International Trade and Individual Labour Market Perspectives – A Micro-Level Analysis of German Manufacturing Workers

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by

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Abstract

This paper studies the impact of international trade on individual labour market outcomes in the German manufacturing sector for the period 1995-2006. Combining micro-level data from the German Socioeconomic Panel and industry-level trade data from input-output tables, we examine the impacts on (1) job-to-unemployment transitions and (2) annual earnings.

The probability of becoming unemployed rises when workers are employed in Trade Sensitive industries and decreases for workers in Trade Gaining industries. Wage effects are statistically significant for three of four trade-exposed groups of industries, but they are relatively small. The personal characteristics of workers seem to exert a substantial effect on employment status and earnings level.

JEL codes: F16, C23, J31, J63

Keywords: International trade, employment status, individual wages

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1 Introduction

The relationship between increasing trade volumes and labour market outcomes was one of the most intensively discussed economic issues over the last two decades and remains subject to ongoing debate. Krugman (1995) identified four new aspects of modern world trade through which trade can impact on labour market outcomes: the rise of trade in similar goods between similar countries (so-called “intra-trade”), the ability of producers to split up the production process into stages, the emergence of “supertraders” (countries with extremely high ratios of trade to GDP) and the emergence of large exports of manufactured goods from low-wage to high-wage countries. Since then, a fifth aspect has emerged: trade in services has increased significantly, due to revolutionary advances in information and communication technologies.

International trade can be measured in various ways. Many researchers use outsourcing measures adapted from Feenstra/Hanson[1] to quantify the increasing international integration of economies (Geishecker 2006, Liu/Trefler 2008, Munch 2005). Others base their calculations on import penetration ratios (Kletzer 2000, Ebenstein et al. 2009), changes in net exports (Davidson/Matusz 2005, Kletzer 2000), growth in goods imports and exports (Egger/Pfaffermayr/Weber 2007), the price of imported goods (Kletzer 1998, 2000) and industry-specific real exchange rates (Goldberg/Tracy/Aaronson 1999). Our study deals comprehensively with the openness to trade of German manufacturing industries. Following Faberman (2004), we group manufacturing industries by their level of trade exposure, taking into account their import penetration ratio, export share and trade openness index. The groups were built using a clear and precise statistical methodology.

One could argue that the risk of becoming unemployed rises when workers are employed in industries that face strong international competition. These so-called “Trade Sensitive” industries have a high import penetration ratio and a low export share. Increased international competition may reallocate jobs to countries with lower unit labour costs, thus exerting downward pressure on wages. By contrast, the unemployment risk for workers in industries that gain from trade should be significantly lower. However, the effect on wages is ambiguous: on the one hand, the wages in highly competitive industries should be higher than those in comparatively disadvantaged sectors. New companies are established in these sectors and

1 See Feenstra and Hanson (1996, 1999).

existing firms invest in increased production and therefore augment labour demand. This should raise wages. On the other hand, firms in highly competitive sectors have to secure their successful position in world markets. Therefore, growth in real wages has to be financed through productivity growth, in order to avoid rising unit labour costs.

Germany is an interesting case, because it is the largest economy in Europe and exceptionally open to international trade. The trade openness index rose from 47.5 per cent in 1995 to 88.3 per cent in 2008. The United States, by comparison, had a trade to GDP ratio of 28.7 per cent in 2008.[2] This extremely high level of openness makes Germany vulnerable to fluctuations in worldwide economic activity and undoubtedly has an impact on labour-market outcomes. Moreover, the German labour market can be characterized as relatively inflexible, due to strict employment protection legislation and fairly rigid wages. Krugman (1995) argues that in countries like Germany, the effects of trade are manifested mainly in changes in employment than in wages.

Empirical research on the impact of trade on labour market outcomes can be divided into two groups:[3] One strand of literature focuses on trade-related changes in aggregate net employment, either at the sector or industry-level.[4] However, these net employment changes conceal an enormous amount of job churning – there are large amounts of job creation and job destruction occurring.

Consequently, the second strand of literature assesses the effects of international factors on gross labour-market flows. *Job flow* studies, on the one hand, look at the effects of international factors on job creation and job destruction. A “direct connection between international factors and the total demand for labour at particular production sites or establishments” (Klein/Schuh/Triest 2003a, p. 73) is assumed. Davis, Haltiwanger and Schuh (1996) conducted the first analysis of trade-related job flows. Their findings show no systematic relationship between the magnitude of gross job flows and exposure to international trade, measured by industry-specific import penetration ratios and export shares. Other prominent examples of job-flow studies are Gourinchas (1998), Klein, Schuh and Triest (2003b), Davidson and Matusz (2001) and Bentivogli and Pagano (1999).

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2 See WTO statistics database, trade profiles.

3 See Klein/Schuh/Triest (2003a) for an overview.

4 See, for example, Grossman (1986), Revenga (1992), Burgess/Knetter (1998), Campa/Goldberg (2001) and Goldberg (2004).

Studies of *worker flows*, on the other hand, look at the impact of international trade on the employment movements of individual workers. In this case, a “direct connection between international factors and the demand for individual workers at particular establishments” (Klein/Schuh/Triest 2003a, p. 78) is assumed. According to Klein, Schuh and Triest (2003a), the worker-flow approach has the advantage of identifying the impact of international factors on gross labour flows at a more fundamental level than job flows – namely within establishments. Moreover, this approach “offers the potential for following workers over time and observing the longer run effects of international factors on workers and labour markets”[5]. Goldberg, Tracy and Aaronson (1999) argue that industry-level data understate job turnover “to the extent that workers change jobs voluntarily and involuntarily without changing their industry of employment”[6]. Munch (2005) argues that international trade has consequences for micro units (i.e. workers and firms), so that micro-level data should be used instead of industry-level data. This could also help to overcome potential endogeneity problems caused by the use of industry-level trade data. However, the worker-flow approach is also disadvantageous in some respects: it is rather difficult to link international trade with specific worker flows, because there are many reasons why workers lose jobs – job destruction due to international factors is just one.

The present paper investigates the impact of international trade on labour market transitions and wages, using a worker-flow approach and combining micro and macro data. There are some researchers who choose a similar strategy. Liu and Trefler (2008) examine the impact of offshore outsourcing in services to China and India on U.S. labour markets. They also consider the reverse flow or “inshoring”, which is the sale of services produced in the United States to unaffiliated buyers in China and India. Liu and Trefler examine four worker outcomes: industry switching, occupation switching, annual changes in weeks spent unemployed as a share of total weeks in the labour force, and changes in earnings.[7] They conclude that the net effect of trade is either marginally positive or zero. Geishecker (2006) analyses how international outsourcing affects individual employment security in 21 German manufacturing industries. He combines monthly spell data from household panel data and industry-level outsourcing measures and finds a positive correlation between changes in international outsourcing and the individual risk of losing employment in 15 of 21 manufacturing industries.

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[5] Klein/Schuh/Triest (2003a), p. 78.
[6] Goldberg/Tracy/Aaronson (1999), p. 204.
[7] The strategy of Liu and Trefler of combining matched CPS data with trade data was influenced by the work of Goldberg and Tracy (2003) on the effect of exchange rates on wages and job switching.

Interestingly, the effect does not differ with regard to skill level, but varies with job duration. Egger, Pfaffermayr and Weber (2007) investigate whether and how growth in goods imports and exports, a change in the terms of trade, and the intensification of outsourcing affect individual transition probabilities between six different states of employment and unemployment/out of labour force for Austrian male workers. Their results show that international factors are important determinants of labour market turnover, especially for net importing industries with a comparative disadvantage. One potential concern with the results is that the authors do not control for individual characteristics (except age), so it is not clear whether the effect of outsourcing could be attributed to ommitted factors.[8] Munch (2005) studies the effects of international outsourcing on individual transitions out of jobs in the Danish manufacturing sector. Outsourcing is found to be positively correlated with unemployment risk for workers, in particular low-skilled workers. Moreover, outsourcing increases the job-change hazard rate and mainly for high-skill workers.

Ebenstein et al. (2009) estimate the impact of trade and offshoring on the wages of American workers. They come to the conclusion that the impact of offshoring on labour-market outcomes depends heavily on the location of offshore activities. Their results point to a positive correlation between offshoring to high wage countries and U.S. manufacturing employment, and to a negative correlation for low wage countries. Moreover, wages for workers who remain in the manufacturing sector are generally affected positively by offshoring. By contrast, workers who leave manufacturing to take jobs in agriculture or service industries face downward pressure on wages.

In this present paper, we examine the impact of trade on German labour-market outcomes by combining information on wages, employment status and worker characteristics from the German Socio-Economic Panel (SOEP),[9] with data on trade volumes across industries and over time, derived from input-output tables. We investigate whether belonging to a specific category of trade-exposed industries raises or lowers the probability of becoming unemployed (job-to-unemployment transitions). Furthermore, we estimate the impact on wages. Our data on the trade exposure of German manufacturing industries was obtained from the Federal Statistical Office and provides comprehensive coverage of the trade activities of firms. We include a rich set of control variables; in particular, we control for technological

[8] See also Munch (2005).
[9] For a detailed discussion of the German Socio-Economic Panel Study, see Wagner/Frick/Schupp (2007).

change (investments in R&D as a share of value added), the growth in value added, employment growth and personal characteristics.

Our results indicate that trade affects labour-market outcomes in Germany, but only to a comparatively small degree. The effects depend substantially on the level of trade exposure of specific industries. The risk of becoming unemployed rises when workers are employed in Trade Sensitive industries. By contrast, workers who are employed in industries that gain from trade through a high export share and low import-penetration ratio, face a significantly lower probability of becoming unemployed. Wage effects are statistically significant for three of our four trade-exposed groups of industries, but they are fairly small. Again, workers in Trade-Gaining industries benefit from international trade. Furthermore, the personal characteristics of workers seem to exert a substantial effect on employment status and earnings level.

The paper is organized as follows. Section 2 describes the data and documents trends in employment and wages of four groups of German manufacturing industries, classified by their trade exposure. Section 3 describes the empirical approach. Estimation results are reported in Section 4. Section 5 concludes.

2 Definition of trade patterns and data description

2.1 The definition of trade patterns

In order to examine the impact of international trade on labour-market transitions and wages, we use data on various German manufacturing sectors. The classification of industries is based on the European industry classification standard NACE, at a two-digit level. The original 23 NACE categories were aggregated into 12 manufacturing sectors to secure a sufficient number of observations per group and to match our trade data with the industry-specific R&D data.[10]

The competitiveness of each sector, at the global level, is determined by the existence of comparative advantages. Due to the fact that Germany is comparatively well endowed with human capital, German industry should benefit from international trade if their production processes are skill-intensive.

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[10] The aggregation scheme is presented in the statistical annex.

Using an input-output approach, Lurweg and Westermeier (2010) show that over the period 1995-2006, jobs were gained through trade mainly in the following manufacturing industries: a) *machinery and equipment, b) motor vehicles, trailers and semi-trailers, c) chemicals and chemical products* and *d) fabricated metal products.* However, some industries also suffered a net loss of jobs. In our study, we determine whether the reasons for these trade-related net employment changes can be revealed at the individual level.

The job effects of trade depend heavily on the level of "trade exposure" of manufacturing industries. For example, the four job-gaining industries mentioned above are similar with regard to the magnitude of export ratio. Following the approach of Faberman (2004), we define four different groups of manufacturing industries with varying trade patterns. *Trade-Sensitive industries* have a relatively high value of imports, but only a small value of exports. *Low-Volume Trade industries* are marginally involved in international trade and therefore have low import and export levels. *Trade-Gaining industries* have a large share of exports, but only low imports. *High-Volume Trade industries* are characterised by both high exports and high imports.

In the next step, we report on the categorization of the 12 manufacturing industries according to their trade exposure. The categorization was conducted on the basis of three trade parameters, namely the *import penetration ratio*, *export ratio* and *trade openness index*, as suggested by Faberman (2004) and the United Nations (2007). Each ratio is calculated at the industry-level.[11] The export ratio or export propensity shows "the overall degree of reliance of domestic producers on foreign markets" (United Nations 2007) and is defined as the ratio of exports to GDP. At the industry-level, the export ratio can be measured by the following equation:

$$(1)\ Export\ ratio\ of\ industry\ i = \frac{Real\ gross\ exports\ of\ industry\ i}{Final\ uses\ of\ goods\ of\ industry\ i}$$

The export ratio index is biased upwards by re-exports, if not corrected for, and tends to be negatively correlated with economic size. Therefore, we subtracted the re-exports from the value of exports.

The import penetration ratio indicates the degree to which domestic demand is satisfied by imports and is calculated as follows:

$$(2)\ Import\ penetration\ ratio\ of\ industry\ i = \frac{Real\ gross\ imports\ of\ industry\ i}{Domestic\ demand\ for\ goods\ of\ industry\ i}$$

[11] The input-output tables which include data on German imports and exports, classified by sectors, can be downloaded free of charge at www.destatis.de (Federal Statistical Office, Fachserie 18, Reihe 2).

Again, we did not consider the imports that are re-exported directly. Domestic demand for goods of industry i was calculated by subtracting gross exports from the value of final uses of goods of industry i.

The trade openness index is defined as follows:

$$(3)\ Trade\ openness\ index\ of\ ind.i = \frac{Real\ gross\ imports + real\ gross\ exports\ of\ industry\ i}{2 * Final\ uses\ of\ goods\ of\ industry\ i}$$

The measure of trade openness reflects the importance of international trade for each particular manufacturing sector.[12] Table 1 reports to which of the four trade-exposed groups the 12 NACE industries are assigned.

Table 1: Categorization of NACE industries with respect to trade exposure

Trade-Sensitive industries	**Low-Volume trade industries**	**Trade-Gaining industries**	**High-Volume trade industries**
DB/DC Manufacture of textiles, and textile products	DA Manufacture of food products, beverages and tobacco	DG Manufacture of chemicals, chemical products and man-made fibres	DH Manufacture of rubber and plastic products
DN Manufacturing n.e.c.	DD/DE Manufacture of wood and wood products; Manufacture of pulp, paper and paper products; publishing and printing	DI Manufacture of other non-metallic mineral products	DL Manufacture of electrical and optical equipment
	DF Manufacture of coke, refined petroleum products and nuclear fuel	DJ Manufacture of basic metals and fabricated metal products	DM Manufacture of transport equipment
		DK Manufacture of machinery and equipment n.e.c.	

For the purpose of assigning the 12 sectors to a specific group, we developed a precise classification methodology which relates the export ratio to the import penetration ratio and the trade openness index. This approach is an extension of the classification methodology described by Faberman (2004).

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12 The values of imports were adjusted to the prices of 2005 using the price index for imported goods. The values of exports were adjusted to the prices of 2005 using the price index for exported goods (Federal Statistical Office, Fachserie 17, Reihe 8).

A NACE sector is a Trade-Sensitive sector if a) the import penetration ratio of Sector i is greater than the mean import penetration ratio over all sectors and if b) the quotient of import penetration ratio and export ratio of Sector i exceeds the corresponding quotient over all sectors and if, at the same time, c) the trade openness index of Sector i exceeds the value of the first quartile of the average trade openness index over all sectors.

A sector is denoted a “Low-Volume Trade industry” if a) neither the export ratio nor the import penetration ratio of Sector i exceed the mean of the corresponding quotients over all sectors and if b) the trade openness index of Sector i falls below the value of the first quartile of the average trade openness index over all sectors.

A sector is a Trade-Gaining sector if a) the export ratio of Sector i is greater than the mean export ratio over all sectors and if b) the quotient of export ratio and import penetration ratio of Sector i exceeds the corresponding quotient over all sectors and if, at the same time, c) the trade openness index of Sector i exceeds the mean of the trade openness index over all sectors.

A sector is a High-Volume Trade industry if a) the export ratio as well as the import penetration ratio of Sector i exceed the mean of the corresponding quotients over all sectors and if b) the trade openness index of Sector i exceeds the value of the third quartile of the average trade openness index over all sectors.

In the following table, we show the average import penetration ratio, export ratio and trade openness index for each group of trade-exposed industries and for all manufacturing industries.

Table 2: Trade linkages of the four trade-exposed groups

Group	Export ratio	Import penetration ratio	Trade openness index
Trade-Sensitive industries	0.415	0.504	0.534
Low-Volume Trade industries	0.381	0.167	0.252
Trade-Gaining industries	0.735	0.232	0.407
High-Volume Trade industries	0.666	0.428	0.450
All manufacturing	0.628	0.297	0.401

Notes: Calculations are based on input-output tables of the Federal Statistical Office and survey data of the SOEP. Data were weighted in order to control for non-random selection, due to the sampling design and attrition.

Three of our four Trade-Gaining industries are consistent with the manufacturing industries which Lurweg and Westermeier (2010) identified as trade-benefiting industries in terms of employment, using macroeconomic input-output data. By contrast, the sector "manufacture of other non-metallic mineral products" belongs to the Trade-Gaining industries and the sector "motor vehicles, trailers and semi-trailers" is a High-Volume Trade sector, following our classification strategy.

The next table presents the personal characteristics of workers in our four trade-exposed industry groups. The selected variables refer to labour market and educational aspects, as well as to the age and gender of respondents with valid interviews in the observation period from 1995 to 2006. The descriptive statistics reveal that the four groups differ in some respects, but there are also similarities between Trade-Sensitive and Low-Volume industries on the one hand, and Trade-Gaining and High-Volume Trade industries on the other.

The share of respondents who are somewhat or very concerned about job security is highest in Trade-Sensitive industries. This result is not surprising, because the employment trend in Trade Sensitive industries is clearly negative throughout the observation period. Counterintuitively, employees in Low-Volume Trade industries are less concerned, whereas workers in High-Volume Trade industries are more concerned about job security, even if the employment trend of High-Volume Trade industries is much better. We will discuss this topic later.

Workers in Trade-Gaining industries are employed in their industry for 3.8 years on average without interruption. This means that these employees face less job-to-job or job-to-unemployment transitions than other workers and may have a lower risk of becoming unemployed. Conversely, workers in the Trade Sensitive industries have a considerably higher rate of job transitions, indicating that their employment situation is more precarious. Employees in Low-Volume and High-Volume Trade industries have a similar pattern of job transitions, which is reflected in an average length of uninterrupted employment of 3.1 and 3.3 years respectively.

The different labour market characteristics of workers in the four trade-exposed groups of industries are also reflected in the number of years in full-time employment. Workers in Trade-Gaining industries have more working experience on average than all other workers. Compared to workers in Low-Volume Trade industries, employees in these sectors have two more years of working experience. Even if workers in Trade-Sensitive industries have a relatively short average length of uninterrupted employment, they display a comparatively extensive job experience in full-time employment, compared to the other groups.

Workers in Trade-Sensitive and Low-Volume Trade industries seem to be very similar regarding required and actual levels of education. Furthermore, workers in Trade-Gaining and High-Volume Trade industries also yield similarities in levels of education. Workers in the first group have a lower average required and actual level of education. The share of jobs that require no training, training on the job or an introduction to the job is higher in Trade-Sensitive and Low-Volume Trade industries than in Trade-Gaining and High-Volume Trade industries. Similarly, vocational training or a college/university degree is required for a higher share of workers in Trade-Gaining and High-Volume Trade industries.

Table 3: Worker characteristics in the four trade-exposed groups

		Trade-Sensitive industries	Low-Volume Trade industries	Trade-Gaining industries	High-Volume Trade industries
Share of respondents who are somewhat or very concerned about job security		65.6%	57.5%	64.4%	65.2%
Longest continuous length of employment		2.8	3.1	3.8	3.3
Job experience in full-time employment		17.7	16.2	18.2	17.0
Required level of education	No Training	2.9%	3.5%	2.0%	1.5%
	Introduction to job	17.3%	18.9%	11.4%	14.2%
	On the job training	14.1%	14.9%	12.5%	11.8%
	Courses	2.0%	3.2%	3.2%	3.5%
	Vocational training	58.0%	51.3%	56.3%	50.4%
	Technical college / University	5.7%	8.4%	14.6%	18.7%
Highest level of education	Inadequately	3.3%	2.0%	2.6%	2.2%
	General elementary	16.7%	15.2%	14.0%	12.8%
	Middle vocational	61.2%	57.2%	53.9%	50.0%
	Vocational + Abi	4.3%	5.7%	5.5%	6.1%
	Higher vocational	7.0%	7.4%	9.0%	10.2%
	Higher education	7.5%	12.5%	15.0%	18.7%
Age		41.8	41.2	41.1	40.4
Share of female workers		45.9%	38.6%	20.6%	24.0%

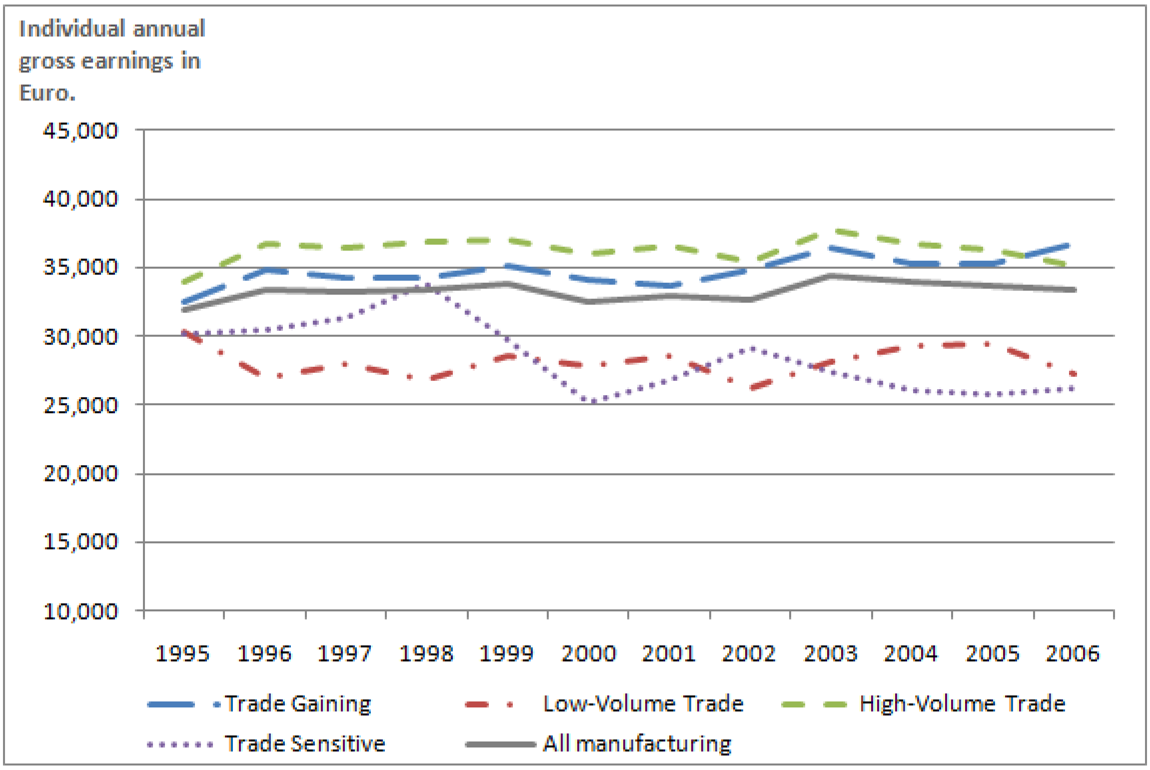
Notes: Calculations are based on SOEP data. Data were weighted in order to control for non-random selection due to sampling design and attrition.

In summary, our data indicates that workers in Trade-Sensitive and Low-Volume Trade industries have a lower level of education, compared to Trade-Gaining and High-Volume Trade industries and that their required level of education is lower. The different educational characteristics conform to traditional trade theory, which predicts that those countries which are well-endowed with human capital should specialize in the production of skill-intensive products. If Trade-Gaining and High-Volume Trade industries are indeed more competitive, this should be also reflected in the individual labour-market perspectives.

2.2 Description of worker outcomes and predictor variables

In order to determine the effects of international trade on labour market outcomes, we applied *log gross income* and *employment status* as outcome measures. Real gross income is quantified by the respondent's average annual earnings from employment, including self-employment.[13] Figure 1 presents the development of earnings for the four trade-exposed groups.

Figure 1: Earnings of employees and self-employed workers in the four trade-exposed groups



Notes: Calculations are based on SOEP data. Data were weighted in order to control for non-random selection due to sampling design and attrition.

Earnings of employees have developed differently among the trade-exposed groups of industries, but the earnings gap has not widened significantly. While workers in the Trade-Gaining and High-Volume Trade industries have benefited from marginally increasing incomes throughout the observation period, workers in Trade-Sensitive and Low-Volume Trade industries suffered earnings losses. These losses can probably be attributed to rising competitive

[13] A rise in real gross income resulting from lower taxation after marriage is controlled for in our estimations by the inclusion of marital status. Real gross income, instead of real net income was applied, in order to avoid changes in income caused only by changes in the German taxation system.

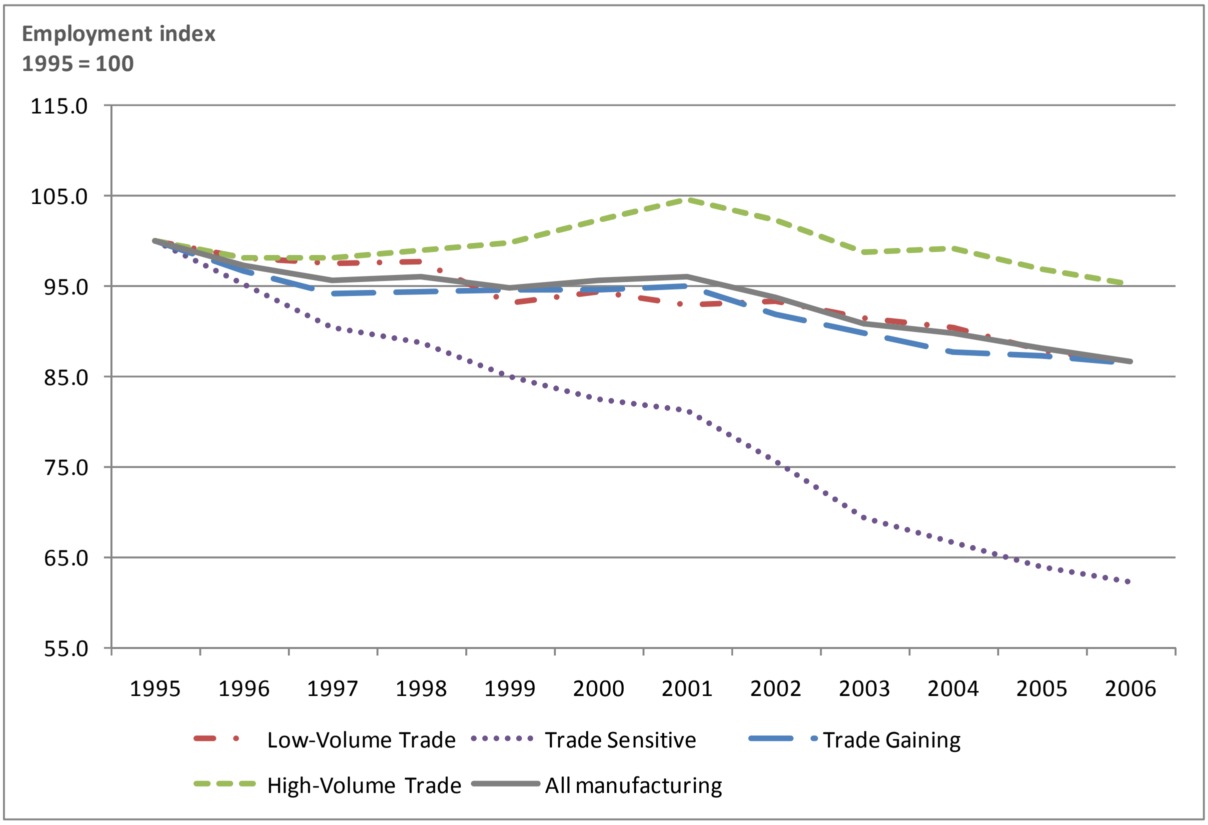
pressure in low-export sectors. However, in the literature, there is controversy as to whether trade can really be regarded as an important reason for rising wage inequality. Many researchers argue that skill-biased technological change is a far more important driver of wage inequality than increasing international trade volumes.[14] We will come back to this later.

The second worker outcome is the respondents' current employment status. Answers vary between 0 = employed and 1 = registered unemployed. In the original survey question, all employed workers and unemployed persons who did not register as unemployed (e.g. students or retirees) were pooled in one group. Those respondents who are voluntarily unemployed, rather than as a result of international trade, were excluded from the data set. Respondents with an employment status of "full-time" or "regular part-time employment" were classified as employed. The share of unemployed respondents was about 13 per cent in 1995 and 2006, at its maximum in 1997 (14.1 %) and its minimum in 2002 (10.5 %).[15] Employment trends in the four trade-exposed groups of industries, based on information from input-output tables, are presented in Figure 2.

[14] See, for example, Davis/Haltiwanger (1991), Bound/Johnson (1992), Lawrence/Slaughter (1993), Berman/Bound/Griliches (1994).

[15] It is important to bear in mind that the mentioned employment status refers to the previous year. The maximum and minimum unemployment rates therefore belong to the years 1996 and 2001. Insofar, the employment trends established at the microeconomic level are in accordance with trends on the macroeconomic level and reflect cyclical fluctuations.

Figure 2: Employment trends in the trade-exposed groups



Notes: Calculations are based on input-output tables of the Federal Statistical Office.

The employment trends are measured by changes in the number of employees in specific manufacturing industries. The number of jobholders in the manufacturing sector has decreased by 13.3 per cent from 1995 to 2006, in contrast to the positive overall national employment trend of +4.0 per cent (Federal Statistical Office 2009, p. 73). Furthermore, labour-market perspectives vary considerably among the four trade-exposed industry-groups. High-Volume Trade industries yield the best labour-market performance, even if their employment trend is also slightly negative. Between 2000 and 2001, High-Volume Trade industries had an employment growth of +4.6 per cent, but the number of jobs in these industries decreased subsequently. Trade-Sensitive Industries face a process of continued job destruction. From 1995 to 2006, the number of workers decreased from 716,000 to 446,000. Trade-Gaining industries and Low-Volume Trade industries have developed similarly, with respect to the number of employees. Both groups have faced a negative employment trend of 13.6 per cent from 1995 to 2006.

Employment status and wages are influenced not only by international trade and increasing competition among workers, but also by the effects of business cycles, overall employment trends, technological progress and the personal characteristics of respondents. To control for these aspects, we included a rich set of control variables in our estimations.[16]

To capture the effects of business cycles on current employment status and on wages, *growth rates of real gross value added* of each sector are included in the model.[17]

The individual employment status and the income level also depend on the industry's employment trend. Negative long-term employment trends, as in the textile sector, raise the unemployment risk of individual workers and exert downward pressure on wages. Therefore, *growth rates of sectoral employment* are applied to the estimation.

Furthermore, it is necessary to include a proxy for technological change, because technological change is often found to affect labour demand and could thus influence employment transitions and income levels. On the one hand, technological progress fosters economic growth and consequently, leads to an increase in the demand for labour. On the other hand, this might rationalise work processes, causing job destruction. Technological progress is measured by *real industry expenditures for research and development as a share of real gross value added*. Even if this measure is far from perfect, it is commonly used in the literature (Berman/Bound/Griliches 1994, Machin/van Reenen 1998 and Munch 2005).[18]

Another industry-specific variable is the *capital coefficient*, which is defined as the capital stock of an industry in relation to its real gross value added. The capital stock is measured in terms of real gross fixed assets. The capital coefficient is a critical factor for industry-level economic growth and provides information on the quantity of capital, which is required to produce a particular amount of output.

Growth rates of real net exports are employed in the estimation, because they contain information about business cycles in international trade and the competitiveness of German manufacturing industries. Growing net exports can be the result of rising international trade volumes or of improved sectoral competitiveness. Therefore, an increase in real net exports may

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16 A detailed data description is presented in the statistical annex.

17 Due to the existence of outliers, growth rates of real gross value added and capital coefficients were eliminated from the sample, if the observations fell into the bottom or top 1 percent of their corresponding distribution.

18 Alternative measures of technological change include computer intensity (Haskel/Heden 1999) or a measure of technological adoption (Doms/Dunne/Troske 1997), but data for these measures is not available to us.

influence the labour-market situation of German workers. Furthermore, the export or import orientation of German industries is reflected in the data.[19]

It is important to control for worker-specific characteristics, otherwise there would be a high risk of unobserved factors which could be correlated with the right-hand-side variables. This endogeneity-problem would lead to biased estimation coefficients. We control for the following personal characteristics: *highest level of education, work experience in full-time employment, gender, health status, marital status and region.*

The *level of education* is based on the ISCED-1997-classification and refers to education and further training at time of survey. The predefined categories range from "Inadequately completed schooling" to "Higher education", but were re-arranged in three dummy-variables, which describe a low, medium and high level of education.[20] The omitted category is "Low level of education".

Work experience in full-time employment provides information on the entire period of full-time employment in the respondent's career up to the point of completing the questionnaire. As Farber (1994) points out, increasing time spent at the job helps to gain firm-specific capital and lowers the risk of job turnover. Unfortunately, firm-specific human capital cannot be measured directly. Therefore, we approximate the variable through work experience in full-time employment. The variable is coded in 11 categories, ranging from "less than one year" to "more than 40 years" of work experience.

Unemployment rates and wage levels vary substantially between East and West Germany, because there are still enormous structural differences between the labour markets which can be ascribed to the ongoing catching-up process of East Germany. We control for such regional heterogeneity by including a dummy variable for the location of the respondent's household at the time of the survey.

Royalty (1998) highlights the importance of *gender* for the transition from job to unemployment. We therefore apply a *dummy for female respondents* and an additional *dummy for singles and married respondents*[21] in our estimation.

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[19] Data of real net exports contains an extremely large range of values. To mitigate the biasing effect of outliers, observations were eliminated from the sample if they fell into either the top or bottom 3 percent of the real net exports distribution.

[20] Low level of education: primary education + lower secondary education; medium level of education: secondary + post-secondary non-tertiary education; high level of education: tertiary education.

[21] The omitted category is "divorced/separated/widowed".

Furthermore, we control for unobserved time-specific heterogeneity by including a set of *time-dummies*. The omitted category is the year 2006.

3 Methodology

In our analysis of worker outcomes, we view current *employment status* and *gross annual earnings* as dependent variables, and dummy variables for *Trade-Sensitive*, *Low-Volume Trade, High-Volume Trade* and *Trade-Gaining industries* as main predictors.

The worker outcomes differ with respect to scale. Whereas earnings are measured on a ratio scale, employment status is a dichotomous variable (ordinal scale). The qualitative nature of the regressand *employment status* requires the estimation of a qualitative response model. There are several reasons for this choice. First, some of the assumptions of the "standard" OLS model are not tenable if the dependent variable has binary values. The disturbances (u_i) are not normally distributed[22] and they are heteroskedastic. Furthermore, the estimated R^2 values are generally lower than in an OLS model and there is no guarantee that the predicted values of the regressand ($\widehat{Y}_i$) lie between 0 and 1. A final point of criticism is that the marginal effect of a one-unit increase in the explaining variables does not necessarily mean a constant, linear increase in the dependent variable (Gujarati 2003, pp. 584-593).[23] A logit model is a sufficient estimation model for binary data. Firstly, the predicted probabilities[24] (P_i=E(Y=1|X)) of the dependent variable range between 0 and 1 and secondly, the relationship between the explaining variables and the regressand is non-linear.[25] In a logistic regression, the coefficients present probabilities of events (here: to become unemployed) as functions of the independent variables. The pooled logistic regression equation is given by:

$$\text{(4) } L_i = \ln\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k + u_{i,}$$

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22 Only for the purpose of statistical inference (but not for the estimation of coefficients) are the disturbances (u_i) assumed to be normally distributed.

23 With the exception of the last point, all problems can be solved by mathematical programming techniques or transformations.

24 Let p_i be the probability that y_i=1, which means that the respondent is unemployed, and 1-p_i the probability of being employed. The odds ratio in favour of unemployment is given by: p_i /(1-p_i).

25 The relationship is assumed to have the shape of a sigmoid curve. This means that if the explaining variable (e.g. real net exports) is very low or very high, a one-unit increase will have little effect on the probability of becoming unemployed.

where $\beta_0 to\ \beta_k$ are maximum likelihood estimates of the logistic regression coefficients and X_1 to X_k are column vectors of the set of independent variables. L_i is the natural log of the probability ratio of becoming unemployed, to the probability that the respondent is employed. If the "logit" L is positive for a one-unit increase in X, the odds that the regressand equals 1, increases. For ease of interpretation, we have computed odds ratios as described by Cornfield (1951). The relationship between the odds ratio and the estimation coefficient is OR = ε^{β_i}, which is the antilog of the estimated logit and we obtain $\left(\frac{P_i}{1-P_i}\right)$. An odds ratio > 1 means that, for a one unit increase in the predictor variable, the odds (or relative risk) of being unemployed exceed the odds of being employed.[26]

In principle, the panel structure of our data implies that a logit model with individual fixed effects would be appropriate. Unfortunately, there is minimal variability in the employment status, leading to a relatively high number of cases with (only) positive outcomes. The estimation of a fixed effects model is not appropriate under these conditions and, as a result, a pooled logit regression was conducted.[27]

The analysis of the effect of international trade on earnings follows a different estimation approach. Worker earnings are measured on an interval scale, which enables us to estimate an OLS model with fixed individual-level effects. Formally, the estimation equation is:

$$(5)\ Y_{it} = \beta_0 + \beta_1 X_{it1} + \cdots + \beta_k X_{itk} + \gamma_1 D_{it1} + \cdots + \gamma_k D_{itl} + \alpha_i + u_{it}.$$

Y_{it} is the levelof real gross earnings for individual i at time t. Time-variant predictors are expressed in the k variables X_{it1} through X_{itk}, and dummy variables are covered by D_{it1} through D_{i1l}. The unobserved individual effect is given by α_i, and u_{it} is the error term.

Compared to the logit model, we drop the assumption that heterogeneity across respondents can be captured completely by controlling for observable characteristics. Instead, an individual specific time-invariant component α_i is included to eliminate unobserved individual effects. A fixed-effects approach is appropriate for two reasons. Firstly, a Hausman specifica-

[26] An odds ratio of one indicates that there is no change due to the predictor variable.

[27] A robust variance estimator was applied. Its main advantage is that it is robust with respect to the assumptions that the logit function is linear and that all necessary right-hand-side variables are in the model. Furthermore, standard errors were clustered at the industry-level. This means that data need not necessarily be independent within groups, but must be independent across groups. A cluster technique should be used if error terms are serially correlated, e.g. if a random shock affects the outcome of an industry in the current and subsequent periods.

tion test indicated that a fixed-effects model should be used.[28] Secondly, it is reasonable to assume that the unobserved individual effects might be correlated with the observed predictors. The underlying argument is that such personal characteristics as ability, motivation or genetics, which are time-invariant, cannot be observed and are likely to affect the explaining variables, for example the level of education or the choice of occupation (and the membership of a particular trade-exposed group). If α_i is not independent of the explaining variables, this will create an endogeneity problem, leading to biased estimation coefficients. The individual-specific fixed-effects approach controls for such correlation structures.

Similarly to the logit model, we compute robust standard errors at the industry-level and apply a robust variance estimator. Categorical values like health status, educational degree and working experience are included in the model as dummy variables.[29] Additionally, we employ time-specific dummy variables for each year of observation.

4 Effects on worker outcomes: Empirical results

In order to analyse the impact of international trade on labour market outcomes, we estimated four different specifications of Equation (4), one for each trade-exposed group of industries, so as to avoid multicollinearity. Table 4 reports the four logit estimates of Equation (4). We report the odds ratios for all the logits.

Consider Column 1, which shows that workers in a Low-Volume Trade industry have no greater probability of a job-to-unemployment transition than other manufacturing workers. This result is not surprising, because it reflects the macroeconomic employment trend presented in Figure 2. Employment development in Low-Volume Trade industries is similar to the overall manufacturing employment trend.

The hypothesis that workers in Trade-Sensitive industries face a higher unemployment risk is confirmed by our estimation. Column 2 reports an odds ratio of 1.943, which means that workers taking up employment in a Trade-Sensitive industry have a 1.943 greater probability of becoming unemployed than other workers. This result conforms to international trade theory, which suggests that the risk of becoming unemployed rises when workers are employed

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[28] The null hypothesis (no systematic difference in the estimation coefficients) cannot be rejected. Chi^2 value: 794.96, p-value 0.000***.

[29] The omitted categories are “very good health status”, “low level of education” and “less than one year of work experience”.

in industries that face strong international competition, due to relatively low exports and high imports. Increased international competition leads to a reallocation of jobs to countries with lower unit-labour costs and to worker flows from comparatively disadvantaged sectors to sectors with a comparative advantage.

Contrarily, we cannot prove that workers in High-Volume Trade industries have better labour market perspectives than other manufacturing workers. This result is somewhat surprising, because the employment trend shown in Figure 2 is far better for High-Volume Trade industries than for any other manufacturing industry. However, the net employment changes, which are documented using input-output data for sectoral employment, conceal an enormous amount of job churning – many jobs are created and destroyed in all sectors of the economy. Consequently, the relatively positive employment trend in the High-Volume Trade industries does not mean that the unemployment risk of an individual worker automatically declines when he is employed in one of the sectors belonging to this group of industries. As Table 3 reveals, the average length of stay without interruption in a High-Volume Trade industry is indeed shorter than in Trade-Gaining industries (3.3 years versus 3.8 years), indicating that workers in High-Volume Trade industries have a higher rate of individual labour market transition (job-to-job as well as job-to-unemployment transition). This could be a reason for the insignificant coefficient.

Workers in Trade-Gaining industries face a lower risk of unemployment than other manufacturing workers. Column 4 reports an odds ratio of 0.804, which means that workers taking up employment in a Trade-Gaining industry have a 1.244 higher probability of remaining employed than other workers. This confirms our hypothesis that the unemployment risk of workers employed in industries that gain from trade through a high export share and a low import penetration ratio is significantly lower.

The set of industry-specific control variables does not exert a significant influence on the individual unemployment risk in our model. However, Munch (2005) concludes that R&D intensity, capital output ratio and net exports affect labour market outcomes. The estimation of a competing risk model reveals that R&D intensity and the capital output ratio significantly lower the unemployment risk of Danish manufacturing workers. By contrast, a positive effect of net exports on the unemployment risk can only be established for workers with higher educational attainment. The coefficient for output growth is imprecisely estimated, as in our model. According to Geishecker (2006), technological progress is found to significantly raise the probability of German manufacturing workers leaving employment. However, the coefficient estimates for net exports and the industry-level capital output ratio (by equipment) are imprecise, as in our estimation. Geishecker also controls for industry output; the coefficient is negative and only weakly significant.

In contrast to the macroeconomic variables, most of the personal characteristics of workers affect the individual unemployment risk significantly. Our estimation reveals that a one-unit increase in the average level of education and work experience in full-time employment significantly lowers the probability of becoming unemployed. By contrast, East German households, as well as workers with a poorer state of health, face a higher unemployment risk. However, we cannot prove that the employment perspectives of female workers are significantly worse than those of male workers.[30]

[30] The estimation results of Geishecker (2006) also reveal that the unemployment risk decreases with higher educational attainment. However, in contrast to our results, he finds that women face a significantly higher risk of leaving employment than men.

Table 4: Trade exposure and unemployment probability

Variables	Odds ratios and p-values			
	(1)	(2)	(3)	(4)
Low-Volume Trade	0.862			
	(0.377)			
Trade Sensitive		1.943		
		(0.000)***		
High-Volume Trade			1.223	
			(0.220)	
Trade Gaining				0.804
				(0.036)**
Capital Coefficient	1.012	0.904	0.973	1.033
	(0.922)	(0.182)	(0.800)	(0.762)
Employment Growth	0.136	1.394	0.139	0.104
	(0.261)	(0.877)	(0.478)	(0.343)
Growth Rates of Gross Value Added	1.149	1.147	1.123	1.193
	(0.851)	(0.856)	(0.874)	(0.807)
R&D Expenditures / Gross Value Added	0.585	0.969	0.631	0.426
	(0.525)	(0.947)	(0.466)	(0.398)
Real Net Exports	1.101	1.119	1.132	1.126
	(0.431)	(0.347)	(0.286)	(0.316)
Divorced /Separated/Widowed	1.086	1.105	1.078	1.081
	(0.595)	(0.505)	(0.633)	(0.615)
East German Household	2.070	2.046	2.068	2.074
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Level of Education	0.741	0.745	0.741	0.741
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Female	1.078	1.061	1.050	1.060
	(0.461)	(0.580)	(0.631)	(0.562)
Health Status	1.522	1.520	1.519	1.520
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Work Experience	0.876	0.876	0.878	0.877
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Observations	16,281	16,281	16,281	16,281
R^2	0.0557	0.0585	0.0566	0.0560

Notes: Cluster-robust standard errors in parentheses. ***, **, * = significant at 1%, 5% and 10%-levels.

There is presently a very large empirical literature dealing with the impact of international trade on wages and the distribution of income, often stating that rising trade openness leads to increasing wage inequality. Much of the literature focuses on the United States and is limited to the manufacturing sector.[31] Yet, there are also publications dealing with European labour markets, such as Hijzen, Görg and Hine (2005), Geishecker and Görg (2008) and Geishecker, Görg and Munch (2010).

Table 5 reports the estimated coefficients of Equation (5) for our four trade-exposed groups of industries. The results are presented as marginal effects. The wages of workers taking up employment in Trade-Sensitive industries do not change significantly. Workers, who move to Low-Volume or High-Volume Trade industries, face a significant reduction in wages. The wage effect of taking up employment in Trade-Gaining industries is positive and statistically significant.

Even if the wage effects are statistically significant for three of our four trade-exposed groups, they are relatively small. This result is not surprising, because the earning levels did not fluctuate much between 1995 and 2006, even if the trade openness of German manufacturing firms increased substantially (from 34.6 per cent in 1995 to 45.8 per cent in 2006). As Figure 1 reveals, the average individual gross earnings of workers in Trade-Gaining and High-Volume Trade industries were higher than those of workers in Trade-Sensitive and Low-Volume Trade industries throughout the period of observation, but the gap did not widen significantly. By contrast, employment in Trade-Sensitive industries reveals considerable downward trend and developed well below average. This underlines the hypothesis that in countries with relatively inflexible wages, the effects of trade are manifested mainly in changes in employment, rather than wages.

[31] See, for example, Borjas/Freeman/Katz (1992), Lawrence/Slaughter (1993), Gaston/Trefler (1994) and Feenstra/Hanson (1996, 1999, 2002).

Table 5: Trade exposure and wages

Variables	Coefficients and p-values			
	(1)	(2)	(3)	(4)
Low-Volume Trade	-0.050			
	(0.089)*			
Trade Sensitive		0.046		
		(0.298)		
High-Volume Trade			-0.030	
			(0.026)**	
Trade Gaining				0.025
				(0.059)*
Capital Coefficient	-0.012	-0.017	-0.018	-0.022
	(0.309)	(0.141)	(0.154)	(0.111)
Employment Growth	0.002	0.017	0.003	0.012
	(0.993)	(0.930)	(0.986)	(0.949)
Growth Rates of Gross Value Added	0.000	0.000	-0.003	-0.004
	(0.986)	(0.987)	(0.859)	(0.806)
R&D Expenditures / Gross Value Added	0.112	0.147	0.197	0.228
	(0.081)*	(0.018)**	(0.031)**	(0.018)**
Real Net Exports	0.014	0.013	0.012	0.012
	(0.342)	(0.350)	(0.409)	(0.418)
Divorced /Separated/Widowed	-0.008	-0.008	-0.008	-0.009
	(0.741)	(0.735)	(0.726)	(0.719)
Level of Education (high)	0.167	0.167	0.167	0.167
	(0.009)***	(0.010)***	(0.009)***	(0.009)***
Level of Education (medium)	0.131	0.130	0.131	0.131
	(0.008)***	(0.009)***	(0.008)***	(0.008)***
Health Status (bad health)	-0.155	-0.155	-0.154	-0.154
	(0.045)**	(0.045)**	(0.046)**	(0.047)**
Work Experience (1-2 years)	0.280	0.280	0.279	0.279
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Work Experience (2-40 years)	0.369 – 0.594	0.369 – 0.595	0.368 – 0.592	0.369 – 0.592
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Work Experience (> 40 years)	0.367	0.368	0.365	0.365
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Observations	17,257	17,257	17,257	17,257
Overall R^2	0.2669	0.2574	0.2711	0.2667

Notes: Cluster-robust standard errors in parentheses. ***, **, * = significant at 1%, 5% and 10%-levels.

In contrast to international trade, technological progress seems to exert a substantial effect on the earnings level. The estimated coefficient is positive and statistically significant for all four trade-exposed groups of industries. The lowest positive effects are reported for Low-Volume Trade and Trade-Sensitive industries, the highest for High-Volume Trade and Trade-Gaining industries. However, as many studies on labour-market effects of technological change reveal, technological change affects workers differently. For example, Hijzen, Görg and Hine (2005) find that R&D intensity has a positive and significant effect on the demand for skilled workers and a negative effect on the demand for semi-skilled and unskilled workers in the United Kingdom.[32]

The different skill structure of labour demand presumably has an impact on wages. If the demand for high-skilled labour rises, the wages of high-skilled workers should rise as well. By contrast, a decreasing demand for less-skilled labour should put downward pressure on wages for this skill group. Consequently, we estimate the impact of R&D intensity on earning levels for high-skilled, medium-skilled and low-skilled workers separately (see Table 6), using interaction terms.

The results show that R&D intensity has a positive impact on wages for high-skilled workers in all four trade-exposed industry groups, but the effect is only statistically significant for workers employed in Trade-Gaining and High-Volume Trade industries. This can be explained by the fact that the share of high-skilled workers is highest in these two sectors. Firms, whose production is relatively skill-intensive, pay a wage premium for high-skilled workers. Workers who are medium-skilled benefit from R&D intensity, regardless of the sector. The estimated coefficients of low-skilled workers are negative, but not statistically significant.

Our results underline the hypothesis that the wage effects of technological progress are unevenly distributed across skill groups. High-skilled and medium-skilled workers in German manufacturing industries seem to benefit from technological change.

For the remaining set of industry-specific control variables, we cannot report significant results, even if the employed variables are industry-level. However, other studies also yield

32 Their findings are in line with Machin and van Reenen (1998) and Haskel and Heden (1999). However, the negative effect of R&D intensity on the demand for semi-skilled and unskilled workers is only statistically significant in the pooled regressions.

insignificant effects of macroeconomic control variables, which are comparable to our estimates.[33]

Conversely, personal characteristics influence log gross annual earnings significantly. With the exception of the control variable for marital status, all other individual characteristics are statistically significant. Workers with a high and medium level of education benefit from an 18 per cent and a 14 per cent earnings surplus respectively, compared to less qualified respondents. Unsurprisingly, respondents with a poor health status suffer from earnings losses, compared to those with a very good health status.

The varying coefficients of work experience indicate a non-linear (concave) relationship with log earnings. This result corresponds with the findings of Baumgarten et al. (2010). Full-time work experience has an increasing influence, up to 25 years of work experience and compared to workers with less than one year of work experience (mostly apprentices). The coefficient of more than 25 years and less than 40 years of full-time employment is slightly smaller in all estimations. Respondents with more than 40 years of work experience still have a wage surplus, compared to respondents with less than one year of experience, but the effect is smaller.

The estimated coefficients of personal characteristics do not differ much across the four estimations, which indicates the robustness of our estimations. Furthermore, we obtain narrow confidence intervals, which suggests that our estimates are precise.

It is surprising that personal characteristics exert a greater influence on earnings than the trade linkages of industries. This means that worker outcomes depend substantially on microeconomic aspects, rather than on macroeconomic ones. Due to the fact that the employed control variables are expressed by the individual respondent and can therefore be directly linked with individual worker outcomes, the results seem reasonable. Another reason why trade, business cycles and other macroeconomic variables exert only small effects on worker outcomes is that labour markets are subject to economic policy interventions. Short-term work regulations, for example, aim to prevent unemployment during phases of economic recession. Accordingly, the effects of business cycles and short-term trade fluctuations on employment and wages can be mitigated. Additionally, wage agreements between employers

[33] Baumgarten, Geishecker and Görg (2010) use controls for production value and capital intensity to analyse the effect on log hourly wages, but obtain insignificant results. Geishecker, Görg and Munch (2010) employ a measure of industry output value, but do not detect a significant effect on log hourly wages for German workers.

and employees aim at achieving a positive and steady development of wages. However, political interventions and wage agreements cannot prevent long-term structural changes between industries, which are caused by trade and ongoing globalisation. This will necessarily lead to changing labour-market perspectives for workers. Jobs which are threatened, due to a lack of competitiveness, cannot be protected by policy interventions in the long-run. However, in this paper, we concentrate on short-run labour market dynamics.

Table 6: Technological progress and levels of education

Variables	Coefficients and p-values			
	Low-Volume Trade	**Trade Sensitive**	**Trade Gaining**	**High-Volume Trade**
R&D/Y * ED: high	0.121	0.160	0.250	0.211
	(0.153)	(0.107)	(0.031)**	(0.062)*
R&D/Y * ED: medium	0.188	0.224	0.316	0.278
	(0.025)**	(0.007)***	(0.010)**	(0.017)**
R&D/Y * ED: low	-0.121	-0.092	-0.009	-0.041
	(0.439)	(0.526)	(0.951)	(0.786)
Observations	17,257	17,257	17,257	17,257
Overall R^2	0.2666	0.2565	0.2668	0.2712

Notes: Cluster-robust standard errors in parentheses. ***, **, * = significant at 1%, 5% and 10%-levels. Main predictors, macroeconomic variables and personal characteristics were omitted for reasons of clarity and readability. The omitted coefficients are very similar to those presented in Table 5.

5 Conclusion

The present paper investigates the impact of international trade on labour market transitions and wages, using a worker-flow approach and combining micro and macro data. The main contribution of our analysis is that we develop a clear and precise statistical methodology, in order to group German manufacturing industries by their level of trade exposure, taking into account their import penetration ratio, export share and trade openness index. Thus, the labour market effects of trade are analysed comprehensively, considering that trade entails more than the issues of "offshoring" or "outsourcing".

Furthermore, we use a worker-flow approach as recommended by Klein, Schuh and Triest (2003a), who argue that the worker-flow approach has the advantage of identifying the impact of international factors on gross labour flows at a more fundamental level than job flows

– namely within establishments. The analysis is based on individual-level data, which enables us to control for the major proportion of unobserved individual heterogeneity, thus reducing the potential endogeneity bias.

Our results indicate that trade affects labour-market outcomes in Germany, but only to a comparatively small degree. The effects depend substantially on the level of trade exposure of specific industries. The risk of becoming unemployed rises when workers are employed in Trade-Sensitive industries. By contrast, workers who are employed in Trade-Gaining industries, face a significantly lower probability of becoming unemployed. Wage effects are statistically significant for three of our four trade-exposed groups of industries, but they are fairly small. Again, workers in Trade-Gaining industries benefit from international trade.

Personal characteristics exert a greater influence on employment status and earnings than the trade linkages of industries. This means that worker outcomes depend substantially on microeconomic aspects, rather than on macroeconomic ones.

Further research, using individual-level data instead of industry-level data, would further enhance our understanding of the impact of international trade on labour-market outcomes.

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Table 7: Aggregation of NACE categories

No.	Original category	Observa-tions	New category	Observa-tions	Note
1	Agriculture and hunting	2,161	A/B Agriculture, hunting, forestry and fishing	2,423	Ex-cluded
2	Forestry	253			
5	Fishing	9			
10	Mining and quarrying of energy producing materials	397	C Mining and quarrying	519	Ex-cluded
11		45			
14	Mining and quarrying, except of energy producing materials	77			
15	Manufacture of food products and beverages	2,572	DA Manufacture of food products, bevera	2,608	
16	Manufacture of tobacco products	36			
17	Manufacture of textiles	897	DB/DC Manufacture of textiles, textile	1336	
18	Manufacture of wearing apparel; dressing and dyeing of fur	311			
19	Manufacture of leather and leather products	128			
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	622	DD/DE Manufacture of wood, wood product	3,300	
21	Manufacture of pulp, paper and paper products	608			
22	Publishing, printing and reproduction of recorded media	2,070			
23	Manufacture of coke, refined petroleum products and nuclear fuel	117	DF Manufacture of coke, refined petrole	117	
24	Manufacture of chemicals, chemical products and man-made fibres	3,498	DG Manufacture of chemicals, chemical	3498	
25	Manufacture of rubber and plastic products	1,142	DH Manufacture of rubber and plastic pr	1142	
26	Manufacture of other non-metallic mineral products	881	DI Manufacture of other non-metallic mi	881	
27	Manufacture of basic metals	995	DJ Manufacture of basic metals and fabr	7,562	
28	Manufacture of fabricated metal products, except machinery and equipment	6,567			
29	Manufacture of machinery and equipment n.e.c.	3,625	DK Manufacture of machinery and equipme	3,625	
30	Manufacture of office machinery and computers	99	DL Manufacture of electrical and optica	5,291	
31	Manufacture of electrical machinery and apparatus n.e.c.	3,339			
32	Manufacture of radio, television and communication equipment and apparatus	753			
33	Manufacture of medical, precision and optical instruments, watches and clocks	1,100			
34	Manufacture of motor vehicles, trailers and semi-trailers	3,903	DM Manufacture of transport equipment	4367	
35	Manufacture of other transport equipment	464			
36	Manufacture of furniture; manufacturing n.e.c.	884	DN Manufacturing n.e.c.	992	
37	Recycling	108			
40	Electricity, gas, steam and hot water supply	1,242	E Electricity, gas and water supply	1,454	Ex-cluded
41	Collection, purification and distribution of water	212			
45	Construction	10,365	F Construction	10,365	Ex-cluded

Table 8: Aggregation of NACE categories (continued)

No.	Original category	Observations	New category	Observations	Note
50	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel	1,677			
51	Wholesale trade and commission trade, except of motor vehicles and motorcycles	3,102			
52	Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	14,292			
55	Hotels and restaurants	3,713			
60	Land transport; transport via pipelines	2,986			
61	Water transport	40			
62	Air transport	208			
63	Supporting and auxiliary transport activities; activities of travel agencies	1,990			
64	Post and telecommunications	2,141			
65	Financial intermediation, except insurance and pension funding	3,958			
66	Insurance and pension funding, except compulsory social security	1,629			
67	Activities auxiliary to financial intermediation	479			
70	Real estate activities	1,112			
71	Renting of machinery and equipment without operator and of personal and household goods	147			
72	Computer and related activities	2,049	G - U Total services	96,184	Excluded
73	Research and development	491			
74	Other business activities	7,999			
75	Public administration and defence; compulsory social security	11,850			
80	Education	10,171			
85	Health and social work	16,124			
90	Sewage and refuse disposal, sanitation and similar activities	625			
91	Activities of membership organizations n.e.c.	1,782			
92	Recreational, cultural and sporting activities	2,052			
93	Other service activities	1,274			
95	Activities of households as employers of domestic staff	595			
96	Undifferentiated goods producing activities of private households for own use	1,061			
97	Undifferentiated goods producing activities of private households for own use	898			
98	Undifferentiated services producing activities of private households for own use	1,519			
99	Extra-territorial organizations and bodies	66			
100	Undifferentiated manufacturing activities	154			

Table 9: Descriptive Statistics

Variable	Mean value / category	Std. Dev.	Min.	Max.	Data format
Individual Employment status	0.123	0.329	0	1	0 = Employed; 1 = Registered unemployed
Growth rates of industry labour force	-0.012	0.026	-0.101	0.167	Metrical values
Growth rates of real gross value added	0.006	0.087	-0.420	0.873	Metrical values
Share of R&D expenditures to real gross value added	0.095	0.098	0.003	0.367	Metrical values
Capital coefficient	2.585	0.757	1.373	9.082	Metrical values
Growth rates of real net exports	0.018	0.348	-0.940	0.969	Metrical values
Working experience in full-time employment	7.014	3.518	0	59	Scale in years: 1 = Less than one; 2 = 1-2; 3 =2-3; 4 = 3-4; 5 = 4-5; 6 = 5-8; 7 = 8-12; 8 = 12-15; 9 = 15-25; 10 = 25-40; 11 = More than 40.
Educational degree	3.193	1.278	1	6	1 = Inadequately completed school; 2 = General elementary; 3 = Middle vocational; 4 = Vocational + Abi; 5 = Higher vocational; 6 = Higher education
Health status	2.816	1.021	1	5	1 = Very good; 2 = Good; 3 = Satisfactory; 4 = Poor; 5 = Bad
Gender	0.537	0.499	0	1	0 = Male; 1 = Female
Regional origin	0.188	0.391	0	1	0 = West German household; 1 = East German household

Notes: Calculations are based on survey data from the SOEP and input-output tables from the Federal Statistical Office.