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Jobs Gained and Lost through Trade –
The Case of Germany

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This paper is based on a presentation at the “12th Göttingen Workshop on International Economic Relations” at the Georg-August-University of Göttingen in collaboration with the Center for European, Governance and Economic Development Research (cege), February 24-26, 2010.

The aim of this annual workshop is to offer a forum for young researchers from the field of International Economics to present and to discuss their current topics of research with other experts. The workshop also provides the opportunity to gain an overview of recent developments, problems and methodological approaches in this field.

Detailed information on past workshops and the planning for the 2011 workshop are available at http://workshop-iwb.uni-goettingen.de/. Do not hesitate to contact Prof. Dr. Gerhard Rübel, cege (gruebel@uni-goettingen.de) for further questions.
Jobs Gained and Lost through Trade –
The Case of Germany

by
Maren Lurweg* and Andreas Westermeier

Abstract

The nature of international trade has changed significantly. For centuries, trade concentrated on the exchange of finished goods. It now increasingly involves bits of value that are added at different locations to combine into one final product. Therefore, trade in functions or tasks are of growing importance and exports of final goods are no longer an appropriate indicator of the international competitiveness of countries.

The process of globalisation has an impact on domestic labour markets. Due to the increasing integration of the world economy, some jobs are gained and others lost in any open economy. Concerns about German workers losing jobs to foreign competition dominate many political debates. Many people fear that being integrated in the world economy is disadvantageous for Germany.

In this paper, we use input-output analysis to explore the relationship between trade and both job creation and job destruction in Germany over the period 1995-2006. We present two main findings. First, in an autarkic situation, around 7.0 per cent of total German jobs would not have existed at all in 2006. The job effect of trade was positive in every reporting year. Second, the manufacturing sector contributed most to this positive job effect, but also in the service sector, many jobs were retained through trade.

JEL-CLASSIFICATION: F14, F16, C67

KEYWORDS: input-output analysis, international trade, employment

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Introduction

The nature of international trade has changed significantly. For centuries, trade concentrated on the exchange of finished goods. Now it increasingly involves bits of value that are added in different locations to one final product. Therefore, trade in functions or tasks are of growing importance and the exports of final goods are no longer an appropriate indicator of the international competitiveness of countries.

Furthermore, high communication and transportation costs have led to a concentration of production for a long time. However, revolutionary advances in transportation as well as information and communication technology increasingly facilitate the geographical separation of specific tasks. If instructions can be communicated instantaneously, unfinished goods moved quickly, and the output of many different tasks delivered electronically, firms can exploit factor price disparities between different countries without sacrificing the gains from specialisation. This leads to an increased offshoring of tasks, not only in manufacturing industries, but most notably in business services as well as in computer and information services. However, it is important to bear in mind that not all trade in goods and services is related to offshoring, and it is not possible to identify the share of trade in goods and services that is directly related to this phenomenon.

Without doubt, the process of globalisation has a significant impact on the domestic labour market. Due to the increasing integration of the world economy, jobs are gained and lost in any open economy. Concerns about German workers losing jobs to foreign competition, especially to emerging and developing economies, have reached high levels and dominate many political debates. Critics fear that being integrated in the world economy is disadvantageous for Germany.

The number of German firms engaging in offshoring has indeed increased over time. According to a study conducted by the Federal Statistical Office in 2008, 33.4 per cent of those firms which engaged in offshoring activities until 2006, did so before 2001, 41.3 per cent from 2001 to 2003 and 65.1 per cent from 2004 to 2006. Auxiliary functions are more likely to be offshored than core business activities. This finding emphasizes the notion that trade in tasks is of growing importance. In contrast to traditional trade theory, the offshoring of auxiliary functions is most pronounced in skill-intensive services.

In this paper, we use input-output analysis to explore the relationship between trade and both job creation and job destruction in Germany. 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 German exports. The objective is to obtain a measure of the net effect of trade on Germany’s employment. This measure is referred to as “German jobs embodied in net exports” and its development is examined for the period 1995-2006.

We have two main findings. First, in an autarkic situation, around 7.0 per cent of total German jobs would simply not have existed in 2006. This result shows that being integrated into the world economy is advantageous for Germany. Moreover, the job effect of trade was positive in every reporting year. Second, the manufacturing sector contributed most to this positive job effect of trade. Also in the service sector, many jobs were retained through trade. Interestingly, mainly through the trade relations of the export-oriented service sectors, that are most exposed to international trade and where one might expect losses, jobs were retained in Germany.

**Job Effects of Trade: A Literature Review**

A substantial body of both theoretical and empirical research has been undertaken on the relationship between trade and employment.6

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 import-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.7

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6 See Jansen and Lee (2007) for an overview.
7 See, for example, Hoekman and Winters (2005).
The suitability of traditional trade models for predicting the job effects of trade is limited for two additional reasons. 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 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.

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 (2008) 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 parties 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. Following Molnar, Pain and Taglioni (2007), empirical studies on the labour market effects of trade can be classified into three groups: trade in finished goods, trade in intermediate goods (also known as “material offshoring”) and offshoring of services.

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

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negatively correlated.\textsuperscript{10} 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.

\textit{Trade in intermediate goods}

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. It is important to bear in mind that labour demand is not only affected in import-competing industries, but in all industries that use foreign inputs to produce final goods.\textsuperscript{11} That’s why Feenstra and Hanson (2003) argue that trade in intermediates may have a greater impact on aggregate employment than trade in final 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.\textsuperscript{12} Between 1995 and 2000, material offshoring grew in 13 out of 17 economies.\textsuperscript{13} 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.

\textsuperscript{11} See Hijzen, Görg and Hine (2005).
\textsuperscript{12} 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.
\textsuperscript{13} Material offshoring decreased in Denmark, Greece, Norway and in the United Kingdom.
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.\textsuperscript{14}

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.\textsuperscript{15} The authors find that narrow outsourcing\textsuperscript{16} 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 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.

\textsuperscript{14} 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).

\textsuperscript{15} They estimate relative demand functions for skilled workers, based on a translog cost function.

\textsuperscript{16} Only the imported intermediates in a given industry, from the same industry abroad, are taken into account.
Offshoring of services

Compared to the offshoring of goods, that of services is a comparatively new phenomenon. Rapid technological advances in information and communication technologies increasingly facilitate trade in services. The service categories that are most exposed to international trade are business services and computer and information services.

During the US election campaign of 2004, the labour market effects of increased service offshoring were discussed intensively. The theoretical debate was dominated by Paul Samuelson and Jagdish Bhagwati. Samuelson (2004) bases his arguments on a Ricardian model demonstrating that the labour market effects of offshoring can be negative, if the trade partner were able to realise productivity gains in a formerly non-competitive sector. A share of the comparative advantage that was previously limited to the home economy could thus be sacrificed.

Bhagwati (2004) uses a specific-factor model indicating that service offshoring is always advantageous for the country of origin and leads to welfare gains. This is due to the fact that imported service goods are essential for the production of final goods. If the production factors which initially lose from trade, are financially compensated for their losses, all production factors can win.

There are quite a few empirical studies on the labour market effects of service offshoring. Van Welsum/Reif (2005) suggest that around 20 per cent of total employment in selected OECD countries could potentially be affected by international sourcing of IT and ICT-enabled services. Nevertheless, they come to the conclusion that in the long run, the positive effects of service offshoring outweigh the negative effects. This can be explained by the fact that those countries facing rapid increases in service exports (like India and China) also have rapid increases in service imports at the same time.

For the United States, Jensen and Kletzer (2006) estimate that the share of workers in tradable professional and business service industries exceeds the share of workers in tradable manufacturing industries. Workers employed in tradable sectors have higher skills and significantly higher wages than those in non-tradable sectors. Jensen and Kletzer suggest that ongoing technological change augments the share of tradable services. The United States should, therefore, concentrate on the production of services where they have a comparative advantage.

Initially, public and political debate on service offshoring was concentrated in Anglo-Saxon countries. The geographical and cultural proximity to the middle and eastern European countries, which are now part of the European Union, is the main reason why the increased tradability of services is now also discussed intensively in Germany. Moreover, data shows how important both the offshoring and onshoring of services has become for the country.17

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17 In 2006, Germany was the largest absolute offshorer of computer and information services and the second largest offshorer of business services (behind the United States). At the same time, Ger-
Schöller (2007) estimates that service offshoring exerts a potentially negative impact on manufacturing employment. Between 1991 and 2000, approximately 42,800 jobs were destroyed, due to an increase in service offshoring intensity. However, the positive employment effects resulting from an increase in real output could counteract these negative effects.

Studies on the employment effects of service offshoring for the United States and United Kingdom arrive at a different conclusion.\(^\text{18}\) In both countries, no negative correlation could be found between the offshoring intensity of services and aggregate employment in the manufacturing sector. A possible explanation of the different employment effects is that German companies that offshore services, do not create new jobs, even if they achieve offshore-induced efficiency gains.

**Methodology**

In order to determine the job effects of international trade flows, we apply an input-output approach.\(^\text{19}\) Using input-output tables is advantageous for three main reasons. First, input-output tables offer insights into the globalization of value chains, through providing data on the value of intermediate goods and services that have been imported from companies external to the country of the sourcing company. Second, they also provide information on the growing importance of services for production processes and, due to the availability of import data, the increasing offshoring of service activities can be measured. Third, indirect effects associated with impacts on other sectors are accounted for.\(^\text{20}\)

The input-output matrix provided by the Federal Statistical Office (Destatis) encompasses 71 sectors.\(^\text{21}\) We apply a wide definition and add all mining and quarrying industries to the primary sector. In addition to these industries, major businesses in this sector include agriculture, agribusiness, fishing and forestry. The secondary sector encompasses those economic sectors that create a finished, usable product by transforming raw or intermediate materials provided by the primary sector. Major businesses in this sector include manufacturing and construction. The tertiary sector of the economy involves the provision of services to businesses as well as to final consumers. Therefore, the economy is divided into 8 primary sectors, 36 secondary sectors and 27 tertiary sectors.\(^\text{22}\)

\(^\text{18}\) See Amiti and Wei (2005) and Amiti and Wei (2006).
\(^\text{19}\) See Groshen, Hobijn and McConnell (2005), De Backer and Yamano (2008) and Lurweg, Oelgemöller and Westermeier (2009). For further information on input-output tables and the methodology of the input-output analysis, see also Bleses (2007) and Kowalewski (2009).
\(^\text{20}\) See De Backer and Yamano (2008).
\(^\text{21}\) The input-output matrix can be downloaded free of charge at www.destatis.de (Federal Statistical Office, Fachserie 18, Reihe 2).
\(^\text{22}\) Due to the aggregation of some secondary and tertiary sectors, our analysis encompasses 59 sectors. For the specific sectors, see the appendix (Table A.1). 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
The input-output matrix also includes data on German imports and exports, classified by trading partners and sectors. Our analysis covers the period 1995 to 2006. For this period, we have annual input-output tables. The key element of our analysis is the following equation:

\[ LC \ast (I - A)^{-1} \ast TM = \text{German jobs embodied in net exports} \]

\((I-A)^{-1}\) is the inverse Leontief matrix (see Figure 1). 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.

**Figure 1 Inverse Leontief Matrix (Extract from the 2005 Input-Output Matrix)**

<table>
<thead>
<tr>
<th>CPA</th>
<th>01</th>
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<th>03</th>
<th>04</th>
<th>05</th>
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<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lade und Verkehrswesen</strong></td>
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<td>0.0009</td>
<td>0.0016</td>
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<td><strong>Verarbeitende Industrie</strong></td>
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<tr>
<td><strong>Agriculture and Forestry</strong></td>
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</tr>
</tbody>
</table>

Source: Federal Statistical Office.

For example, the inverse input coefficient in row 1, column 2 shows how many units of intermediate production, produced domestically in sector 1 (agriculture), are directly and indirectly needed to provide one unit of goods, produced domestically in sector 2 (forestry), for final consumption.

To calculate the employment effects resulting from the export demand and the import supply of the foreign trade sector, the direct and indirect production effects have to be calculated. Therefore, the inverse Leontief matrix is multiplied by the trade matrix.

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23 The system of national accounts was changed in 2005 retrospectively as of 2000. Therefore, the comparability of the results before and after the year 2000 is limited.

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

25 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.
**TM. TM** is a diagonal matrix having, as entries, the real net exports or real net imports of each of the 59 sectors of the economy. If only certain sectors (e.g. the manufacturing sectors) are to be analyzed, the exports and imports of the other sectors are set at zero. By multiplying the inverse Leontief matrix by the trade matrix, we obtain a measure of the change in production that would be needed to replace real net imports by domestic production or for the change in production that is needed to produce real net exports in a specific sector.

In order to compute the employment effects of international trade, the matrix of additional production is multiplied by the diagonal matrix of labor coefficients \( LC \). The labour coefficient for each sector illustrates how many jobs are needed to produce one unit of output. Therefore, the labour coefficient for a specific sector \( i \) is calculated as follows: employment/output\(_i\). The input-output matrix provides data on employment (persons in employment) and output for each sector. By multiplying the diagonal matrix \( LC \) by \( (I-A)^{-1}TV \), we obtain a measure for the number of jobs needed to produce, for example, net exports in a specific sector.

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

- 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

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26 The values of imported intermediate inputs and imported goods for final consumption 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).

27 We have just considered the imports that become part of the production process in Germany and not those that are directly re-exported. Those imports that are directly re-exported are not responsible for job losses in Germany. Therefore, total imports are composed of imported intermediate goods and services and imported goods and services for final domestic demand. For the same reason, we also subtracted the re-exports from the value of exports.

28 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). The values were adjusted to the prices of 2005 using the consumer price index for Germany (Federal Statistical Office).

identified: more efficient resource allocation, a greater division of labour, greater returns on investment and technology spillovers.\textsuperscript{30}

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

**Results**

In 2006, real net exports were positive for all sectors except for the primary sectors (Figure 2). The greatest surplus occurred in the secondary sectors, with exports exceeding imports at a level of 197 billion Euros. More surprisingly, the exports of the tertiary sectors exceeded the imports at a level of 61 billion Euros. Particularly the net exports of the export-oriented service sectors, which are most exposed to international trade, were positive.\textsuperscript{31} This can be explained by the fact that many of the countries that are mentioned frequently in the offshoring debate (such as India, China and the Eastern European countries) have indeed experienced a rapid growth of these exports, but they are also facing a rapid growth of their imports of these services. In 2006, Germany was the largest importer of computer and information services, but at the same time, the fourth largest exporter of these services. Ultimately, Germany was a net exporter of these internationally traded services.\textsuperscript{32}

*Figure 2 Development of Net Real Exports*

![Development of Real Net Exports](image)

Source: own calculations, Data: Federal Statistical Office.


\textsuperscript{31} The export-oriented service sectors produce business services in a broad sense (for the sector classification, see the appendix, Table A.2).

\textsuperscript{32} See UNCTAD Handbook of Statistics 2008.
Because we wanted to analyze the economy as a whole, we included the primary sectors in our analysis. Nonetheless, their importance is fairly limited for our purposes, given that these sectors do not generally do offshoring. Consequently, the measure of German jobs embodied in real gross imports and real net exports is shown once for the entire economy, with its three main sectors, and once just for the secondary and tertiary sectors (Figure 3).

The positive job effect of German exports has exceeded the negative job effect of German imports in every reporting year.\(^\text{33}\) In 2006, about 2.7 million jobs were needed to produce total German real net exports. This fact demonstrates that being integrated into the world economy is advantageous for Germany. If only the jobs embodied in the net exports of the secondary and tertiary sectors are considered, the effect is even larger, with about 3.0 million jobs being retained due to international trade. This can be explained by the fact that the primary sectors normally run a trade deficit.

**Figure 3 Employment Effects of Gross Imports and Net Exports**

Source: own calculations, Data: Federal Statistical Office.

The employment effect of trade is now shown separately for the manufacturing and service sectors.\(^\text{34}\) Figure 4 indicates that the net exports of the manufacturing industries are job intensive. Due to the net exports, around 1.7 million German jobs are retained, evidence of the high international competitiveness of the German manufacturing sectors.

\(^{33}\) For the results, on a sectoral basis, see the appendix (Table A.7).

\(^{34}\) Manufacturing sectors: sequential numbers 9-30 (CPA 15-36), service sectors: sequential numbers 35-59 (CPA 50-95). See the appendix, Table A.1.
In our analysis, we differentiated between durable and non-durable manufacturing industries. The distinction is based on whether the goods can be used only once for the purposes of production or consumption (non-durable manufacturing industries) or whether they can be used repeatedly, or continuously (durable manufacturing industries). Interestingly, the non-durable manufacturing industries ran a deficit until 1999 and started to contribute to the positive job effects of the entire sector in 2000. Therefore, the positive job effects of trade were achieved mainly by the durable manufacturing industries. The highest job effects were achieved by the sectors “Machinery and equipment” (around 674,000 jobs created through the production of net exports), “Motor vehicles, trailers and semi-trailers” (413,000 jobs), “Chemicals and chemical products” (245,000 jobs) and “Fabricated metal products” (162,000 jobs).

Figure 4 Employment Effects of Trade (manufacturing sectors)

![Graph showing employment effects of trade in manufacturing sectors](image)

Source: own calculations, Data: Federal Statistical Office.

Due to the export surplus of the service sectors, around 1.4 million jobs were retained in Germany in 2006 (Figure 5). Again, we divided the sector into two parts: the “exporting service sectors” are typical offshoring sectors. They comprise tradable business activities in a broad sense: wholesale trade, post and telecommunications, financial intermediation except insurance and pension funding, activities related to financial intermediation, renting of machinery and equipment, computer and related activities, research and development as well as other business activities.

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35 An example of durable manufacturing industries is the sector “machinery manufacturing”. Examples of non-durable manufacturing industries are the sectors “food manufacturing” and “clothing manufacturing”. For the specific sectors, see the appendix (Table A.2).

36 The aggregation is based on Kalmbach et al. (2005).
Consumer-related and social services are among the “non-exporting service sectors”. Consumer-related services in general do not represent typical offshoring services, because they have to be performed physically close to a specific domestic location. Examples of consumer-related services are the repair of motor vehicles, the retail trade, passenger rail transport and accommodation and food-service activities. Social services are usually not tradable, because they have to be delivered personally. Such services include public administration and defense, education as well as human health-related activities.37

The net exports of the exporting service sectors are job-intensive. In 2006, they accounted for around 1.5 million German jobs. This figure underlines the importance of trade in services for the domestic labour market. The positive job effects were almost completely achieved by the two sectors “Wholesale trade and vehicles” (around 1,100,000 jobs created through the production of net exports) and “Other business services” (421,000 jobs). In contrast to the exporting service sectors, the trade-induced job effects of the non-exporting service sectors were negative in 2006: around 150,000 jobs were destroyed.

Figure 5 Employment Effects of Trade (service sectors)

In order to gain an impression of the importance of trade-induced job gains relative to total employment in Germany, Figure 6 shows how many German jobs would be gained or lost, if the country were not to participate in international trade. This is shown for the entire economy and its three main sectors.

37 For a detailed discussion of potentially offshorable jobs or tasks see Blinder (2007) and Levy and Murnane (2006). For the specific sectors, see the appendix (Table A.2).
In an autarkic situation, around 7.0 per cent of total German jobs would not have existed in 2006. The manufacturing sectors contributed most to this positive job effect of trade, with its real net exports retaining around 4.3 per cent of total employment. Around 3.4 per cent of total German employment was retained through the real net exports of the service sectors. Only due to the net imports of the primary sectors, were jobs lost to the extent of around 0.8 per cent of total employment. However, this result must be interpreted with caution, because, in many cases, the imports of the primary sectors cannot be produced domestically. This is due to the non-availability of raw materials inland (e.g. crude oil, natural gas) or unfavourable climatic conditions (e.g. for the production of bananas and pineapples).

**Figure 6 Trade-induced Job Gains as a Share of Total Employment**

Our calculation is based on three components: inverse input coefficients, real net exports and labour coefficients. In a final step, we calculated the employment trends in the German economy, assuming that two of the three variables would have remained stable at the 1995 level. The underlying question is: How do labour coefficients, inverse input coefficients and real net exports influence employment trends?

If only the real net exports of the manufacturing sectors had changed since 1995 (assuming constant inverse input coefficients and constant labour coefficients), the employment trend in Germany would have been even more favourable (Figure 7). This can be explained by the fact that the labour coefficients have decreased continuously. Fewer jobs were needed in 2006 to produce one unit of output, compared to 1995, because labour is increasingly being substituted by capital, due to technological progress. The inverse input coefficients have remained almost stable since 1995 and, therefore, have not influenced the employment trend significantly.
An examination of the employment trends, resulting from the service sector trade relations, reveals a similar picture. The trade-induced employment trend would have been more favourable, if the inverse input coefficients and labour coefficients had remained stable at the 1995 level (Figure 8). However, in contrast to the manufacturing sectors, the inverse input coefficients have influenced the employment trend negatively in this case. Fewer units of intermediate production of a given sector were directly and indirectly needed to produce one unit of final demand for services from another sector in 2006 compared to 1995. A possible explanation is that imports of intermediate inputs increasingly substitute for domestic production.\footnote{We used the inverse input coefficients (domestic production) to calculate the job effect of real net exports.}

**Figure 7 Employment Trends (manufacturing sectors)**

Source: own calculations, Data: Federal Statistical Office.
Concluding Remarks

Input-output analysis has been used to explore the relationship between trade and both job creation and job destruction in Germany over the period 1995-2006. The results show that being integrated into the world economy has been increasingly advantageous for the domestic economy. In 1995, trade in goods and services led to job gains in the amount of 900,000 jobs. In 2006, the trade-induced job gains reached a level of around 2,700,000. This figure is equivalent to around 7.0 per cent of total German employment compared to 2.4 per cent in 1995. The positive job effects of trade were achieved mainly by the net exports of the manufacturing sector, but the service sector also contributed significantly to the job gains. The driving forces behind these gains were the durable manufacturing industries (e.g. machinery and equipment) and the export-oriented service sectors (e.g. wholesale trade and vehicles). Only the net imports of the primary sectors were responsible for trade-induced job losses.

However, even though the trade relations of the German economy lead to positive job effects, the high level of openness makes Germany vulnerable to fluctuations in worldwide economic activity. In 2009, the German economy faced a dramatic reduction in GDP and an increasing rate of unemployment due to a worldwide decline in overall economic production. Nonetheless, protectionism is not the answer. As soon as the world economy picks up, the German economy, and above all, the manufacturing sector, will recover and jobs created.
References


## Appendix

### Table A.1 Sector classification I

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## Table A.2 Sector classification II

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