreign national	4.02	4.79	6.69	11.07	2.75
% foreign nationals:					
basic manual occupation	8.49	11.21	13.34	17.88	2.11
qualified manual occupation	4.36	5.08	5.71	6.11	1.40
engineers and technicians	2.83	2.59	2.66	6.27	2.21
basic service occupation	6.83	8.88	8.20	15.46	2.26
qualified service occupation	4.68	4.22	1.44	4.31	0.92
semi-professional	3.10	5.47	6.96	4.74	1.53
professional	1.86	2.52	2.83	2.84	1.53
basic business occupation	3.11	3.07	2.22	6.13	1.97
qualified business occupation	1.75	1.39	3.86	6.45	3.69
manager	1.37	2.39	3.80	8.29	6.04

[a] A list of occupations associated with each category is given in Table 15.
[b] Weighted by sample weights.

never export, and those that always export.[9] We then calculate, from the worker-level data, hires of foreign workers for each plant. Table 4 reports the proportion of workers hired who are foreign for these three groups of plants.

Table 4: *Hiring behaviour before and after exporting starts*

	Proportion of hires which are foreign			p-values[a]	
	Export Starters at t	Never export	Always export	starters =never	starters =always
Exports in $t+3$	0.035	0.044	0.086	0.490	0.000
Exports in $t+2$	0.060	0.045	0.085	0.148	0.013
Exports in $t+1$	0.067	0.044	0.086	0.028	0.076
Exports in t	0.045	0.045	0.087	0.940	0.000
Exported in $t-1$	0.056	0.043	0.084	0.126	0.001
Sample size	263	15,197	6,532		

[a] Using standard errors clustered at the plant level.

Although the sample of export starters is small, Table 4 suggests that plants which start exporting at t increase their hiring of foreign workers in the two years before exporting starts. Three years before exporting starts foreign hiring rates are equal between starters and non-exporters ($p = 0.490$), but the hiring rate increases in the export starters, and the difference is significant in the year before exporting starts ($p = 0.028$). However, it is also noticeable that the group of plants which always export have significantly higher hiring rates of foreign workers throughout.

[9] To reduce the possibility of measurement error, an export starter is defined as a plant which exports at t and at $t+1$, and has not previously exported. In this way, plants which start and stop exporting over a short period of time are excluded.

4 Methods and hypotheses

In this section we describe the methods we use to examine whether the proportion of foreign workers in a plant has a causal impact on the probability of entering export markets. We also describe the methods we use to test various additional hypotheses which, if true, provide further support for the idea that foreign workers lower informal trade barriers.

4.1 Causality

A potential problem is that the proportion of foreign workers in a plant may not be exogenous. Some factor which causes plants to hire more foreign workers might also cause them to export. This might arise because of some factor which is correlated with transaction costs and hiring decisions (such as the plant's location), or because of reverse causality: perhaps foreign workers choose to work for plants which export their output. Our empirical methods are intended to test whether there is a genuine causal relationship, or merely a correlation.

We start with a linear probability model which relates the exporting status of plant j in year t to the proportion of employees in the plant who have foreign nationality on June 30th in the previous year:

$$\Pr(\text{exporter}_{jt} = 1) = \beta_0 + \beta_F \bar{F}_{jt-1} + \beta_{\mathbf{x}} \mathbf{x}_{jt} + u_{jt} \tag{1}$$

If F_i is a dummy variable recording whether worker i is foreign, and N_{jt} is employment in plant j at time t, the proportion of foreigners at t is given by

$$\bar{F}_{jt} = \frac{\sum_{i=1}^{N_{jt}} F_i}{N_{jt}}$$

Because foreign workers are distributed across plants non-randomly with respect to observable characteristics which themselves may be correlated with exporter status, Equation (1) includes a vector of characteristics $\mathbf{x}_{jt}$. For example, the proportion of foreigners in a plant may vary with geographical location, plant size and industry, and these characteristics may also be correlated with exporting status. Because we have linked data we can also include measures of the education and occupation level of the plant's workforce.[10] This controls for any difference in education and skill level between foreign and German workers.

[10] These are also measured on June 30th in the year before the exporting information is recorded.

If foreign workers are also non-randomly distributed across plants with respect to some unobservable attribute which is correlated with exporting status, then our estimate of β_F from Equation (1) will still be biased. Our second model therefore instruments $\bar{F}_{it}$ with a measure of the proportion of foreign workers in the local region who do not themselves work in plant j. Our instrument for $\bar{F}_{jt}$ is therefore

$$z_{jt} = \frac{\left(\sum_j^{J_r} \sum_{i=1}^{N_{jt}} F_i\right) - \sum_{i=1}^{N_{jt}} F_i}{\left(\sum_j^{J_r} N_{jt}\right) - N_{jt}}, \tag{2}$$

where J_r is the number of plants in region r. Note that z_{jt} varies at the plant level (not just the regional level) because it excludes workers from plant j.

If plants hire workers only from other firms in their local region then this instrument will be highly correlated with $\bar{F}_{it}$, and should have a coefficient of approximately one, because an increase in the share of foreigners in other plants in the region should be associated with an equal increase in the share of foreigners in the plant. The extent to which the coefficient varies from one will give us some indication of the extent to which plants do hire mainly from the local region. For z_{jt} to be a valid instrument, we require that the effect of z_{jt} on the probability of exporting operates only via its effect on $\bar{F}_{jt}$, and not through u_{jt}. This will hold if plants' location with respect to the number of foreigners in the region is independent of their unobserved exporting propensity, u_{jt}. To construct the instrument we use the entire employment statistics register collapsed down to the district level (*Kreis*).[11] We also contruct a similar instrument which calculates z_{jt} at a higher regional level (*Regierungbezirk*).[12]

A third approach to the problem of the endogeneity of $\bar{F}_{jt}$ is to examine the relationship between changes in exporting status and hires of foreign workers by estimating a plant fixed-effects model. This relies on the assumption that the endogeneity of $\bar{F}_{jt}$ arises because of some fixed unobserved difference between exporting and non-exporting plants. A well-known problem here is that measurement error in $\bar{F}_{jt}$ may make changes or within-deviations unreliable. This is particularly so if $\bar{F}_{jt}$ is relatively stable within plants over time.

4.2 Investigating why foreign workers affect exporting

The three basic models above (OLS, IV and FE) investigate the causality of the relationship between $\bar{F}_{jt}$ and the probability of exporting. In addition, there are a

[11] *Kreises* are administrative units at an intermediate level between the German States (*Länder*) and the local municipal levels (*Germeinden*).

[12] However, this subdivision is only used in five states.

number of related hypotheses which, if true, would provide more support for the hypothesis that foreign workers genuinely lower transaction costs and help plants to export.

First, we test whether the proportion of foreigners in senior occupations is more important than the overall proportion of foreigners. It seems unlikely that workers in low-level occupations have much genuine effect on plants exporting status. To do this we regress exporting on the proportion of foreigners in each of eight basic occupational groups.

Second, we would like to test whether plants are more likely to export to a particular country if they employ workers who originate from that country. One possibility is that transaction costs are lowered because of specific country links, for example because of language barriers. A second possibility is that foreign workers are beneficial in lowering transaction costs to a number of destinations. Although the data do not record the precise destination of exports, from 1998 onwards we do know whether plants export to the European Monetary Union (EMU), and from 2004 onwards we know whether plants export to the new Eastern European members of the European Union. To distinguish between these hypotheses we regress an indicator for exports to region r on the proportion of foreign workers from region r *and* the proportion of foreign workers from other regions. We expect, for example, that the probability of exporting to EMU countries is affected by the proportion of workers from EMU countries, but it is *not* affected by the proportion of workers from other countries.

Third, we investigate whether foreign workers with stronger ties to their home country have a stronger exporting effect. As noted, the definition of a foreign worker we use is actually a measure of "nationality", rather than country of birth, and a significant number of workers coded as foreign may well have been living in Germany for many years, or may have been born in Germany. We do not know precisely when foreign workers arrived in Germany, but we can record the date at which they first entered the social security system. This provides, for foreign workers, the latest possible date at which an individual moved to Germany. Of course, many foreign workers will have moved to Germany before they enter the employment register, but it provides a lower bound on the number of years in Germany.

Another implication of the "strength of ties" hypothesis is that, if workers from countries which signed *Gastarbeiter* agreements in the 1950s and 1960s have been resident in Germany for longer, then excluding them from our measure of foreign workers should strengthen the relationship between exporting and nationality.

Yet another approach to testing the strength of ties for recent migrants is to ex-

ploit the fact that there were very few non-Germans in Eastern Germany before re-unification in 1991 (see Table 16 in the Appendix). Testing whether the foreign worker effect is stronger in East Germany therefore also provides additional evidence on this hypothesis.

Fourth, we test whether the effect of foreign workers is greater for plants which produce "non-standard" products. A physical product with a specific set of characteristics might be easier to export without detailed knowledge of the destination country's language and legal system. This is related to the argument of Gould (1994), who finds larger migration effects on trade for less homogeneous products. The most obvious test in our data is to compare exporting plants in the manufacturing and service sectors. If manufactured goods are more standardised, then the effect of foreign workers should be weaker.

Finally, there are a number of other specification issues. Equation (1) imposes the assumption that the effect is linear in the proportion of foreigners. There are alternative possibilities. For example, it seems plausible that the first foreign worker in a plant might have a greater effect than then tenth. We therefore examine this linearity assumption by testing the effect for different quantiles in the proportion of foreign workers without imposing linearity. Equation (1) also only considers the binary exporting decision. However, if foreign workers help plants break into additional export markets after the first one, or if they help plants find new customers in existing export markets, then we should also consider the volume of exports for exporting plants.

5 Results

We start with the basic linear probability model given in Equation (1), and then estimate a large number of alternative specifications suggested in Section 4 which serve to test the robustness of the relationship, and to investigate the underlying hypothesis more closely.

The dependent variable is an indicator which takes the value 1 if a plant exports any of its sales in the previous calendar year, and 0 otherwise. The key explanatory variable is $\bar{F}_{jt}$, the proportion of foreign workers in the plant in the year prior to the exporting information. Table 5 reports our first set of results.

The first column reports the raw effect. An increase in the share of foreigners in the plant of 10 percentage points is associated with a significant increase in the probability of exporting of 0.064. Less than 20% of the plants in our sample are exporters,

Table 5: *Basic OLS models*[a]

	Raw effect	Plant chars.	Plant and worker chars.	Full set of *Kreis*[b]	Excluding *Gastarbeiter*[c]
$\bar{F}_{jt}$	0.642	0.110	0.090	0.106	0.210
	(0.040)	(0.026)	(0.025)	(0.025)	(0.043)
Year (1993-2008)		15	15	15	15
Region		16	16	443	16
Industry		10	10	10	10
Employment size cat.		9	9	9	9
Education			3	3	3
Occupation			8	8	8
R^2	0.021	0.321	0.353	0.374	0.353
Number of obs.	85,711	85,711	85,711	85,711	85,711
Number of plants	21,946	21,946	21,946	21,946	21,946

[a] Standard errors in parentheses are clustered at the plant level.
[b] *Kreises* are administrative units at an intermediate level between the German States (*Bundesland*) and the local municipal levels (*Germeinden*)
[c] *Gastarbeiter* are workers whose nationality is recorded as Italian, Greek, Turkish, Portuguese or Yugoslavian.

so this is a sizable increase. In the second column we include a set of plant-level controls. We include dummies for time, *Bundesland*, industry, and employment size categories. This reduces the estimated coefficient considerably to 0.110. This means, for example, that foreign workers are employed in regions, industries and size classes which themselves are associated with a higher exporting probability. Controlling for these factors therefore increases the R^2 considerably. In the third column we exploit the fact that we have data on individual workers, and include measures of the education and occupational distribution of workers in the plant. We include a measure of the proportion of the workforce in three educational categories and 10 occupational categories. It turns out that these have relatively little additional explanatory power: the R^2 increases to only 0.321 from 0.353. The coefficient on $\bar{F}_{jt}$ falls only slightly and is still highly significant. Thus, the relationship between exporting and foreign workers does not arise because foreign workers have different educational or occupational backgrounds.

In the fourth column we check that our result is not driven by the within-region distribution of foreign workers. As noted, there may be border effects, or effects driven by the location of plants and foreign workers in cities. Including a full set of *Kreis*-level dummies has almost no effect on the coefficient on $\bar{F}_{jt}$.

The final column uses an alternative definition of $\bar{F}_{jt}$ which ignores workers from *Gastarbeiter* countries. Workers from *Gastarbeiter* countries are more likely to have been in Germany for longer periods, and are also more likely to be in manual oc-

cupations which are less relevant for exporting decisions.[13] Excluding *Gastarbeiter* workers causes the coefficient to effectively double in size. This is consistent with our hypothesis that workers from other countries are more important for plants exporting decisions.

In Table 6 we consider this idea further, by splitting the proportion of foreigners into the ten occupational categories listed in Table 15. We expect that the influence of foreign workers on exporting decisions is greater for more senior workers, and this is exactly what we find. In the first column (all foreign workers) the largest effects are found for the proportion of workers in managerial, engineering and qualified business occupations. In the second column, when we exclude workers from *Gastarbeiter* countries, the largest effects are for managers, qualified and basic business occupations.

Table 6: *Occupation-specific effects*[a]

	All foreign workers	Excluding *Gastarbeiter*
$\bar{F}_{jt}$ (Basic manual occupations)	0.114	−0.053
	(0.026)	(0.056)
$\bar{F}_{jt}$ (Qualified manual occupations)	−0.007	−0.138
	(0.031)	(0.075)
$\bar{F}_{jt}$ (Engineers and technicians)	0.201	−0.032
	(0.055)	(0.092)
$\bar{F}_{jt}$ (Basic service occupations)	0.021	0.142
	(0.024)	(0.055)
$\bar{F}_{jt}$ (Qualified service occupations)	−0.044	0.101
	(0.044)	(0.074)
$\bar{F}_{jt}$ (Associate professional occupations)	0.136	0.081
	(0.062)	(0.053)
$\bar{F}_{jt}$ (Professional occupations)	0.076	0.072
	(0.044)	(0.054)
$\bar{F}_{jt}$ (Basic business occupations)	−0.002	0.191
	(0.032)	(0.048)
$\bar{F}_{jt}$ (Qualified business occupations)	0.155	0.432
	(0.045)	(0.117)
$\bar{F}_{jt}$ (Managers)	0.201	0.143
	(0.036)	(0.040)
R^2	0.356	0.404
Number of obs.	85,711	85,711
Number of plants	21,946	21,946

[a] Standard errors in parentheses are clustered at the plant level. Regressions include the same set of controls used in Table 5. A list of occupations associated with each category is given in Table 15.

[13] Although we have controlled for occupational structure within plants, these are fairly aggregate categories.

The fact that the coefficients on managerial occupations are large and significant is consistent with the hypothesis that foreign workers lower trade barriers. However, the results are not completely clear cut because some lower-level occupations which appear to have no direct exporting role are also significant. For example, the proportion of foreigners in basic manual occupations is significant and quite large in the first column. This suggests either that there are unobserved factors which are correlated with $\bar{F}_{jt}$ and exporting, or that the occupation codes are not sufficiently precise to measure all the roles of workers in plants.

We now consider whether the association between foreign workers and exporting arises because of direct links between workers and export markets, or because foreign workers are in general "good" workers who facilitate exporting. In the first case, we would expect that exports to France would be facilitated by French workers. In the second case, exports to France could be facilitated by, for example, a Dutch manager, perhaps because, on average, foreign workers are more productive than natives.

Table 7: *Export region effects*[a]

	All destinations	Exports to EMU[b]	All destinations	Exports to NMS[c]
$\bar{F}_{jt}$ (All countries)	0.084	−0.008	0.070	−0.079
	(0.028)	(0.031)	(0.038)	(0.030)
$\bar{F}_{jt}$ (EMU countries)		0.239		0.089
		(0.059)		(0.045)
$\bar{F}_{jt}$ (NMS countries)		−0.024		0.123
		(0.080)		(0.069)
R^2	0.335	0.326	0.331	0.235
Years	1998–2007	1998–2007	2004–2007	2004–2007
Number of observations	66,415	66,415	28,774	28,774
Number of plants	18,747	18,747	11,225	11,225

[a] Standard errors in parentheses are clustered at the plant level. Regressions include the same set of controls used in Table 5.
[b] EMU countries are those countries which are members of the European Monetary Union: Austria, Belgium, Finland, France, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Spain.
[c] NMS are New Member States which joined the European Union in 2004: Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia.

The results from Table 7 strongly suggest that foreign workers help to lower export costs to those regions from which the foreign workers originate. As noted, we have information on exports to EMU countries from 1998 onwards, and exports to New Member States (NMS) from 2004 onwards. In columns (1) and (3) we therefore repeat the base model, but restrict the sample to these years. The basic result remains, with slightly larger standard errors. Columns (2) and (4) then report the result of regressing exports to each region on region-specific measures of $\bar{F}_{jt}$. For exports to EMU countries the results are very clear. The proportion of foreigners

from non-EMU countries has no effect, but the proportion of foreigners from EMU countries is large and significant. For exports to NMS countries, the results are slightly weaker, partly because of the reduced sample size. The coefficient on the proportion of NMS foreigners in the plant is larger than the other coefficients, but is only significant at the 7.4% level. Furthermore, the proportion of EMU foreigners is still significant, suggesting that these foreign workers help plants to export to countries other than those from which they originate.[14]

We now turn to the question of whether foreign workers who arrived more recently have stronger effects. As noted, we do not know when foreign workers arrived in Germany, but we can measure their first appearance in the employment register, which gives us the latest date they could have arrived. In Table 8 we report estimates where the proportion of foreigners is split by time since first appearance in the employment register. Contrary to expectations, we find that the coefficient is largest for the proportion of foreigners who first appeared in the employment register more than 15 years ago.

Table 8: *Recent migration effects*

	Time since first job	West Germany	East Germany
$\bar{F}_{jt}$		0.079	0.140
		(0.027)	(0.086)
$\bar{F}_{jt}$ (<5 years)	0.052		
	(0.046)		
$\bar{F}_{jt}$ (5–10 years)	0.052		
	(0.044)		
$\bar{F}_{jt}$ (11-15 years)	0.014		
	(0.054)		
$\bar{F}_{jt}$ (>15 years)	0.192		
	(0.046)		
Number of observations	85,711	54,656	31,055
Number of plants	21,946	14,767	7,316
R^2	0.353	0.361	0.301

[a] Standard errors in parentheses are clustered at the plant level. Regressions include the same set of controls used in Table 5.

The second and third column of Table 8 reports estimates of the base model split

[14] One might argue that these results are driven by border effects. For example, workers from EMU countries work in plants located close to a border with EMU countries, and these plants are more likely to export to those countries. We therefore re-estimated the EMU export regressions using only East German plants (which have no border with EMU countries) and the NMS export regression using only West German plants excluding Bavaria (which have no border with NMS countries). The NMS export result becomes slightly larger when we do this. The EMU export result also becomes larger but also has a much larger standard error because the proportion of EMU foreigners in East German plants is extremely small.

between East and West German plants. Since foreigners in East Germany are more likely to be recent arrivals, we expect stronger effects for foreigners, and this is what we find.

Gould (1994) argues that the effect of migrant links on trade patterns will be more pronounced for more complex differentiated products which require greater country-specific trade information. In our data, exports of services are much more likely to require the specific knowledge which foreign workers bring, and so in Table 9 we split the sample between manufacturing and service-sector plants. The result is very strong: the proportion of foreigners in manufacturing plants has no effect on export propensity, but it has a large and highly significant effect in service sector plants. The result is even more pronounced when we exclude workers from *Gastarbeiter* countries.

Table 9: *Manufactured exports vs. service exports*[a]

	All foreign workers		Excluding *Gasterbeiter*	
	Manufacturing	Services	Manufacturing	Services
$\bar{F}_{jt}$ (All foreigners)	−0.031	0.123	0.000	0.314
	(0.045)	(0.029)	(0.078)	(0.049)
R^2	0.390	0.105	0.390	0.107
Number of observations	39,958	45,753	39,958	45,753
Number of plants	9,374	12,572	9,374	12,572

[a] Standard errors in parentheses are clustered at the plant level. Regressions include the same set of controls used in Table 5.

Thus far we have only modelled the linear effect of the proportion of foreigners on the exporting decision. But it seems possible that only small numbers of foreign workers in a plant might have a significant effect, if they are in key roles within the plant. The first column of Table 10 supports this view to some extent, where we report estimates of the effect of different quartiles of $\bar{F}_{jt}$ on the exporting decision. All four quartiles are significant, and the effect of the first quartile (having less than 3% of foreign workers) is nearly as large as the effect of the last quartile (having more than 15% of foreign workers).

The second column of Table 10 repeats the basic model, but with the proportion of output exported (conditional on exporting) rather than the basic binary exporting outcome. The proportion of foreign workers is still highly significant and economically meaningful. A 10pp increase in the share of foreigners in the workforce is associated with a 1.7pp increase in the proportion of output exported.

Theory and evidence suggest that the probability of exporting depends to a large extent on the probability of exporting in the previous period because of the existence of fixed exporting costs. Thus, a more appropriate specification should include lagged

Table 10: *Linearity and export volume effects*[a]

Dep. var	Any exports	Proportion of output exported
$\bar{F}_{jt}$		0.172
		(0.047)
$\bar{F}_{jt} < 0.03$[b]	0.049	
	(0.010)	
$0.03 \leq \bar{F}_{jt} < 0.07$	0.077	
	(0.010)	
$0.07 \leq \bar{F}_{jt} < 0.15$	0.082	
	(0.010)	
$0.15 \leq \bar{F}_{jt}$	0.065	
	(0.010)	
R^2	0.355	0.180
Number of observations	85,711	28,866
Number of plants	21,946	8,507

[a] Standard errors in parentheses are clustered at the plant level. Regressions include the same set of controls used in Table 5.
[b] Cutoffs correspond to the 25th, 50th and 75th percentile of $\bar{F}_{jt}$ for those plants with any foreign workers.

exporting as an additional control variable. Estimates of such a model are reported in the first column of Table 11. As expected, the coefficient on lagged exporting is large and highly significant. But the estimated long-run effect of $\bar{F}_{jt}$ on the export probability is very close to the base model ($0.032/(1 - 0.725) = 0.116$).

Table 11: *Lagged and fixed effects estimates*[a]

	Lagged exports	Fixed effects
$\bar{F}_{jt}$	0.032	0.049
	(0.012)	(0.024)
export_{t-1}	0.725	
	(0.005)	
R^2	0.703	0.837
Number of observations	61,632	85,711
Number of plants	15,340	21,946

[a] Standard errors in parentheses are clustered at the plant level. Regressions include the same set of controls used in Table 5.

In the second column of Table 11 we report fixed effects estimates of the relationship between foreign workers and exporting. This parameter is identified only off the within-plant variation in $\bar{F}_{jt}$ and exporting, and so is a much stronger test of the hypothesis, because the effect of any fixed plant-level attribute (whether observed or not) is swept out. For example, if distance to a national border is correlated with the proportion of foreign workers in a plant and with the propensity to export,

this effect is entirely removed by this estimation method, since plants' location is fixed.[15] The coefficient estimate is approximately half the size of the OLS estimate, but still significant at conventional significance levels. There are two interpretations of the smaller fixed-effect estimate. One is that measurement error attenuates the true coefficient to zero. The second is that there are plant-level fixed unobservable attributes which are correlated with hiring decisions and exporting propensity.

An alternative method for dealing with the possible endogeneity of $\bar{F}_{jt}$ is to use the instrument defined in Equation (2) and estimate by 2SLS. Table 12 reports the results of this exercise. The first column reports the coefficient estimate on z_{jt} from the first stage regression. As expected, the coefficient is close to one and highly significant, because there is a close relationship between the proportion of foreign workers in a *Kreis* and the proportion of foreign workers in the plant. The second column reports the 2SLS estimate, which is about four times larger than the OLS estimate, albeit with a much larger standard error. However, these estimates are sensitive to the choice of regional controls. The inclusion of region fixed effects (columns 3 and 4) leads to a 2SLS estimate which is insignificantly different from zero. Excluding workers from *Gastarbeiter* countries (and including region fixed effects) leads to 2SLS estimates which are again about four times larger than the equivalent OLS estimate.

Table 12: *2SLS estimates*[a]

	Excluding region		Including region		Excluding *Gastarbeiter*	
	$\bar{F}_{jt}$	Exporter	$\bar{F}_{jt}$	Exporter	$\bar{F}_{jt}$	Exporter
z_{jt}	0.802		0.827		0.763	
	(0.030)		(0.018)		(0.031)	
F_{jt}		0.406		−0.024		0.800
		(0.115)		(0.148)		(0.332)
R^2	0.252	0.345	0.254	0.352	0.081	0.347
Number of observations	85,509		85,509		85,509	
Number of plants	21,866		21,866		21,866	

[a] Standard errors in parentheses are clustered at the plant level. Regressions include the same set of controls used in Table 5.

Finally, we also report 2SLS estimates which split by export destination and country of origin of foreign workers. There are now two instruments, one for the proportion of EMU foreigners in the plant, and one for the proportion of NMS foreigners in the plant. The two first stage regression results for EMU exports are reported in the first two columns of Table 13. We find that the proportion of NMS foreigners in the plant is less strongly related to the instrument The 2SLS results (column 3) show

[15] Note that the OLS estimates reported in Table 5 include a specification which includes *Kreis*-level fixed-effects, so we do not think that endogeneity due to location is likely to be a severe problem in any case.

a large effect on the proportion of EMU foreigners in the plant, but no significant effect for the proportion of NMS foreigners. Columns 4–6 repeat the exercise for exports to NMS, but the results are very imprecisely estimated.

Table 13: *2SLS destination-specific estimates*[a]

	Exports to EMU			Exports to NMS		
	$\bar{F}_{jt}$ (EMU)	$\bar{F}_{jt}$ (NMS)	Exporter	$\bar{F}_{jt}$ (EMU)	$\bar{F}_{jt}$ (NMS)	Exporter
z_{jt} (EMU countries)	0.853	0.030		0.794	0.038	
	(0.030)	(0.010)		(0.047)	(0.018)	
z_{jt} (NMS countries)	−0.086	0.265		0.070	0.273	
	(0.081)	(0.074)		(0.138)	(0.103)	
F_{jt} (EMU countries)			0.741			−0.461
			(0.352)			(0.427)
F_{jt} (NMS countries)			−2.231			0.094
			(4.519)			(5.145)
R^2	0.130	0.017	0.307	0.116	0.026	0.229
Number of observations		66,349			28,774	
Number of plants		18,703			11,225	

[a] Standard errors in parentheses are clustered at the plant level. Regressions include the same set of controls used in Table 5.

6 Conclusion

This paper provides new evidence which shows that plant-level exporting heterogeneity is partly explained by worker nationality. We show that plants with a higher proportion of foreign workers in year $t-1$ are significantly more likely to export in year t.

We have shown that the relationship which exists in the raw data is not due to the industrial, occupational or (most importantly) geographical concentration of foreign workers. Even within narrowly defined regions, a higher share of foreign workers is significantly associated with a higher probability of exporting. Thus, the effect is not driven by the co-location of foreign workers and plants in regions with low exporting costs. We have also shown that the effect is about twice as large for workers who are more likely to play a role within the plant in facilitating exporting decisions (i.e. managers) and for workers which are *not* from Germany's *Gastarbeiter* countries. Even more strikingly, the relationship is also stronger when we consider exports to specific regions and workers from those regions within plants.

If plants' ability to hire foreign workers depends, to a large extent, on the availability of foreign workers in the local labour market, then one could argue that the proportion of foreign workers in a plant is exogenous, since it seems unlikely that plants are geographically mobile. If this is the case, then OLS results provide an estimate of the causal impact of foreign workers on exporting decisions. However, if there are un-

observed factors which determine both export propensity and hiring policy, then an instrumental variable or fixed effects strategy is required. Instrumental variable estimates tend to be larger than the OLS estimates, but are very imprecisely estimated, and we cannot reject the exogeneity assumption. Within-plant fixed-estimates are smaller but still significantly different from zero.

There are several further issues which remain to be investigated. First, there is the possibility that *changes* in the costs of exporting and the proportion of foreigners in local labour markets might be simultaneously driven by the lowering of political boundaries. For example, plants in Bavaria which are located close to the Czech border might have increased their exports after the 2004 EU expansion, while at the same time hiring more Czech workers. This effect is not dealt with by either IV or FE strategies, because changes occur even within plants which remain in the same location.

Second, our model assumes a constant effect of worker nationality on all plants. But it seems plausible that plants close to some exporting threshold might experience larger gains from hiring foreigners than plants which are far from that threshold. Heterogeneous effects provides another reason for using IV estimation methods.

Despite these caveats, the results are strongly suggestive of a relationship between workers' nationality and plants' export performance.

References

Anderson, J. & van Wincoop, E. (2004), "Trade costs", *Journal of Economic Literature* **42**(3), 691–751.

Bender, S., Haas, A. & Klose, C. (2000), "The IAB employment subsample 1975–1999", *Schmollers Jahrbuch* **120**(4), 649–662.

Bernard, A. & Jensen, B. (2004), "Why some firms export", *The Review of Economics and Statistics* **86**(2), 561–569.

Bernard, A., Jensen, J., Redding, S. & Schott, P. (2007), "Firms in international trade", CEP Discussion Paper No. 795.

Fischer, G., Janik, F., Müller, D. & Schmucker, A. (2009), "The IAB Establishment Panel — things users should know", *Schmollers Jahrbuch* **129**(1), 133–148.

Frankel, J. (1997), *Regional Trading Blocs in the World Economic System*, Washington: Peterson Institute for International Economics.

Girma, S. & Yu, Z. (2002), "The link between immigration and trade: evidence for the United Kingdom", *Review of World Economics* **138**(1), 115–130.

Gould, D. (1994), "Immigrant links to the home country: Empirical implications for U.S. bilateral trade flows", *The Review of Economics and Statistics* **76**(2), 302–316.

Greenaway, D. & Kneller, R. (2007), "Firm heterogeneity, exporting and foreign direct investment", *The Economic Journal* **117**, F134–F161.

Head, K. & Ries, J. (1998), "Immigration and trade creation: Econometric evidence from Canada", *Canadian journal of economics* **31**(1), 47–62.

Kneller, R. & Pisu, M. (2008), "Export market entry, sunk costs and firm performance", Final Report for UK Trade and Investment.

Molina, D. & Muendler, M. (2009), "Preparing to export", Mimeo.

Rauch, J. & Casella, A. (2003), "Overcoming informational barriers to international resource allocation: prices and ties", *The Economic Journal* **113**, 21–42.

Roberts, M. & Tybout, J. (1997), "The decision to export in Columbia: an empirical model of entry with sunk costs", *American Economic Review* **87**(4), 545–564.

Wagner, D., Head, K. & Ries, J. (2002), "Immigration and the trade of the provinces", *Scottish Journal of Political Economy* **49**(5), 507–525.

Wagner, J. (2004), "On the micro-structure of the German export boom: Evidence from establishment panel data, 1995 - 2002", *Review of World Economics* **140**(3), 496–509.

Wagner, J. (2008), "A note on why more West than East German firms export", *International Economics and Economic Policy* **5**(4), 363–370.

A Appendices

Table 14: *Most common nationalities working in sample plants*

Germany	92.03%
Turkey	2.57%
Yugoslavia[a]	1.20%
Italy	0.84%
Greece	0.49%
France	0.35%
Austria	0.30%
Poland	0.24%
Portugal	0.21%
Spain	0.19%
Netherlands	0.13%
United Kingdom	0.12%

Weighted by sample weights.
[a] Former Yugoslavian countries grouped together.

Table 15: *Occupational coding*

Occupation group	Most common occupational titles
Basic manual occupations	Chemical plant operatives (9%) Metal workers (9%) Assistants (8%) Goods examiners, sorters (6%) Electrical parts assemblers (6%) Packagers, goods receivers, dispatchers (5%) Other assemblers (5%) Plastics processors (4%)
Qualified manual occupations	Electrical fitters, mechanics (13%) Engine fitters (12%) Plant fitters (10%) Turners (7%) Toolmakers (6%) Motor vehicle repairers (5%)
Engineers and technicians	Other technicians (18%) Mechanical engineers (13%) Electrical engineers (11%) Foremen, master mechanics (10%)
Basic service occupations	Stores and transport workers (25%) Motor vehicle drivers (20%) Warehouse managers, warehousemen (19%)
Qualified service occupations	Railway drivers (28%) Railway controllers and conductors (21%) Firefighters (18%) Hairdressers (9%)
Associate professional	Journalists (41%) Librarians, archivists (14%) Technical and vocational instructors (11%) Other teachers (9%)
Professional	Social scientists, statisticians (41%) Visual and commercial artists (14%) Legal representatives and advisors (11%) Interior designers (10%) Pharmacists (5%)
Basic business occupations	Salespersons (37%) Commercial agents (22%) Typists (22%) Office auxiliary workers (10%)
Qualified business occupations	Office specialists (67%) Data processing specialists (13%) Wholesale and retail trade buyers (12%) Accountants (4%)
Managers	Entrepreneurs, managing directors, divisional managers (67%) Management consultants, organisers (16%) Chartered accountants (9%)

Table 16: *Proportion of foreigners by Bundesland*

	No. of districts	Prop. foreign 1993	Prop. foreign 2000	Prop. foreign 2006	25% 1993	25% 2000	25% 2006	75% 1993	75% 2000	75% 2006
Schleswig Holstein	15	0.0462	0.0376	0.0357	0.0331	0.0299	0.0259	0.0557	0.0471	0.0453
Hamburg	1	0.0883	0.0705	0.0657	0.0883	0.0705	0.0657	0.0883	0.0705	0.0657
Niedersachsen	46	0.0465	0.0379	0.0366	0.0335	0.0285	0.0290	0.0565	0.0480	0.0462
Bremen	2	0.0707	0.0641	0.0619	0.0603	0.0581	0.0545	0.0810	0.0701	0.0693
Nordrhein-Westfalen	54	0.0945	0.0828	0.0765	0.0757	0.0661	0.0599	0.1102	0.1006	0.0935
Hessen	26	0.1031	0.0866	0.0801	0.0611	0.0539	0.0497	0.1404	0.1152	0.1138
Rheinland-Pfalz	36	0.0715	0.0661	0.0620	0.0509	0.0460	0.0389	0.0871	0.0829	0.0808
Baden-Württemberg	44	0.1320	0.1137	0.1023	0.1079	0.0852	0.0803	0.1611	0.1343	0.1180
Bayern	96	0.0875	0.0678	0.0628	0.0551	0.0397	0.0355	0.1166	0.0959	0.0839
Saarland	6	0.0724	0.0857	0.0779	0.0583	0.0614	0.0542	0.0925	0.1248	0.1085
Berlin	1	0.0752	0.0563	0.0550	0.0752	0.0563	0.0550	0.0752	0.0563	0.0550
Brandenburg	18	0.0068	0.0076	0.0111	0.0049	0.0053	0.0069	0.0082	0.0096	0.0149
Mecklenburg-Vorpommern	18	0.0032	0.0044	0.0069	0.0021	0.0029	0.0045	0.0042	0.0052	0.0094
Sachsen	29	0.0058	0.0052	0.0078	0.0038	0.0036	0.0058	0.0077	0.0063	0.0090
Sachsen-Anhalt	12	0.0044	0.0050	0.0073	0.0031	0.0036	0.0055	0.0052	0.0068	0.0085
Thüringen	23	0.0045	0.0057	0.0081	0.0033	0.0037	0.0057	0.0061	0.0073	0.0097