Lurweg, Maren; Oelgemöller, Jens; Westermeier, Andreas

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Sectoral Job Effects of Trade – An Input-Output Analysis for Germany

CAWM Discussion Paper No 19

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by

Maren Lurweg[1]

Jens Oelgemöller[2]

Andreas Westermeier

Abstract

The current globalisation process is characterized by the emergence of global value chains. That is, production processes are becoming increasingly geographically fragmented. Not only are final goods traded internationally, but in particular, trade in intermediate goods and services has increased significantly over time.

In the industrialised countries, the manufacturing sectors were the first that were compelled to face the challenges of globalisation. When services were still considered non-tradable, manufacturing firms had already decided to relocate their production sites to developing or emerging economies, due to lower wage levels abroad and increasing price competition domestically.

In this paper, we use input-output analysis to explore the relationship between trade and both job creation and job destruction in the German manufacturing industry in 2005. The results show that being integrated into the world economy is advantageous for the German economy. In 2005, the net exports of the manufacturing industries led to trade-induced job gains of around 2,400,000. This figure is equivalent to 6.2 per cent of total German employment. Furthermore, the job effects of trade were positive for a large majority of countries. The greatest job gains resulted from trade with the United States, the United Kingdom and France. Interestingly, even trade with the new EU Member States is beneficial in terms of job creation.

JEL-CLASSIFICATION: F14, F16, C67

KEYWORDS: input-output analysis, international trade, employment

1. Maren Lurweg, Centre for Applied Economic Research Münster, Am Stadtgraben 9, 48143 Münster, lurweg@insiwo.de.
2. Jens Oelgemöller, Centre for Applied Economic Research Münster, Am Stadtgraben 9, 48143 Münster, oelgemoller@insiwo.de.

Introduction

The current globalisation process is characterized by the emergence of global value chains. That is, production processes are becoming increasingly fragmented in geographical terms. Revolutionary advances in information and communication technology and decreasing transportation costs have led to the tradability of formerly untradeable goods and services. Thus, firms can exploit factor price disparities between countries without sacrificing the gains from specialisation. Not only are final goods traded internationally, but in particular, trade in intermediate goods and services has increased significantly over time.[1]

In the industrialised countries, the manufacturing sectors were the first that were compelled to face the challenges of globalisation. When services were still considered non-tradable, manufacturing firms had already decided to relocate their production sites to developing or emerging economies, due to lower wage levels abroad and increasing price competition domestically. This process had already started in Germany in the 1970s, when many jobs in the textile industry were relocated to Southeast Asia.[2] The fall of the "iron curtain" at the end of the 1980s further accelerated the increasing fragmentation of production. At present, manufactured goods are almost infinitely tradable.

The transnational and often world-wide relocation of jobs is often discussed under the designation "offshore outsourcing" or "offshoring".[3] Many people fear that, due to the increased competitiveness of low-wage countries, jobs in their home country are endangered. Concerns about workers losing jobs to international competition are widespread. Not only are blue-collar jobs relocated, but also white-collar jobs are increasingly at risk of being offshored. The number of German manufacturing firms engaging in offshoring has indeed increased over time. According to a study conducted by the Federal Statistical Office in 2008,[4] 36.4 per cent of those manufacturing firms, which engaged in offshoring activities until 2006, did so before 2001, 45.6 per cent from 2001 to 2003 and 68.6 per cent from 2004 to 2006. Core business activities are more likely to be offshored than auxiliary functions, but the differences are marginal. This finding emphasizes the notion that trade in tasks is of growing importance.[5]

According to a study of the Kiel Institute for the World Economy (2009), around 63 per cent of all jobs in the German manufacturing sector are potentially offshorable. This result is alarming, given that 22 per cent of the German work force are employed

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1 See Grossman and Rossi-Hansberg (2006) and Feenstra and Hanson (2003).

2 From 1970 to 2007, the number of employees in the German textile industry decreased from 379,000 to 88,000. See Kruber Meyer (2008).

3 These two terms refer to the purchase of goods and services that were previously produced inside the purchasing company, from foreign companies. Therefore, offshoring includes offshore/international outsourcing and captive offshoring/international insourcing. In the latter case, foreign affiliates of domestic parent companies export goods and services to their parent companies. The cross-border aspect is the distinguishing feature of offshoring. See Molnar, Pain and Taglioni (2007).

4 See Statistisches Bundesamt (2008).

5 See Grossman/Rossi-Hansberg (2006).

in the secondary sector. If firms decided to relocate these jobs, this would have a major impact on the domestic labour market.

In this paper, we use input-output analysis to explore the relationship between trade and both job creation and job destruction in the German manufacturing industry in 2005. The work is based on two premises. First, the offshoring of jobs is regarded as another form of import activity rather than as a completely new phenomenon. Second, not only the jobs lost to imports are measured, but also the jobs created through the production of exports.[6]

The manufacturing sectors are ranked according to their trade-induced employment effect.[7] We also show which sectors benefit most from trade relations of the manufacturing sectors, in terms of job creation. This ranking also includes service sectors, because, due to the net exports of the manufacturing sectors, jobs are created in the service sectors as well. This bipartite analysis (jobs created economy-wide through the production of net exports by a specific manufacturing sector *and* jobs created in a specific sector due to the net exports of all manufacturing industries) is also conducted for Germany's most important trade partners.

The results are then compared to the findings of a Revealed Comparative Advantage-Analysis (RCA)[8]. Do the sectors with the greatest trade-induced employment effect also possess a comparative cost advantage?

Sectoral Job Effects of Trade: A Literature Overview

A substantial body of both theoretical and empirical research has been undertaken on the relationship between trade and both aggregate and sectoral employment.[9]

Traditional trade theory suggests that, if resources are reallocated in accordance with the principles of comparative advantage, they can be used more effectively and create gains from trade for everyone involved. These comparative advantages can be due either to relative technology differences (as stated in Ricardian models) or different factor endowments (as stated in Heckscher-Ohlin models). The competitiveness of each sector, at the global level, is therefore determined by the existence of comparative advantages.

On the one hand, the reshuffling of production factors can lead to job losses, due to firm closures in comparatively disadvantaged sectors, which can be identified as im-

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6 In a previous paper by Lurweg and Westermeier (2009), a measure of the net effect of trade on Germany's employment was calculated for the period 1995 to 2006. We had two main findings. First, in an autarkic situation, 7.0 per cent of total German jobs would not have existed in 2006. Second, the manufacturing sector contributed most to this positive job effect. However, also in the service sector, many jobs were retained through trade.

7 One has to keep in mind that net exports from the manufacturing sectors not only lead to job creation in the secondary sector, but in the primary and tertiary sector as well. The production process in the manufacturing industries depends on intermediate inputs provided by the service sectors, such as by the sector "business services".

8 See Oelgemöller and Westermeier (2009).

9 See Jansen and Lee (2007) for an overview.

port-competing sectors. Displaced workers suffer phases of unemployment or inactivity. On the other hand, new companies are established in highly competitive sectors and existing firms invest in increased production and therefore augment labour demand. These are the exporting sectors. An increase in trade is therefore associated with both job destruction *and* job creation.

In neoclassical models, the level of economic activity and thus employment can fluctuate in the short run, but in the long run, the labour market will clear, in the absence of distortions. Workers who have been laid-off, automatically move into new jobs meaning that trade cannot lead to increased unemployment. The equilibrium wage is determined by the intersection of supply and demand. Therefore, trade can affect workers through a mere change (a decrease or an increase) in equilibrium wages. This restrictive assumption of full employment has often been criticized.[10]

The suitability of traditional trade models for predicting the job effects of trade is limited for two additional reasons.[11] First, traditional trade models do not consider the possibility of FDI. In contrast to trade with finished goods, FDI induces preceding capital flows to the destination country. Second, traditional trade models concentrate on trade with finished goods, whereas trade in intermediate goods and the offshoring of services gain in importance. One can assume that trade in intermediates may even have a greater impact on aggregate and sectoral employment than trade in final goods. This is due to the fact that labour demand in an open economy is affected not only in import-competing industries, but in all industries using foreign inputs to produce final goods.[12]

Theoretical research on the job effects of trade has developed over time. Some models treat labour as a homogeneous factor, others allow for different skill levels among workers. Feenstra and Hanson (1996) study an economy in which a single manufactured good is produced from a continuum of intermediate inputs, which are in turn produced by skilled workers, unskilled workers and capital. One country (the "South"), produces and exports a range of intermediate inputs up to a critical ratio of skilled to unskilled labour, while the other country, (the "North"), produces the remaining inputs. The inputs produced by the North are skilled-labour intensive, such as R&D and marketing, whereas unskilled-labour intensive activities are offshored to the South. Feenstra and Hanson show that any increase in the capital stock of the South relative to the North, or neutral technological progress in the South, will result in higher relative wages of skilled workers in both countries, due to a shift in more skilled-labour intensive production activities to the South.

Grossman and Rossi-Hansberg (2006) develop a theoretical model to consider how improvements in offshoring affect the wages of different types of labour. They identify a productivity effect, resulting from improvements in the technology for trading tasks. A decline in the cost of task trade directly augments the productivity of the factor whose tasks become easier to offshore. The authors conclude that all domestic par-

[10] See, for example, Hoekman and Winters (2005).
[11] See Schöller (2006).
[12] See Hijzen, Görg and Hine (2005).

ties can gain, due to improved opportunities for offshoring, if the ensuing adjustment in relative prices or its impact on factor prices is not excessive.

Different models predict different effects of trade on employment. Therefore, the effects of trade on employment need to be tested empirically. Empirical studies on the labour market effects of trade can be classified into two groups: trade in finished goods and trade in intermediate inputs. The latter comprises material offshoring and service offshoring.[13] Because our analysis focuses on trade in intermediate goods or material offshoring, studies on service offshoring are not cited.

Trade in finished goods

According to studies on the effect of international trade on aggregate employment, trade can lead to adjustment costs, because workers are forced to move between different sectors and occupations. Some studies conclude that net imports and aggregate employment in goods-producing industries in the importing economy are negatively correlated.[14] However, trade is not the only determinant of employment changes; the influence of technological change is considered to exert an even more significant impact on employment structures.

Hoekman and Winters (2005) point out that the effects of trade on wages and employment depend on labour market institutions, the efficiency of capital markets, social policies and the mobility of factors across sectors. Employment is expected to return to its long-run sustainable level, if relative factor prices and relative factor demands are able to adjust fully, and if labour markets are not segmented in the importing economy. Nevertheless, trade has an impact on the relative price of factors that are used intensively in import-competing sectors – their price will be lower than before. If the adjustment process is hampered by market restrictions, the adjustment of relative factor prices will be reduced, and factor demands will decrease in the long-run. This will result in increasing unemployment.

According to the OECD (2005), the different levels of market regulation in Europe and the United States can be regarded as one reason for the observed difference in labour market outcomes. Empirical evidence suggests that re-employment rates following displacement are considerably lower in Europe than in the United States. Yet, earnings changes between the old and the new job vary less widely in Europe than in the United States.

Trade in intermediate goods

According to findings from the OECD (2007), the share of imported intermediates in total output has increased in most OECD economies, although the degree of material offshoring varies significantly.[15] Between 1995 and 2000, material offshoring grew in

[13] See Lurweg and Westermeier (2009).

[14] See Baldwin (1995), Greenaway and Nelson (2001) and OECD (2005).

[15] The selected OECD economies are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Italy, Netherlands, Norway, Portugal, Spain, Sweden, the United Kingdom and the United States. Material offshoring is most pronounced in Belgium, with a share of total output of 15.6 per cent, and least pronounced in the United States, with a share of just 2.8 per cent.

13 out of 17 economies.[16] Even if the rate of increase of material offshoring seems to have slowed down during the second half of the 1990s and service offshoring has gained in importance, intermediate goods still account for most of the trade in intermediates.

There are many empirical studies dealing with the employment effects of trade in intermediate goods. Falk and Wolfmayr (2005) distinguish between materials imported from low-wage countries and those imported from high-wage countries into seven EU member States (Austria, Denmark, Finland, Germany, Italy, Netherlands and Sweden). The authors conclude that imported materials from low-wage countries exert a significant negative impact on total employment in the economies in question. This effect is most pronounced in manufacturing industries. Falk and Wolfmayr estimate that the increase in imported materials from low-wage countries has decreased employment by at least 0.26 percentage points per year over the period 1995-2000. Conversely, the share of imported inputs from high-wage countries has a positive impact on aggregate employment. Therefore, imports from high-wage countries and domestic employment seem to be complements rather than substitutes.[17]

Some studies have found evidence that the international sourcing of intermediate goods may affect the skill structure of labour demand in the home country. For instance, Hijzen, Görg and Hine (2005) investigate the link between international sourcing and the skill structure of labour demand in the United Kingdom.[18] The authors find that narrow outsourcing[19] has a negative effect on the demand for all types of labour. However, the impact of international sourcing on aggregate employment is stronger the lower the level of skills. Therefore, international sourcing can explain part of the changing skill structure in the United Kingdom. The other important reason for the trend towards the use of more skilled labour is technological change induced by research and development activities.

According to Geishecker (2004), international outsourcing is of very little importance for determining the relative demand for low-skilled workers in German manufacturing industries as a whole. In only four industries (electrical engineering, chemicals, office machinery/computers and paper and pulp) international outsourcing had a negative impact on the relative demand for low-skilled labour between 1978 and 1993. In these four industries, between 14 per cent and 47 per cent of the decrease in the low-skilled cost share could be explained by increased imports of intermediate inputs.

Marin (2004) finds evidence suggesting that German multinationals tend to offshore skill and R&D intensive activities to Eastern Europe. Almost 60 per cent of total investment in Eastern Europe is allocated to manufacturing industries. According to the

[16] Material offshoring decreased in Denmark, Greece, Norway and in the United Kingdom.

[17] In a later study, Falk and Wolfmayr concentrate on the employment effects of service outsourcing. But they find again a significant negative impact of imported materials from low-wage countries on manufacturing employment in Austria, Finland, Germany, Italy and the Netherlands. See Falk and Wolfmayr (2008).

[18] They estimate relative demand functions for skilled workers, based on a translog cost function.

[19] Only the imported intermediates in a given industry, from the same industry abroad, are taken into account.

author's econometric analysis, offshoring activities have helped to create jobs in Germany. Offshoring has enabled German firms to save 65 to 80 per cent of their labour costs, helping them to remain competitive in a highly competitive environment.

Methodology and Data

In order to determine the job effects of international trade flows of the German manufacturing sector, we apply an input-output approach.[20] Using input-output tables is advantageous for two main reasons. First, input-output tables offer insights into the globalization of value chains, through providing information on the value of intermediate goods and services that have been imported from companies external to the country of the sourcing company. Second, indirect effects that are associated with impacts on other sectors are accounted for.[21]

The Federal Statistical Office (Destatis) provides an input-output matrix for 71 sectors (8 primary sectors, 36 secondary sectors and 27 tertiary sectors).[22] Data on imports and exports, classified by trading partners and sectors, is also available from the Federal Statistical Office.[23] Since the data for imports and exports with Germany's trade partners is only available for 22 manufacturing sectors, some manufacturing sectors of the original input-output matrix had to be aggregated.[24]

The core element of our analysis is the following equation:

$$LC * (I - A)^{-1} * TM = German\ jobs\ embodied\ in\ net\ exports$$

(I-A)$^{-1}$ is the inverse Leontief matrix.[25] The values l_{ij} of this matrix, the so called inverse input coefficients, show how many units of intermediate production of sector i are needed to produce one unit of final demand for goods of sector j directly and indirectly. The production is therefore described as a function of final demand. The values in a column correspond to the direct and indirect requirements of a specific sector, in order to deliver an increase of one unit of output to final demand.[26]

LC is a diagonal matrix having the labour coefficients as diagonal entries. The labour coefficient for each sector illustrates how many jobs are needed to produce one unit

[20] See Groshen, Hobijn and McConnell (2005), De Backer and Yamano (2008) and Lurweg and Westermeier (2009). For further information on input-output tables see also Bleses (2007) and Kowalewski (2009)..

[21] See De Backer and Yamano (2008).

[22] The input-output matrix can be downloaded free of charge from www.destatis.de.

[23] Data source: "Imports and exports (special trade) by division of the national Product Classification for Production Statistics".

[24] For this occurrence, we also aggregated some service sectors. Our analysis therefore encompasses 59 sectors. For the specific sectors, see the appendix (manufacturing sectors: sequential numbers 9-30; CPA 15-36). The 59 sectors are in accordance with the 59 sectors at the two-digit level of the European System of Accounts (ESA) 95. At the two digit level, the "Classification of Products by Activity" (CPA) corresponds with the "General Industrial Classification of Economic Activities within the European Communities" (NACE).

[25] The inverse Leontief matrix is published each year by the Federal Statistical Office (Input-Output-Rechnung, Tabelle 2.3).

[26] To calculate the employment loss due to imports of goods and services, we used the input coefficients from the Input Coefficients Table (Domestic Production) and multiplied them by the imports.

of output. Therefore, the labour coefficient for a specific sector i is calculated as follows: $employment_i/output_i$. The input-output matrix provides data on employment (persons in employment) and output for each sector.[27] By multiplying the diagonal matrix *LC* by $(I\text{-}A)^{-1}$, the number of jobs which are directly and indirectly needed for the production of one unit of final demand is calculated for each sector. The multiplication yields a *59 x 59* matrix (see Figure 1).

Figure 1 Matrix connotation I

$$\begin{bmatrix} a_{1,1} & a_{1,2} & \cdots & a_{1,59} \\ a_{2,1} & \ddots & & \vdots \\ \vdots & & \ddots & \vdots \\ a_{59,1} & \cdots & & a_{59,59} \end{bmatrix}$$

For example, the entry $a_{2,1}$ represents the number of jobs which are necessary in Sector 2 as an intermediate input for Sector 1, if the latter produces one unit of output for final demand. Therefore, the sum of Column 1 stands for the number of jobs that are directly and indirectly required in all sectors of the economy, if Sector 1 produces one unit of output for final demand. The sum of Row 1 represents the number of jobs that are created in Sector 1, if all sectors of the economy produce one unit of output for final demand.

Finally, the matrix $LC * (I\text{-}A)^{-1}$ is multiplied by *TM* (trade matrix). *TM* is a diagonal matrix having, as entries, for example, the net exports of each sector.[28] By multiplying $LC^* (I\text{-}A)^{-1}$ by *TM*, we obtain a measure of the number of jobs needed to produce net exports (see Figure 2).

Figure 2 Matrix connotation II[29]

$$\begin{bmatrix} a_{1,1}*NE_1 & a_{1,2}*NE_2 & \cdots & a_{1,59}*NE_{59} \\ a_{2,1}*NE_1 & \ddots & & \vdots \\ \vdots & & \ddots & \vdots \\ a_{59,1}*NE_1 & \cdots & & a_{595,9}*NE_{59} \end{bmatrix}$$

[27] We calculated the output of each sector by subtracting the final uses of imported products (Input-Output-Rechnung, Tabelle 1.2) from the total uses of products (Input-Output-Rechnung, Tabelle 1.1).

[28] We also calculate the job effects of gross imports (that are negative) and the job effects of gross exports (that are positive) for each sector, but our analysis focuses on the net effect of trade on sector employment.

[29] The matrix containing the real values is shown in the appendix (Table A.1).

The sum of Row 1[30] represents the number of jobs created in Sector 1 through the net exports of all sectors. The sum of Column 1[31] represents the number of jobs created in all sectors of the economy, due to the net exports of Sector 1.[32]

The analysis is limited by the assumptions that underlie the input-output tables:[33]

- We assume constant-factor input shares, in order to calculate the input requirements for each industry. Therefore, there are no increasing economies of scale.
- The data does not account for qualitative differences between traded and non-traded goods.
- It is assumed implicitly that the technologies for import and export goods and services are identical. This is due to the fact that the manufacturing technologies of the country are assumed to be constant, when calculating the jobs embodied in imports and exports.
- Furthermore, imports and domestic production are assumed to be perfectly interchangeable, without any costs.
- Dynamic gains of trade, defined as trade-related changes in the long-run rate of productivity growth, are not taken into account. Four possible channels through which trade can have a positive impact on productivity levels can be identified: more efficient resource allocation, a greater division of labour, greater returns on investment and technology spillovers.[34]

Due to these rather restrictive assumptions, the results must be interpreted with caution.

Results

In order to analyze the job effects in the German manufacturing sector that are due to the production of net exports, and to identify interdependencies between the sectors, we assume an export-increase of one billion Euros in each manufacturing sector. This increase can be interpreted as an exogenous demand-shock. The manufacturing sectors are then ranked according to their export-induced employment effect. In the next step, we determine how many of the created jobs remain in the same sector.

Table 1 shows the ten sectors with the highest economy-wide job effects. If the export-induced production of Sector 15 (food products and beverages) increases by one billion Euros, 18,020 jobs will be created in Germany. Only 43.37 per cent of

[30] The sum of Row 1 is calculated as follows: $\sum_{i=1}^{59} a_{1,i} * NE_i$

[31] The sum of Column 1 is calculated as follows: $\sum_{i=1}^{59} a_{i,1} * NE_1$

[32] Note that the sectors are numbered sequentially from 1 to 59. For the corresponding CPA (Classification of Products by Activity) number, see the appendix. In the following analysis – if not otherwise specified – the sectors are numbered on basis of the CPA.

[33] See De Backer and Yamano (2008).

[34] See Nordås, Miroudot and Kowalski (2006).

these new jobs remain in Sector 15. Production in other sectors is far less job-intensive. In Sector 23 (coke, refined petroleum products and nuclear fuel) only 1,939 jobs will be created if production increases by one billion Euros, and in Sector 30 (office machinery and computers), about 7,380 jobs. This may indicate a high degree of mechanization and a low intensity of labour.

Table 1 Production-induced employment effects

Employment effects induced by an increase in production of one billion Euros							
Pos.	Sector	Job effects	% of jobs created within sector	Pos.	Sector	Job effects	% of jobs created within sector
1	Food products and beverages	18,020	43,37	6	Textiles	13,400	69,16
2	Publishing and printing products	16,403	64,39	7	Leather and luggage	13,107	63,39
3	Wood products	15,809	60,59	8	Medical, precision and optical instruments	12,883	65,18
4	Furniture and products n.e.c.	14,602	58,65	9	Rubber and plastic products	11,843	63,01
5	Fabricated metal products	13,925	70,93	10	Machinery and equipment	11,709	54,66

Source: own calculations, Data: Federal Statistical Office.

In Table 2, the sectors are ranked according to the share of jobs created within the same sector. In Sector 28 (fabricated metal products, excluding machinery and equipment) and Sector 17 (textiles), around 70 per cent of jobs remain in the sector. Therefore, production in these sectors does not depend highly on intermediate inputs provided by other sectors. The other extreme is Sector 23 (coke, refined petroleum products and nuclear fuel): the share is less than 20 per cent. However, the share of Sector 16 (tobacco products) is already around 10 percentage points higher (27.80 per cent).

Table 2 Production-induced employment effects within the sectors

Employment effects induced by an increase in production of one billion Euros within sectors					
highest shares			lowest shares		
Sector	job effects	% of jobs created within sector	Sector	job effects	% of jobs created within sector
Fabricated metal products	13,925	70,93	Office machinery and computers	7,380	40,41
Textiles	13,392	69,21	Motor vehicles, trailers and semi-trailers	9,495	38,84
Medical, precision and optical instruments	12,871	65,24	Chemicals and chemical products	8,207	35,85
Publishing and printing products	16,403	64,39	Tobacco products	9,598	27,80
Leather and luggage	13,095	63,45	Coke, refined petroleum products and nuclear fuel	1,965	18,08

Source: own calculations, Data: Federal Statistical Office.

We then calculated the employment effects that arise in a specific sector, due a simultaneous increase in production of one billion Euros in each manufacturing sector. Table 3 shows which sectors benefit most, in terms of job creation, from the output of the various manufacturing sectors. This ranking also includes primary and service sectors because, due to interdependencies, jobs are created there too.

Not surprisingly, Sector 74 (other business services) benefits most from increased production by the manufacturing industries (39,281 jobs are created in this sector). In a highly competitive environment, many firms focus on core business activities and therefore decide to outsource auxiliary functions. Service activities (e.g. services provided by the sectors “other business activities” and “wholesale trade and vehicles”) can be considered as auxiliary functions of manufacturing firms. These two sectors are the only service sectors among the first ten with the highest job effects. The second highest job effect occurs in Sector 28 (fabricated metal products) with 14,579 jobs created when each manufacturing sector increases production.

Table 3 Sectoral employment effects

Sectoral employment effects induced by a simultaneous increase in production of one billion Euros in each manufacturing sector

Position	Sector	Job effects	Position	Sector	Job effects
1	Other business services	39,281	6	Textiles	10,529
2	Fabricated metal products	14,579	7	Rubber and plastic products	9,286
3	Wholesale trade and vehicles	14,128	8	Furniture and products n.e.c.	8,692
4	Publishing and printing products	12,345	9	Other non-metallic products	8,660
5	Wood products	10,676	10	Medical, precision and optical instruments	8,614

Source: own calculations, Data: Federal Statistical Office.

In order to determine the job effects of the international trade of German manufacturing industries, we now calculate how many German workers, at current wages, prices, and productivity levels, would be needed to produce the goods imported by Germany. This provides a measure of "employment loss" due to international trade, under the assumption that all imported goods would be produced domestically. We then calculate the "employment gain" due to international trade, by computing the number of manufacturing jobs needed to produce the exports. By subtracting the first figure from the second, a net measure of the employment effect of trade relations is obtained. In the following analysis, we concentrate on the employment effects of net exports.

Our analysis is bipartite: the number of jobs created economy-wide, through the production of net exports by a specific manufacturing sector, is shown in Table 4. The number of jobs created in a specific sector, due to the net exports of all manufacturing industries, is given in Table 5.

The job effects of net exports are by far the greatest in Sector 34 (motor vehicles, trailers and semi-trailers) and in Sector 29 (machinery and equipment). These two sectors are responsible for around two thirds of the total number of jobs created by the net exports of all manufacturing industries. Sector 24 (chemicals and chemical products) follows in third place with 258,662 trade-induced job gains.

However, there are also sectors which have negative trade-induced employment effects. "Wearing apparel", "office machinery and computers", "leather and leather products", "furniture, other manufactured goods" and "radio, television and telecommunication equipment" account for a loss of 90,000 German jobs. This means that the number of jobs created through the production of exports is overcompensated by the number of jobs that are destroyed due to imports. The manufactured goods from these sectors are, in general, not particularly skill-intensive and can, therefore, be produced cheaper abroad.

In total, the input-output-analysis indicates that more than 2.4 million jobs depend on the production of net exports. On the one hand, this result is evidence of the high in-

ternational competitiveness of the German manufacturing sector and confirms the hypothesis that being integrated into the world economy is advantageous for the domestic economy. On the other hand, the sharp decrease in trade volumes in the current economic crisis is hitting the German economy extremely hard; a distinct increase in unemployment will be the consequence.

Table 4 Trade-induced employment effects I

Jobs created economy-wide through the production of net exports **by** a specific manufacturing sector

Jobs destroyed through gross imports		Jobs created through the production of gross exports		Jobs created through the production of net exports	
Sector	job effects	Sector	job effects	Sector	job effects
Motor vehicles, trailers and semi-trailers	-629,624	Motor vehicles, trailers and semi-trailers	1,463,334	Motor vehicles, trailers and semi-trailers	833,710
Chemicals and chemical products	-601,534	Machinery and equipment	1,334,733	Machinery and equipment	806,045
Food products and beverages	-549,469	Chemicals and chemical products	860,195	Chemicals and chemical products	258,662
Machinery and equipment	-528,688	Food products and beverages	532,999	Medical, precision and optical instruments	203,465
Radio, television and communication equipment	-359,837	Electrical machinery and apparatus	463,965	Fabricated metal products	152,175
Total	-5,464,310	Total	7,892,684	Total	2,428,374

Source: own calculations, Data: Federal Statistical Office.

Table 5 presents the number of jobs created in a specific sector due to the net exports of all manufacturing industries. Sector 29 (machinery and equipment) gains most from the net exports of the manufacturing industries; almost half a million jobs are created in this sector. As Table 3 reveals, Sector 74 (other business services) is the non-manufacturing sector which benefits the most from manufacturing export. Around 405,000 jobs are necessary to produce intermediate inputs for the net exports of the manufacturing industries.

Eleven sectors face a job decrease due to net exports of the manufacturing sectors, yielding a total job destruction of 142,007 jobs. The sectors “wearing apparel”, “leather and leather products” and “office machinery and computers” suffer the greatest trade-induced job destruction. They lose the most from structural changes induced by globalization. Production sites are relocated to areas where production costs are cheaper than in Germany, especially to developing and emerging economies.

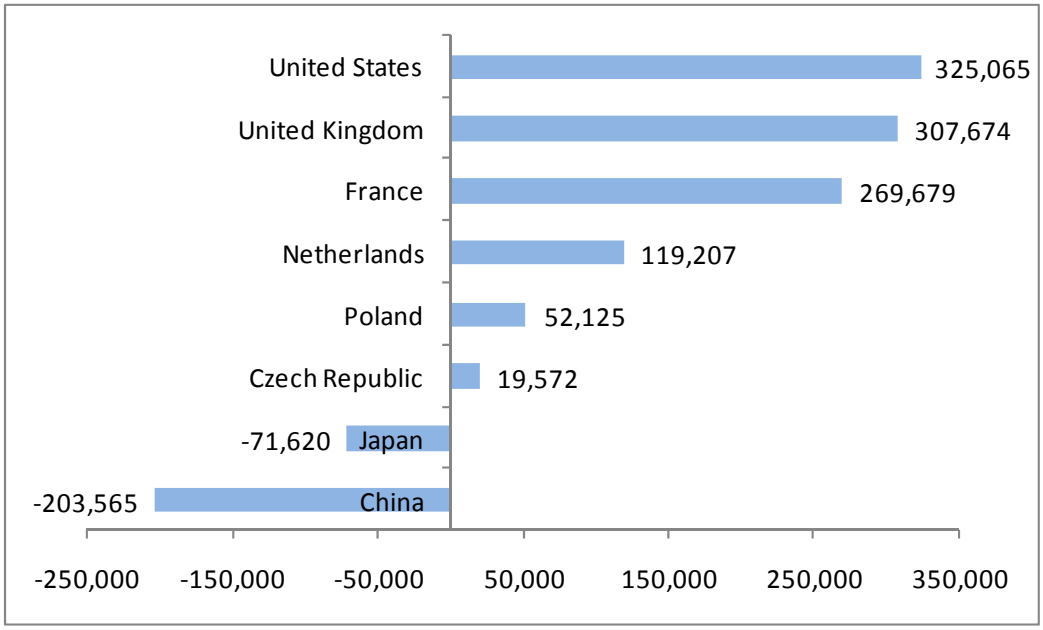
Table 5 Trade-induced employment effects II

Jobs created **in** a specific sector due to the net exports of all manufacturing industries					
Jobs destroyed through gross imports		Jobs created through the production of gross exports		Jobs created through the production of net exports	
Sector	job effects	Sector	job effects	Sector	job effects
Other business services	-882,493	Other business services	1,287,774	Machinery and equipment	461,442
Machinery and equipment	-330,372	Machinery and equipment	791,814	Other business services	405,281
Fabricated metal products	-302,596	Motor vehicles, trailers and semi-trailers	573,098	Motor vehicles, trailers and semi-trailers	325,449
Wholesale trade and vehicles	-281,660	Fabricated metal products	531,165	Fabricated metal products	228,569
Chemicals and chemical products	-250,384	Wholesale trade and vehicles	376,823	Medical, precision and optical instruments	134,764
Total	-5,464,310	Total	7,892,684	Total	2,428,374

Source: own calculations, Data: Federal Statistical Office.

As international integration has increased significantly over the last few decades, the intensity of trade relations has risen. Figure 3 shows how many jobs were gained or lost in Germany in 2005, due to trade relations with different countries. We chose France, the United States, the United Kingdom and the Netherlands, because they are the four most important target countries for German exports. The Czech Republic and Poland were chosen, because they belong to the “new” EU member states. Many people fear that, due to the enlargement of the European Union, the German labour market would face a job loss. After all, wages are significantly lower in Eastern Europe than in Western Europe, and German firms could tend to offshore their production sites to these regions. China has become an important trade partner for Germany, and it is assumed that Chinas influence on the world economy will increase further. Japan is the second biggest economy in terms of nominal GDP and can be considered a competitor in the field of capital- and skill-intensive goods.

Figure 3 Job effects of trade relations with selected countries



Source: own calculations, Data: Federal Statistical Office.

The job effects of trade are positive for a large majority of countries. The greatest job gains result from trade relations to the United States (325,065 jobs created through the production of net exports), the United Kingdom (307,674 jobs) and France (269,679 jobs). Interestingly, even trade relations with the new EU Member States are beneficial in terms of job creation. This shows that the process of EU enlargement, the subject of substantial controversy in Germany, is indeed beneficial for the domestic economy. However, job losses due to trade relations can be found for Japan (-71,620 jobs) and China (-203,565 jobs). The negative job effects of trade for Germany with China are remarkable.

Interestingly, the job effects of the sectors “office machinery and computers” and “radio, television and communication equipment” are negative for Germany’s net exports with China and Japan. This negative effect is not surprising for Japan, because the country has been a leading producer of electronic devices for many years. The sectors “machinery and equipment” (52,944 jobs) and “motor vehicles, trailers and semi-trailers” (20,266 jobs) have the highest positive job effect of manufacturing trade with China. Due to the high capital- and skill-intensity of these goods, the German manufacturing industries are able to remain competitive. For Japan, the positive job effects of the sectors “chemicals and chemical products” (6,578 jobs) and “food products and beverages” (3,253 jobs) are rather marginal.

The positive job effect of trade with Poland is achieved mainly by the sectors “machinery and equipment” and “chemicals and chemical products”. The greatest trade-induced job loss occur due to trade by the sector “furniture, other manufactured goods”. This finding indicates that labour-intensive production is increasingly being relocated to countries with relatively low labour costs, while the production of those goods that depend on human capital and high technology, remain in industrialized countries like Germany.

Comparison with the sectors with comparative cost advantages for Germany

Our final step is to compare the sectors which Oelgemöller and Westermeier (2009)[35] identified as those in which Germany has comparative cost advantages, with those sectors yielding the greatest job effects. They took the Balassa-indicator[36]

$$\mathrm{RCA}_i\,1 = \left[\frac{X_i - M_i}{X_i + M_i}\right],$$

the value of which ranges from -1 to +1. Here, a value above zero indicates comparative cost advantages. The second indicator they chose is another RCA-index constructed by Bela Balassa:[37]

$$RCA_i\,2 = \left[\frac{X_{ij} \Big/ \sum_i X_{ij}}{\sum_j X_{ij} \Big/ \sum_i \sum_j X_{ij}}\right],$$

This indicator ranges from zero to infinity, with values above one indicating comparative cost advantages. Following the trade theory of David Ricardo, a country should concentrate its production on those sectors with comparative advantages. As the theory suggests and as Oelgemöller and Westermeier demonstrated,[38] Germany's advantageous sectors are capital-intensive manufacturing, related to human and financial capital. While a RCA 1-index indicates a high positive job effect, the RCA 2-index does not. It might be possible having a high RCA 2-value while having negative net exports for a specific sector and therefore a negative job effect.[39]

As we established, those sectors with the greatest job-creating effects yield comparative cost advantages (see Table 6). Some problems occur in the analysis of Sector 24. Here, the Unctad differentiates between chemical (24a) and pharmaceutical (24b) production, while Destatis does not. Nonetheless, this trade sector remains one of the important in Germany, although its RCA-2 indicator does not suggest that this is the case. All in all, the present investigation shows that Germany has a sound trade performance and structure, but it is important to invest substantially in human capital and research and development, in order to raise innovative capacity. This is neces-

[35] Oelgemöller and Westermeier used trade data from the Unido, while this examination is based on data from the Destatis. The sector-aggregation is not perfectly congruent, but the results are nonetheless comparable. The RCA-analysis is done for Western Europe. A high RCA-value indicates revealed comparative advantages compared to Western Europe trade.

[36] See Balassa (1986).

[37] See Balassa (1965, 1979).

[38] The results are consistent with the analysis of the DIW (2006).

[39] The RCA 2-index does not consider imports. Therefore, it is possible for a country to have a sector with a high RCA 2-value, even though this country imports more goods from this sector than it exports. The RCA 2-index ranges between 0 and ∞. An RCA 2-value between 0 and 1 indicates that this sector contributes a smaller share to the country exports, than the aggregate level for all sectors. An RCA 2-value from 1 to ∞ indicates that exports from this sector are dominant for the country, while the exports are less important at the aggregate level.

sary, in order to deal effectively with growing international competition, particularly from the new global players of India and China.

Table 6 RCA-values

Sector	Jobs created by sector	Jobs created within sector	RCA 1	RCA 2
Motor vehicles, trailers and semi-trailers	833,710	325,449	**0,33 > 0**	**1,27 > 1**
Machinery and equipment	806,045	461,442	**0,36 > 0**	**1,27 > 1**
Chemicals and chemical products	258,662	104,576	Chemical production: **0,18 > 0**	Chemical production: **1,09 > 1**
			Pharmaceutical production: **0,17 > 0**	Pharmaceutical production: **0,88 < 1**
Medical, precision and optical instruments	203,465	134,764	**0,24 > 0**	**1,11 > 1**
Fabricated metal products	152,175	228,569	**0,27 > 0**	**1,06 > 1**

Source: own calculations, Data: Federal Statistical Office, Unido.

Concluding Remarks

In this paper, we use input-output analysis to explore the relationship between trade and both job creation and job destruction in the German manufacturing industry in 2005. Our analysis is bipartite, entailing a calculation of the number of jobs created economy-wide through the production of net exports by a specific manufacturing sector, and the number of jobs created in a specific sector, due to the net exports of all manufacturing industries.

The results show that being integrated in the world economy is advantageous for the German economy. In 2005, the net exports of the manufacturing industries led to trade-induced job gains of around 2,400,000. This figure is equivalent to 6.2 per cent of total German employment. The positive job effects of trade were achieved mainly by net exports from the sectors “motor vehicles, trailers and semi-trailers” (833,710 jobs) and “machinery and equipment” (806,045 jobs). The sectors “machinery and equipment” and “other business services” benefited most from the net exports of the manufacturing industries: 461,442 jobs and 405,281 jobs respectively were necessary to produce intermediate inputs for the production of net exports of the manufacturing industries. We then show that those sectors with the greatest job-creating effects yield comparative cost advantages.

The job effects of trade are positive for a large majority of countries. The greatest job gains result from trade with the United States, the United Kingdom and France. Interestingly, even trade relations with the new EU Member States are beneficial in terms

of job creation. This demonstrates that the process of EU enlargement, the subject of substantial controversy in Germany, is indeed beneficial for the domestic economy.

However, the fact that more than two thirds of the jobs created through the production of net exports by all manufacturing industries depend on the two sectors “motor vehicles, trailers and semi-trailers” and “machinery and equipment”, shows that the German economy is extremely vulnerable to business fluctuations in these two sectors. The worldwide crisis of the automobile sector and the worldwide decline in industrial production might, therefore, lead to a dramatic reduction in GDP and an increasing rate of unemployment in Germany. Concentration might be advantageous in a constantly growing world economy, but it can become problematic in times of crisis. A stronger diversification of the production structure could, therefore, help to smooth out economic cycles.

References

Balassa, B. (1965): Trade liberalisation and “revealed” comparative advantages. The Manchester School of Economic and Social Studies, Vol. 33, pp. 99-123.

Balassa, B. (1979): The Changing Pattern of Comparative Advantage in Manufactured Goods. Review of Economics and Statistics, Vol. 61(2), pp. 259-266.

Balassa, B. (1986): Comparative Advantage in Manufactured Goods: A reprisal. Review of Economics and Statistics, Vol. 68(2), pp. 315-319.

Baldwin, R. E. (1995): The Effect of Trade and Foreign Direct Investment on Employment and Relative Wages. OECD Economic Studies, No. 23, pp. 7-54.

Bleses, P. (2007): Input-Output-Rechnung. Wirtschaft und Statistik 1/2007, pp. 86-96.

De Backer, K. and Yamano, N. (2007): The Measurement of Globalisation using International Imput-Outpout Tables. OECD Science, technology and Industry Working Papers, 2007/8.

DIW (2006): Exportnation Deutschland – Zukunftsfähigkeit sichern. DIW-Wochenbericht No. 41/2006, pp. 545-551.

Eurostat (2008): Eurostat Manual of Supply, Use and Input-Output Tables. eurostat Methodology and Working papers.

Falk, M. and Wolfmayr, Y. (2005): Employment Effects of Outsourcing to Low Wage Countries: Empirical Evidence for EU Countries. WIFO Working Papers No. 262.

Falk, M. and Wolfmayr, Y. (2008): Services and materials outsourcing to low-wage countries and employment: Empirical evidence from EU countries. Structural Change and Economic Dynamics, Vol. 19, pp. 38-52.

Feenstra, R. C. and Hanson, G. H. (1996): Globalisation, Outsourcing and Wage Inequality. American Economic Review, Vol. 86(2), pp. 240-245.

Feenstra, R. C. and Hanson, G. H. (2003): Global Production Sharing and Rising Inequality: A Survey of Trade and Wages. In: Choi, E. K. and Harrigan, J. (eds.): Handbook of International Trade. Oxford: Basil-Blackwell.

Geishecker, I. (2004): Outsourcing and the Demand for Low-skilled Labour: Exemplary Evidence from German Manufacturing Industries. In: Meulders, D., Plasman, R. and Rycx, F. (eds.): Minimum Wages, Low Pay and Unemployment. Palgrave Macmillan: Basingstoke/New York.

Greenaway, D. and Nelson, D. (2001): Globalisation and Labour Markets: Literature Review and Synthesis. The University of Nottingham Globalisation and Labour Markets Programme Research Paper Series No. 2001/29.

Groshen, E. L., Hobijn, B. and McConnell, M. M. (2005): U.S. Jobs Gained and Lost through Trade: A Net Measure. Current Issues in Economics and Finance Vol. 11, No. 8, August 2005, Federal Reserve Bank of New York.

Grossman, G. M. and Rossi-Hansberg, E. (2006): Trading Tasks: A Simple Theory of Offshoring. NBER Working Paper Series No. 12721.

Hijzen, A., Görg, H. and Hine, R. C. (2005): International Outsourcing and the Skill Structure of Labour Demand in the United Kingdom. Economic Journal, Vol. 115, No. 506, pp. 860-878.

Hoekman, B. and Winters, A. (2005): Trade and Employment: Stylized Facts and Research Findings. Policy Research Working Paper 3676, Washington, DC: World Bank.

Jansen, M. and Lee, E. (2007): Trade and Employment: Challenges for Policy Research. A joint study of the International Labour Office and the Secretariat of the World Trade Organization.

Kowalewski, J. (2009): Methodology of the Input-Output Analysis. HWWI Research Paper 1-25.

Kruber-Meyer (2008): Theoretische Grundlagen des internationalen Handels. Informationen zur politischen Bildung, Heft 299.

Lurweg, M. and Westermeier, A. (2009): Jobs Gained and Lost through Trade: The Case of Germany. CAWM Discussion Paper No. 18.

Marin, D. (2004): 'A Nation of Poets and Thinkers' – Less So with Eastern Enlargement? Austria and Germany. Discussion Paper 2004-06, Department of Economics, University of Munich.

Molnar, M., Pain, N. and Taglioni, D. (2007): The Internationalisation of Production, International Outsourcing and Employment in the OECD. OECD Economics Department Working Papers No. 561.

Nordås, H. K., Miroudot, S. and Kowalski, P. (2006): Dynamic Gains from Trade. OECD Trade Policy Working Papers, No. 43.

OECD (2005): Trade-adjustment Costs in OECD Labour Markets: A Mountain or a Molehill? OECD Employment Outlook 2005, Chapter 1.

OECD (2007): OECD Workers in the Global Economy: Increasingly Vulnerable? OECD Employment Outlook 2007, Chapter 3.

Oelgemöller, J. and Westermeier, A. (2009): RCAs within Western Europa. cege Discussion Paper No. 79.

Schöller, D. (2006): Service Offshoring: A Challenge for Employment? Evidence for Germany. Schriftenreihe des Promotionsschwerpunkts Globalisierung und Beschäftigung Nr. 23/2006, Universität Hohenheim.

Statistisches Bundesamt (2008): Verlagerung wirtschaftlicher Aktivitäten – Ergebnisse der Piloterhebung. Wiesbaden.

Appendix

Table A.1 Job Effect Matrix of Net Exports (Part I)[40]

Sector	1	…	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	…	59	Row Sum
1	0	…	0	-3,557	10	-28	-39	-19	38	32	18	-4	982	59	14	10	30	174	-24	36	-8	36	284	-1	-9	0	…	0	-1,965
2	0	…	0	-8	26	-4	-26	-30	1,082	612	23	-1	164	30	20	5	36	228	-18	28	-8	45	292	-4	-106	0	…	0	2,387
3	0	…	0	-5	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	…	0	-4
4	0	…	0	-23	29	-41	-127	-55	28	183	41	-159	745	231	213	119	238	750	-47	165	-22	142	1,163	-4	-25	0	…	0	3,546
5	0	…	0	-1	1	-2	-4	-2	1	11	2	-11	89	13	12	8	13	39	-1	8	-1	7	62	0	-1	0	…	0	245
6	0	…	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	…	0	0
7	0	…	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	…	0	0
8	0	…	0	-11	2	-13	-22	-19	15	24	6	-2	2,526	114	1,022	27	51	173	-12	46	-9	77	325	-1	-9	0	…	0	4,311
9	0	…	0	-7,142	8	-7	-15	-23	7	13	14	-2	1,702	72	10	9	19	108	-19	19	-6	25	178	-1	-4	0	…	0	-5,037
10	0	…	0	0	5,005	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	…	0	5,005
11	0	…	0	-2	6	-10,306	-8,273	-168	1	8	4	-1	171	184	2	3	28	266	-17	77	-26	142	1,815	-9	-151	0	…	0	-16,247
12	0	…	0	0	0	0	-51,629	0	0	0	1	0	3	0	0	1	5	7	0	1	0	1	10	0	-2	0	…	0	-51,602
13	0	…	0	0	0	0	-2	-26,221	0	0	0	0	5	1	4	1	8	33	0	4	0	24	239	0	-121	0	…	0	-26,025
14	0	…	0	-16	77	-13	-106	-112	10,633	226	24	-5	687	147	94	38	261	1,719	-136	146	-47	217	2,398	-40	-1,006	0	…	0	15,184
15	0	…	0	-88	582	-76	-466	-590	31	18,631	649	-6	2,351	440	129	34	266	1,579	-128	400	-99	697	1,358	-5	-116	0	…	0	25,572
16	0	…	0	-66	223	-103	-1,183	-302	84	507	32,022	-59	2,010	635	205	149	561	4,437	-661	857	-243	1,125	5,958	-21	-228	0	…	0	45,908
17	0	…	0	-3	3	-2	-12	-6	4	8	5	-1,221	212	98	12	17	21	109	-12	20	-3	20	177	-1	-4	0	…	0	-560
18	0	…	0	-48	36	-276	-455	-567	294	475	126	-16	92,740	3,450	312	376	533	2,443	-298	435	-153	453	4,868	-14	-136	0	…	0	104,576
19	0	…	0	-81	75	-59	-403	-116	61	376	56	-21	2,192	76,419	140	51	645	11,310	-265	1,204	-307	2,454	26,940	-24	-418	0	…	0	120,228
20	0	…	0	-55	12	-122	-162	-64	164	58	23	-10	1,350	451	24,985	203	569	1,812	-54	583	-89	1,386	3,598	-8	-78	0	…	0	34,554
21	0	…	0	-9	9	-6	-47	-13	11	34	11	-11	413	176	51	9,799	4,108	12,086	-116	2,038	-136	751	14,978	-70	-49	0	…	0	44,009
22	0	…	0	-93	35	-47	-460	-109	130	180	74	-158	3,839	1,086	281	338	107,945	51,341	-1,244	4,895	-546	5,578	56,358	-300	-553	0	…	0	228,569
23	0	…	0	-67	69	-72	-363	-158	58	240	90	-56	3,039	1,123	465	275	1,743	441,009	-88	596	-49	1,609	12,209	-56	-173	0	…	0	461,442
24	0	…	0	-2	4	-2	-13	-3	4	8	8	-3	113	35	11	9	33	251	-23,344	126	-18	201	217	-1	-4	0	…	0	-22,369
25	0	…	0	-18	20	-27	-130	-46	21	98	39	-22	811	214	98	145	426	16,266	-368	86,541	-150	1,441	20,271	-39	-38	0	…	0	125,552
26	0	…	0	-2	4	-2	-15	-5	2	8	23	-3	78	25	8	5	28	448	-845	509	-12,010	682	1,564	-9	-3	0	…	0	-9,510
27	0	…	0	-6	3	-4	-13	-8	4	32	5	-13	545	139	18	34	165	517	-32	233	-12	132,734	444	-13	-8	0	…	0	134,764
28	0	…	0	-6	3	-2	-12	-6	7	20	5	-8	145	26	69	36	33	1,053	-13	60	-20	270	323,797	-1	-5	0	…	0	325,449
29	0	…	0	-2	9	-3	-15	-5	3	10	9	-4	89	28	10	6	26	226	-80	24	-16	74	228	-1,517	-4	0	…	0	-905
30	0	…	0	0	0	0	-173	0	2	2	1	-1	11	5	3	2	11	41	-7	5	-2	9	7,988	-1	-15,681	0	…	0	-7,785
:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:

[40] Note that the sectors are numbered sequentially. For the corresponding sector number based on CPA, see the sector classification (Table A.2).

Table A.1 Job Effect Matrix of Net Exports (Part II)

Sector	1	…	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	…	59	Row Sum
:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
31	0	…	0	-5	17	-14	-29	-22	5	489	19	-1	334	397	122	357	170	577	-12	97	-10	68	785	-3	-9	0	…	0	3,333
32	0	…	0	-69	75	-135	-442	-190	96	540	142	-72	2,197	781	458	328	811	2,535	-164	564	-77	480	3,956	-14	-87	0	…	0	11,713
33	0	…	0	-24	17	-17	-76	-32	8	110	24	-9	575	110	75	50	156	625	-25	104	-26	102	791	-2	-14	0	…	0	2,524
34	0	…	0	-104	152	-107	-677	-257	120	335	349	-107	2,904	786	375	367	893	4,910	-507	1,028	-197	959	7,517	-19	-149	0	…	0	18,571
35	0	…	0	-125	97	-56	-486	-183	167	312	219	-89	1,891	557	474	200	750	4,416	-555	654	-148	753	31,809	-29	-152	0	…	0	40,476
36	0	…	0	-801	649	-649	-8,034	-3,811	1,077	1,854	1,000	-123	14,682	3,299	2,408	1,639	7,028	38,968	-4,869	6,767	-1,130	7,706	29,342	-153	-1,686	0	…	0	95,163
37	0	…	0	-203	168	-175	-4,902	-2,018	248	595	347	-36	3,150	751	293	108	974	5,440	-265	1,290	-204	2,645	7,217	-59	-361	0	…	0	15,001
38	0	…	0	-10	36	-12	-65	-56	15	43	225	-14	509	113	38	25	126	911	-263	126	-61	270	1,047	-4	-22	0	…	0	2,977
39	0	…	0	-354	376	-191	-1,529	-696	368	1,466	735	-1,241	8,043	2,605	2,090	1,416	2,281	15,410	-1,307	1,931	-426	3,127	27,287	-45	-786	0	…	0	60,559
40	0	…	0	-1	1	-1	-8	-3	1	4	1	-4	91	8	8	10	12	57	-6	8	-1	7	96	0	-1	0	…	0	276
41	0	…	0	-7	43	-14	-64	-18	13	40	42	-13	383	115	34	19	104	1,134	-449	103	-87	390	997	-5	-16	0	…	0	2,743
42	0	…	0	-330	138	-139	-1,201	-521	218	390	233	-147	3,855	1,334	742	419	1,311	12,723	-1,868	1,301	-329	1,654	18,054	-31	-377	0	…	0	37,430
43	0	…	0	-65	112	-76	-540	-173	89	274	702	-110	2,586	872	279	141	952	6,547	-941	1,425	-248	1,394	6,550	-23	-119	0	…	0	19,628
44	0	…	0	-152	242	-117	-692	-178	170	387	428	-210	3,275	1,131	430	238	1,241	7,758	-913	1,552	-267	1,570	10,669	-35	-205	0	…	0	26,320
45	0	…	0	-30	44	-16	-102	-44	43	109	84	-33	940	293	114	52	168	988	-113	171	-41	202	1,615	-5	-55	0	…	0	4,385
46	0	…	0	-43	65	-29	-175	-58	55	132	121	-53	1,306	372	142	73	307	1,966	-219	981	-69	386	2,852	-9	-67	0	…	0	8,034
47	0	…	0	-52	95	-50	-315	-107	59	150	191	-35	1,262	403	158	80	471	2,983	-363	660	-110	529	4,812	-13	-93	0	…	0	10,717
48	0	…	0	-61	39	-22	-144	-81	85	192	228	-26	1,227	467	216	89	428	2,036	-439	454	-104	549	3,076	-8	-68	0	…	0	8,134
49	0	…	0	-48	127	-42	-279	-125	59	201	361	-66	2,796	640	237	187	1,175	6,099	-3,426	1,263	-225	1,051	7,429	-33	-115	0	…	0	17,268
50	0	…	0	-2	2	-5	-11	-9	5	10	4	-1	1,177	259	65	23	35	312	-253	147	-79	78	1,496	-26	-4	0	…	0	3,224
51	0	…	0	-2,156	7,594	-1,420	-7,874	-2,977	1,413	4,857	7,238	-1,985	70,911	16,738	6,124	3,167	11,629	120,428	-9,778	26,785	-6,109	24,445	139,619	-588	-2,777	0	…	0	405,281
52	0	…	0	-107	302	-111	-567	-365	151	508	250	-108	3,968	1,191	569	280	938	4,014	-524	1,185	-204	962	7,075	-22	-160	0	…	0	19,225
53	0	…	0	-64	117	-59	-391	-195	77	142	167	-119	2,813	644	207	169	643	4,111	-674	817	-186	831	6,313	-28	-105	0	…	0	15,230
54	0	…	0	-42	7	-3	-12	-7	3	7	18	-1	506	114	6	4	12	254	-8	42	-9	43	954	0	-3	0	…	0	1,884
55	0	…	0	-41	33	-22	-103	-119	51	412	51	-13	2,881	285	93	127	265	1,034	-67	136	-23	140	1,639	-4	-31	0	…	0	6,722
56	0	…	0	-73	105	-84	-431	-185	54	188	226	-115	1,850	510	232	120	447	2,642	-466	582	-135	651	4,242	-14	-89	0	…	0	10,256
57	0	…	0	-95	869	-52	-333	-117	51	189	2,690	-65	2,613	567	203	109	401	4,011	-350	875	-202	826	6,732	-19	-102	0	…	0	18,799
58	0	…	0	-91	211	-55	-395	-135	160	263	365	-67	2,922	598	290	195	646	4,731	-684	1,250	-291	1,445	12,019	-19	-150	0	…	0	23,208
59	0	…	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	…	0	0
Column Sum	0	…	0	-16,470	17,981	-14,892	-94,040	-41,328	17,548	35,994	49,735	-6,662	258,662	121,141	44,673	21,691	152,175	806,045	-57,340	151,354	-24,980	203,465	833,710	-3,351	-26,736	0	…	0	2,428,374

Table A.2 Sector Classification

Sequential Number	Classification of Products by Activity (CPA)	Sector Name
1	1	Agricultural products, hunting products
2	2	Forestry products
3	5	Fish and fishing products
4	10	Coal and lignite
5	11	Crude petroleum and natural gas
6	12	Uranium and thorium ores
7	13	Metal ores
8	14	Stones, sand and clay, minerals, salt, other mining products
9	15	Food products and beverages
10	16	Tobacco products
11	17	Textiles
12	18	Wearing apparel, products of dressing and dyeing of fur
13	19	Leather, luggage, saddler, harness and footwear
14	20	Wood and products of wood and cork, straw and plaiting materials (excl. furniture)
15	21	Pulp, paper and paper products
16	22	Publishing and printing products
17	23	Coke, refined petroleum products and nuclear fuel
18	24	Chemicals and chemical products
19	25	Rubber and plastic products
20	26	Other non-metallic products (glass, ceramics, bricks, tiles, cement, lime, plaster, concrete, stone products, etc.)
21	27	Basic metals
22	28	Fabricated metal products, except machinery and equipment
23	29	Machinery and equipment n.e.c.
24	30	Office machinery and computers
25	31	Electrical machinery and apparatus, n.e.c.
26	32	Radio, television and communication equipment and apparatus, electronic components
27	33	Medical, precision and optical instruments, watches and clocks
28	34	Motor vehicles, trailers and semi-trailers
29	35	Other transport equipment
30	36	Furniture and products n.e.c. (jewelry, musical instruments, sports goods, games and toys, etc.)
31	37	Recovered secondary raw materials
32	40	Electricity, gas, steam and hot water
33	41	Collected and purified water, distribution services of water
34	45	Construction work
35	50	Trade, maintenance and repair service of motor vehicles, etc.
36	51	Wholesale trade and vehicles etc.

37	52	Retail trade services, except of motor vehicles etc.
38	55	Hotel and restaurant services
39	60	Land transport and transport via pipeline service
40	61	Water transport service
41	62	Air transport service
42	63	Supporting and auxiliary transport services; travel agency services
43	64	Post and telecommunication services
44	65	Financial intermediation services, excl. insurance and pension funding services
45	66	Insurance and pension funding services
46	67	Services auxiliary to financial intermediation
47	70	Real estate services
48	71	Renting services to machinery and equipment
49	72	Computer and related services
50	73	Research and development services
51	74	Other business services
52	75	Public administration and defense services; compulsory social security services
53	80	Education services
54	85	Health and social work services
55	90	Sewage and refuse disposal services, sanitation and similar services
56	91	Membership organization services n.e.c.
57	92	Recreational, cultural and sporting services
58	93	Other services
59	95	Private households with employed persons

Table A.3 Employment effects I

Employment effects induced by an increase in production of one billion Euros			Jobs created economy-wide through the production of net exports **by** a specific manufacturing sector					
			Jobs destroyed through the production of gross imports		Jobs created through the production of gross exports		Jobs created through the production of net exports	
Sector	job effects	% of jobs created within sector	Sector	job effects	Sector	job effects	Sector	job effects
15	18,020	43.37%	15	-549,469	15	532,999	15	-16,470
16	9,585	27.84%	16	-6,968	16	24,949	16	17,981
17	13,392	69.21%	17	-165,682	17	150,791	17	-14,892
18	11,486	54.90%	18	-190,653	18	96,613	18	-94,040
19	13,095	63.45%	19	-83,821	19	42,493	19	-41,328
20	15,809	60.59%	20	-70,617	20	88,164	20	17,548
21	10,325	51.76%	21	-130,977	21	166,971	21	35,994
22	16,403	64.39%	22	-37,662	22	87,397	22	49,735
23	1,939	18.32%	23	-30,608	23	23,946	23	-6,662
24	8,207	35.85%	24	-601,534	24	860,195	24	258,662
25	11,828	63.08%	25	-191,269	25	312,411	25	121,141
26	13,852	55.93%	26	-91,271	26	135,943	26	44,673
27	8,349	45.18%	27	-332,674	27	354,365	27	21,691
28	13,925	70.93%	28	-205,647	28	357,822	28	152,175
29	11,697	54.71%	29	-528,688	29	1,334,733	29	806,045
30	7,380	40.71%	30	-229,420	30	172,080	30	-57,340
31	11,488	57.18%	31	-312,611	31	463,965	31	151,354
32	8,728	48.08%	32	-359,837	32	334,857	32	-24,980
33	12,871	65.24%	33	-231,382	33	434,846	33	203,465
34	9,495	38.84%	34	-629,624	34	1,463,334	34	833,710
35	9,601	45.27%	35	-262,326	35	258,975	35	-3,351
36	14,602	58.65%	36	-221,568	36	194,832	36	-26,736
Total	266,598		Total	-5,464,310	Total	7,892,684	Total	2,428,374

Table A.4 Employment effects II

Sectoral employment effects induced by a simultaneous increase in production of one billion Euros in each manufacturing sector		Jobs created **in** a specific sector due to the net exports of all manufacturing industries					
		Jobs destroyed through gross imports		Jobs created through the production of gross exports		Jobs created through the production of net exports	
Sector	job effects	Sector	job effects	Sector	job effects	Sector	job effects
1	4,060	1	-122,787	1	120,822	1	-1,965
2	1,307	2	-9,504	2	11,891	2	2,387
5	6	5	-180	5	176	5	-4
10	534	10	-10,730	10	14,277	10	3,546
11	29	11	-700	11	944	11	245
12	0	12	0	12	0	12	0
13	0	13	0	13	0	13	0
14	508	14	-10,224	14	14,535	14	4,311
15	7,937	15	-243,317	15	238,281	15	-5,037
16	2,668	16	-1,940	16	6,945	16	5,005
17	10,529	17	-136,910	17	120,663	17	-16,247
18	6,310	18	-104,757	18	53,155	18	-51,602
19	8,384	19	-54,512	19	28,487	19	-26,025
20	10,676	20	-63,910	20	79,095	20	15,184
21	6,758	21	-88,834	21	114,406	21	25,572
22	12,345	22	-62,419	22	108,327	22	45,908
23	431	23	-7,227	23	6,667	23	-560
24	4,966	24	-250,384	24	354,960	24	104,576
25	9,357	25	-177,751	25	297,979	25	120,228
26	8,671	26	-72,818	26	107,372	26	34,554
27	5,100	27	-190,541	27	234,550	27	44,009
28	14,579	28	-302,596	28	531,165	28	228,569
29	8,038	29	-330,372	29	791,814	29	461,442
30	3,083	30	-95,268	30	72,899	30	-22,369
31	7,715	31	-220,436	31	345,989	31	125,552
32	4,476	32	-180,983	32	171,473	32	-9,510
33	8,581	33	-156,259	33	291,023	33	134,764
34	3,883	34	-247,649	34	573,098	34	325,449
35	4,416	35	-120,423	35	119,519	35	-905
36	8,693	36	-136,663	36	128,878	36	-7,785
37	8,113	37	-11,361	37	14,694	37	3,333
40	1,511	40	-31,250	40	42,964	40	11,713
41	297	41	-6,440	41	8,963	41	2,524
45	2,033	45	-44,396	45	62,967	45	18,571
50	2,272	50	-55,879	50	96,355	50	40,476
51	14,128	51	-281,660	51	376,823	51	95,163
52	3,549	52	-64,829	52	79,830	52	15,001
55	372	55	-7,580	55	10,557	55	2,977
60	6,524	60	-143,216	60	203,775	60	60,559
61	25	61	-715	61	991	61	276

62	325	62	-8,180	62	10,924	62	2,743
63	3,492	63	-84,349	63	121,778	63	37,430
64	1,900	64	-42,234	64	61,862	64	19,628
65	2,531	65	-57,282	65	83,602	65	26,320
66	493	66	-10,541	66	14,926	66	4,385
67	777	67	-17,796	67	25,831	67	8,034
70	1,026	70	-22,408	70	33,124	70	10,717
71	993	71	-19,734	71	27,868	71	8,134
72	2,023	72	-50,848	72	68,116	72	17,268
73	291	73	-9,806	73	13,030	73	3,224
74	39,281	74	-882,493	74	1,287,774	74	405,281
75	2,535	75	-47,407	75	66,632	75	19,225
80	1,432	80	-35,459	80	50,689	80	15,230
85	129	85	-4,238	85	6,122	85	1,884
90	682	90	-17,090	90	23,812	90	6,722
91	1,327	91	-26,845	91	37,100	91	10,256
92	2,542	92	-34,966	92	53,765	92	18,799
93	1,941	93	-45,213	93	68,421	93	23,208
95	0	95	0	1	120,822	95	0
Total	266,586	Total	-5,464,310	Total	7,892,684	Total	2,428,374

Table A.5: Employment Effects by Country I (Part I)

Jobs created economy-wide through the production of net exports **by** a specific manufacturing sector

	Austria		**Belgium**		**China**		**Czech Republic**	
Rank	Sector	Job Effects	Sector	Job Effects	Sector	Job Effects	Sector	Job Effects
1	29	31,399	24	54,582	29	10,350	24	7,273
2	24	17,555	34	43,100	34	9,665	15	5,933
3	18	14,553	29	26,423	24	5,373	25	4,914
4	15	12,162	28	11,027	28	4,370	33	3,939
5	31	11,253	33	8,030	31	3,131	27	2,698
:	:	:	:	:	:	:	:	:
25	19	2,416	16	264	19	-22,483	18	-6
26	21	851	17	-1,533	18	-45,606	20	-1,129
27	16	-137	23	-2,373	36	-51,818	31	-2,922
28	20	-1,100	15	-8,934	32	-53,810	36	-3,315
29	27	-2,779	27	-12,496	30	-57,452	34	-7,909
	Total	168,383	Total	156,893	Total	-203,270	Total	19,812

Table A.5: Employment Effects by Country I (Part II)

Jobs created economy-wide through the production of net exports **by** a specific manufacturing sector								
	France		**Hungary**		**Italy**		**Japan**	
Rank	Sector	Job Effects	Sector	Job Effects	Sector	Job Effects	Sector	Job Effects
1	29	60,931	29	7,953	34	71,348	24	6,576
2	34	35,410	24	5,693	24	34,888	15	3,248
3	33	20,638	28	4,300	33	17,589	34	1,546
4	24	19,896	25	3,739	32	16,524	27	1,132
5	28	19,871	17	1,853	29	14,914	20	8,62
:	:	:	:	:	:	:	:	:
25	22	3,668	36	-2,600	26	-2,561	35	-5,129
26	19	1,517	30	-2,906	18	-5,183	29	-7,065
27	23	688	33	-3,334	36	-7,922	31	-14,458
28	16	34	34	-5,845	19	-10,552	30	-20,408
29	15	-6,599	32	-7,483	17	-11,732	32	-33,444
	Total	268,542	Total	3,822	Total	177,117	Total	-71,549

Table A.5: Employment Effects by Country I (Part III)

Jobs created economy-wide through the production of net exports **by** a specific manufacturing sector								
	Netherlands		**Poland**		**Russia**		**Spain**	
Rank	Sector	Job Effects	Sector	Job Effects	Sector	Job Effects	Sector	Job Effects
1	29	34,398	29	19,294	29	48,901	34	50,678
2	34	29,078	24	18,210	34	18,242	29	44,851
3	33	12,458	32	7,533	32	14,028	32	19,546
4	31	12,251	25	7,042	24	13,888	24	17,724
5	28	11,668	17	5,169	15	13,044	31	15,834
:	:	:	:	:	:	:	:	:
25	30	-2,387	35	-1,096	19	1,367	20	2,115
26	24	-4,336	20	-2,649	16	377	22	1,495
27	32	-4,942	18	-3,598	20	-1,109	23	1,418
28	23	-11,738	15	-7,504	23	-2,524	26	697
29	15	-12,763	36	-18,888	27	-18,594	19	-814
	Total	117,990	Total	52,466	Total	145,028	Total	225,150

Table A.5: Employment Effects by Country I (Part IV)

Jobs created economy-wide through the production of net exports **by** a specific manufacturing sector								
	Sweden		**Switzerland**		**United Kingdom**		**United States**	
Rank	Sector	Job Effects	Sector	Job Effects	Sector	Job Effects	Sector	Job Effects
1	34	21,176	34	22,123	34	107,188	34	179,976
2	29	18,422	22	9,971	29	49,740	29	96,392
3	15	9,201	36	8,731	15	26,526	33	21,241
4	31	8,409	30	8,272	28	18,540	31	19,914
5	33	6,016	18	7,313	32	17,430	28	15,380
:	:	:	:	:	:	:	:	:
25	16	62	21	-2,228	16	54	22	398
26	23	-348	32	-2,540	27	39	16	-87
27	20	-379	24	-3,130	23	-285	30	-12,070
28	27	-3,133	29	-8,985	35	-913	32	-15,066
29	21	-18,628	33	-10,767	24	-5,138	35	-46,026
	Total	71,874	Total	53,000	Total	307,311	Total	324,792

Table A.6: Employment Effects by Country II (Part I)[41]

Jobs created **in** a specific sector due to the net exports of all manufacturing industries								
	Austria		**Belgium**		**China**		**Czech Republic**	
Rank	Sector	Job Effects	Sector	Job Effects	Sector	Job Effects	Sector	Job Effects
1	74	25,532	74	29,830	29	28,342	74	3,782
2	29	18,143	24	20,067	34	7,860	25	2,985
3	28	11,707	34	16,805	27	5,422	24	2,823
4	51	8,365	29	15,902	35	5,076	15	2,626
5	25	8,123	28	13,803	33	1,091	33	2,596
:	:	:	:	:	:	:	:	:
55	61	18	23	-376	30	-23,431	50	-114
56	5	4	17	-659	18	-25,042	20	-757
57	27	-31	1	-1,688	74	-26,450	31	-1,735
58	16	-38	15	-3,495	32	-26,676	36	-2,019
59	20	-54	27	-3,903	36	-30,287	34	-3,052
	Total	168,383	Total	156,893	Total	-203,270	Total	19,812

[41] The sectors 12 (uranium and thorium ores), 13 (metal ores) and 59 (private households) always have an employment effect of zero and are therefore not stated in the tables.

Table A.6: Employment Effects by Country II (Part II)

Jobs created **in** a specific sector due to the net exports of all manufacturing industries								
	France		**Hungary**		**Italy**		**Japan**	
Rank	Sector	Job Effects	Sector	Job Effects	Sector	Job Effects	Sector	Job Effects
1	74	41,147	29	4,374	74	36,152	24	1,958
2	29	35,146	28	2,863	34	27,814	15	1,433
3	28	23,564	25	2,176	24	13,171	1	703
4	34	13,926	24	2,139	33	11,651	34	554
5	33	13,691	17	1,203	29	9,926	19	507
:	:	:	:	:	:	:	:	:
55	11	28	30	-1,186	26	-612	29	-4,024
56	16	9	36	-1,582	18	-2,843	30	-8,347
57	5	-2	33	-2,159	36	-3,965	31	-8,759
58	1	-1,252	34	-2,264	19	-6,706	74	-13,799
59	15	-2,676	32	-3,658	17	-8,432	32	-16,453
	Total	268,542	Total	3,832	Total	177,117	Total	-71,549

Table A.6: Employment Effects by Country II (Part III)

Jobs created **in** a specific sector due to the net exports of all manufacturing industries								
	Netherlands		**Poland**		**Russia**		**Spain**	
Rank	Sector	Job Effects	Sector	Job Effects	Sector	Job Effects	Sector	Job Effects
1	29	19,707	74	11,592	29	27,420	74	39,557
2	28	13,276	29	10,915	74	23,408	29	26,134
3	74	12,844	24	6,935	28	11,043	34	19,814
4	34	11,360	25	4,906	25	7,255	28	15,127
5	25	9,149	28	4,735	34	7,168	31	11,667
:	:	:	:	:	:	:	:	:
55	30	-929	1	-1,534	11	4	85	144
56	23	-2,125	18	-1,976	37	-125	61	24
57	32	-2,244	20	-2,156	20	-240	11	23
58	1	-2,722	15	-3,121	23	-437	5	1
59	15	-5,535	36	-11,046	27	-6,816	19	-472
	Total	117,990	Total	52,466	Total	145,028	Total	225,150

Table A.6: Employment Effects by Country II (Part IV)

Jobs created **in** a specific sector due to the net exports of all manufacturing industries								
	Sweden		**Switzerland**		**United Kingdom**		**United States**	
Rank	Sector	Job Effects	Sector	Job Effects	Sector	Job Effects	Sector	Job Effects
1	74	11,141	22	8,587	74	45,410	34	70,079
2	29	10,592	74	6,986	34	41,770	29	55,492
3	34	8,259	22	6,796	29	29,627	74	47,064
4	28	7,199	36	5,349	28	25,504	28	26,470
5	31	5,803	18	4,016	51	13,531	31	17,381
:	:	:	:	:	:	:	:	:
55	20	-94	15	-731	11	22	5	2
56	37	-224	21	-908	16	15	16	-24
57	2	-303	32	-1,083	5	9	30	-4,800
58	27	-384	29	-4,402	23	6	32	-7,003
59	21	-9,358	33	-6,994	35	-321	35	-20,759
	Total	71,874	Total	53,000	Total	307,311	Total	324,792