International Trade and the Servitization of Manufacturing: Evidence from German Micro Data*

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Abstract

This paper examines the impact of the increasing trade intensity and exposure on the employment structure of establishments in the German manufacturing sector. To identify the causal relationship between trade openness and the occupation-skill mix within establishments, we use the "Establishment History Panel" (in German: Betriebs-Historik Panel (BHP)) provided by the German Federal Employment Office, a very rich and detailed micro data set that covers all establishments in Germany between 1975 and 2010. To capture the openness to international trade, we match the BHP with sectoral trade data on the basis of the actual composition of production and consumption of the German manufacturing industries that we derive from statistics provided by the German Federal Statistical Office.

Keywords: Servitization, Employment Structure, International Trade, Trade in Tasks

JEL codes: J21, F16, F61, L23

*The calculations for this paper are based on the "Establishment History Panel" provided by the Research Data Centre of the German Federal Employment Agency at the Institute for Employment Research. For our research, we have access to the data via on-site use at the Research Data Centre in Nürnberg as well via remote data access. We thank the members of the data centre for running the Stata do-files and checking the log-files for violation of data protection.

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1 Introduction

Ever since the 1990s the impact of international trade on employment and wages is a widely discussed field in economic literature, political debates and the popular press. Surprisingly enough, rather little empirical research has been conducted, to shed light on how trade openness impacts different workers, both in terms of occupations and skill level. In this paper we identify three potential channels through which trade influences the employment structure of German manufacturing establishments between 1975 and 2010: First, imports of inputs and intermediate goods used in the production process ("import intensity"), second exports of final goods ("export intensity"), third imports of final goods that compete with final goods of domestic establishments ("import exposure").

The employment composition of German establishments went through a substantial change during the last decades. Since 1975, establishments in the manufacturing sector experienced a steep increase in the share of service occupations. While structural change as an inter-sectoral process, i.e. the rising service sector and the decline of the manufacturing sector, is a widely discussed issue in the literature[1], we focus on another empirical fact: the rise of services as an intra-sectoral transformation within the German manufacturing sector between 1975 and 2010.

First, our data confirm the inter-sectoral aspect concerning a sectoral reallocation. Ever since the mid 70s the size of the service sector in Germany faced a tremendous growth from 45% to about 63% of all employees in 2010. During the same time period the share of employees working in the manufacturing sector declined from 55% to 37%. Nevertheless, the rise of services within the manufacturing industries is even more severe. Our data show that besides the increasing share of the service sector, there is also considerable growth of service activities within the manufacturing sector. While the share of production occupations in manufacturing establishments steadily declined since 1975, service tasks became more important. This leads to a substantial change of the employment structure within German manufacturing establishments. During the same time period, the openness of the German economy to international trade increased significantly. Trade data for Germany show that the trade volume in 2010 is alomst five times higher than it was in 1975.

The goal of our paper is to examine the apparent simultaneity of increasing activities in international trade and the change of the composition of occupations and skills

[1] See for example Kuznets (1966), Jorgenson & Timmer (2011) and Alvares-Cuardrado & Long (2011).

within establishments. We empirically analyze the effects of both increasing import and export intensities as well as import exposure on the employment structure within German manufacturing establishments. Despite the substantial shift of occupations from production to services, very little is known about international trade as the driving force behind these occupational changes.

The channel that is most discussed in the economic literature is the one we define as import intensity. There exists a large body of economic theories discussing this phenomenon as "offshoring" or "trade in tasks". According to Grossman & Rossi-Hansberg (2008), firms are able to unbundle the production process into a continuum of tasks. After substantial progress in the IT-technology and due to trade liberalization in many economies, e.g. China, the costs of offshoring declined significantly. Therefore, an increasing number of establishments benefit from relocating some tasks to low wage countries. Mostly production tasks, for instance low-skilled tasks such as assembling, are offshorable since they often represent jobs that do not require physical proximity or human interaction.[2] According to this strand of literature, the share of service occupations increases because German manufacturing establishments relocate parts of the production to low wage countries to benefit from wage differences. Hence, an increasing number of inputs and intermediate goods that has been produced by the establishments in Germany in the past is now imported. Tasks that remain in the domestic establishments are mostly high-skilled, non-routine headquarter services, R&D activities and more complex steps of production that both require physical proximity and much human interaction, because the costs of offshoring are still too high for these tasks. The link between offshoring and the relative demand for different types of labor has been investigated by a large body of economic literature. The most prominent empirical work by Feenstra & Hanson (1996) argues for the U.S. that mainly low-skilled workers in production occupations face an increasing competition from low wage countries and thus suffer from job losses. Using disaggregated plant data for Germany, Becker, Ekholm & Muendler (2013) estimate that offshoring leads to a significant shift towards non-routing tasks and high-skilled workers, in particular if offshoring to low-income countries is considered. Further empirical analyses, e.g. by Hijzen et al. (2005) or Hogrefe (2013) confirm these findings.

[2]Baldwin & Robert-Nicoud (2007) distinguish in accordance with Grossman & Rossi-Hansberg (2008) between routine tasks and non-routine tasks. According to their definition, there are tasks that are easy to codify and to communicate. Therefore, it is possible to check if they are performed according to the guidelines of the domestic firm. Assembling a "standard good" is a task that can be defined as "routine". In contrast, there are more complex tasks that require physical closeness and frequent interaction and are hardly to ship or to send via email. It is much more difficult or even not possible to offshore these "non-routine"-tasks, e.g. legal advice.

Much less has been done to uncover the effect of exporting on the employment structure of manufacturing firms. Preexisting literature in this field mainly focuses on total employment effects or, at most, distinguishes between few groups of employees such as "production" and "non-production" or "high-skilled" and "low-skilled". For instance Biscourp & Kramarz (2007) find that for French firms exports have a negative impact on the unskilled share in manufacturing employment, but a positive impact on the share of production jobs. Bernard & Jensen (1997) obtain different results for the US manufacturers. They find that exporting is positively correlated with a within firm change towards non-production occupations. Mauron, Thesmar & Koenig (2002) observe no evidence that exporting effects the distribution of workers across production and service tasks. Exporting however has a positive effect on the high skilled share of workers within both categories. Most of the skill upgrading occurs within the non-production sector such as development and marketing. There is general agreement that exporting increases the share of high-skilled workers, the effect on production and service occupations is, however mixed.

The third channel through which trade influences the employment structure of German manufacturing establishments focuses on imports of final goods that compete with the production of final goods of domestic suppliers. The most prominent study by Autor, Dorn & Hanson (2012) analyzes the regional employment effects of trade openness in the U.S. to import competition from China. The authors conclude that regions with a high exposure to Chinese import competition have suffered from rising unemployment. This result is confirmed by Tomiura (2003) for Japan. He also estimates the employment effects of rising import competition and finds that a substantial part of the observed employment decline in the Japanese manufacturing sector can be explained by a rising import competition. In contrast to the studies mentioned before, we analyze the employment effects of rising import competition on a much more disaggregated level. Instead of examining effects on the level of employment, we calculate the effects on the composition manufacturing employment. The work that is closest to our is the one by Biscourp & Kramarz (2007). The authors investigate the employment effects of trade in France and confirm job losses due to increasing imports of finished goods. Furthermore they observe that especially large firms mostly reduce (low skilled) production occupations.

In addition, this paper touches a growing strand of literature that discusses the link between international trade and firm organization, where reorganization of firms often goes in hand with rising service and high-skilled employment shares.

For instance Caliendo and Rossi-Hansberg (2012) develop a model that shows an increase in management layers as a result of exporting. Davidson et al. (2013) use detailed Swedish data to study the effect of globalization on the occupational mix of firms. They find that exporters, especially multinational exporters, have an occupational distribution towards the more skilled. Marin et al. (2014) implement trade in tasks into a theory of the firm organization à la Marin and Verdier (2012). They show both theoretically and empirically that offshoring leads to a more decentralized management.

For our empirical analysis, we use the "Establishment History Panel" (in German: Betriebs-Historik Panel (BHP)), a very disaggregated data set at the establishment-level. The data contain all German establishments in the 1975 to 2010 period (before 1991 only establishments in Western Germany) and is provided by the German Federal Employment Office. We have access to a 50% sample of all establishments in a given year that can be connected to a panel data set with valuable information on a wide range on establishment characteristics such as the industry classification at the 3-digit level, the region where the establishment operates or the date of the first and last appearance. The data set gives a unique insight into the structure of the organization of German establishments over 35 years, as it contains detailed information regarding the structure of employment of the respective establishment, e.g. the number of employees, the composition of employees regarding educational qualifications and especially the structure of employees by Blossfeld occupational groups.[3] We match the core data set with sectoral trade data for German imports and exports since there is no information about trade activities in the BHP.

Our paper contributes to the existing economic literature in various aspects. First, we analyze the effects of international trade on the employment structure by using a very detailed data set at the establishment-level that covers a 35-year period. It allows us to have a unique insight into the organization of production of all German establishments in the manufacturing sector and to observe changes in the employment structure in detail. Thus, we are able to estimate the impact of international trade by controlling for all establishment-specific effects, which improves the calculated effects in comparison to various other studies which uses industry-level data.[4] Second, since there does not exist a long time establishment-level data set including information on international trade, we match the BHP with trade data from the UN Comtrade data base. In contrast to the standard approach in the

[3]For further information see Blossfeld (1987) and Appendix 1.

[4]See for example Feenstra & Hanson (1996).

literature, we do not match the trade data by using a single correspondence table between the commodity classification of the trade data and the industry classification of the BHP. With the help of two data sets provided by the German Federal Statistical Office, we can improve the allocation of trade flows to the industries significantly. By using the statistic concerning materials and commodities received by the industries (in German: "Material- und Wareneingangsstatistik", hereafter called "Input Statistic"), we can assign the imports according to the goods received in each industry. With regard to the exports we allocate the commodity flows according to the production structure of each industry on the basis of the Survey of Production. Third, with these data at hand, we are able to analyze the effects of "import intensity", "export intensity" and "import exposure" of the German manufacturing sector on the employment structure very closely. In contrast to the wide range of literature that investigates the effects of international trade on employment levels or on wages, we focus on the composition of occupations within an establishment. To our knowledge, this paper is the first that examines these disaggregated effects by using a combination of a detailed, establishment-level data base that covers more than three decades and a very accurate approach of assigning trade flows to every single industry.

The rest of the paper is organized as follows. In the following section we present stylized facts about changes in the employment structure in Germany and the openness to international trade. Section 3 shows and discusses the data set, the matching approach to add information concerning trade flows to the core data set and the estimation strategy. Section 4 presents empirical findings. The final section concludes and summarizes.

2 Stylized Facts

Using the occupation of each employee[5] rather than the classification of economic activities of each establishment it can be shown that the servitization measured at the firm-level is much higher than indicated by standard measurements at the industry-level. Thus, there is an increasing proportion of manufacturing establishments that engages in services (see Henze (2014)).

Figure 1 shows the growth of service occupations in general and in particular within

[5]The data set contains information about the tasks of each employee according to the Blossfeld classification of occupations (Blossfeld (1987)). A detailed overview about the occupational groups we consider is provided in Appendix 1.

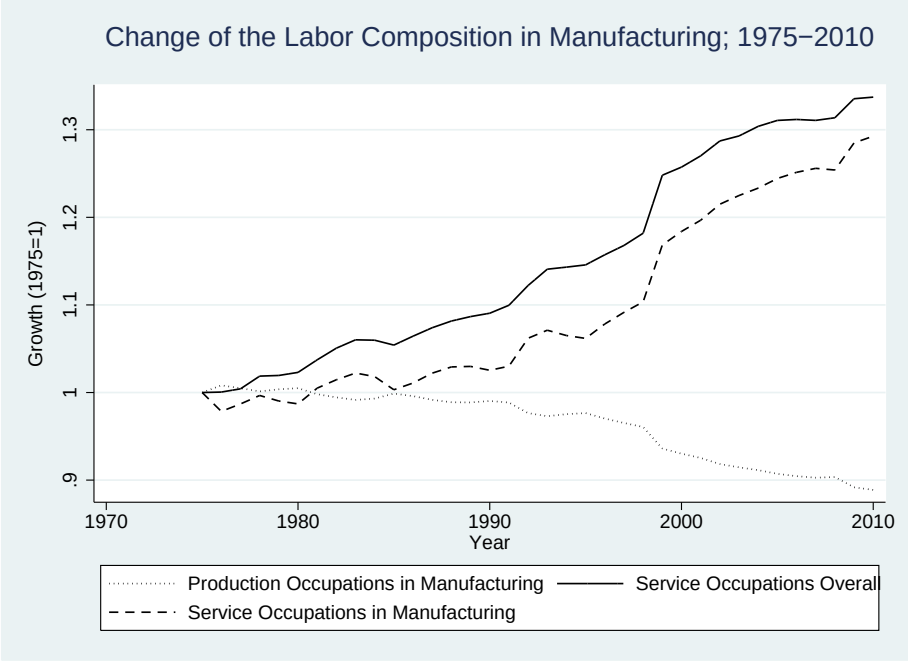

Figure 1:
Growth of Service Occupations (1975=1)
Source: "Establishment History Panel", authors' computation.

the manufacturing sector between 1975 and 2010 in Germany. It illustrates the share of employees within establishments that perform manufacturing or service tasks. On the basis of the Blossfeld occupational groups, it is possible to distinguish between the occupations of employees as bundle of tasks related to service or manufacturing activities. The solid line in Figure 1 shows that the average share of service occupations over all establishments and industries increased by almost 34% which is in line with the previous mentioned growth rates of occupations. Furthermore, if the establishments of the service sectors are excluded, it becomes clear that most to the growth of service occupations occurred within the manufacturing sector. The share of service occupations within establishments that are classified as manufacturers grew by 29% in the 1975 to 2010 period. In contrast, tasks that are related to production occupations decreased by 12%. These findings highlight the substantial change of the labor composition, especially within the manufacturing sector.
Table 1 distinguishes between different occupational groups according to the Blossfeld classification. The depicted employment growth of each occupational group within the German manufacturing sector[6] shows that the employment structure has changed significantly in the 1975-2010 period. While the low-skilled and skilled

[6]Here, all manufacturing establishments with at least 20 employees are included. We have to restrict the establishment size since the Survey of Production, our basis for the derivation of German export flows, only captures establishments with at least 20 employees. For further information see Chapter 3.

Table 1: Growth of Blossfeld Occupational Groups within Manufacturing, 1975-2010

Occupational Group	Abs. Employment (1975)	Growth overall
Production		
Unskilled manual occupations	1.506.494	-33,66%
Skilled manual occupations	934.780	-14,60%
Technicians	269.634	+4.74%
Engineers	82.243	+105.81%
Services		
Unskilled services	306.833	-18.91%
Skilled Services	22.146	-19.32%
Semiprofessions	10.684	+66.26%
Professions	7765	+51.33%
Administration		
Unskilled commercial and administrational occupations	196.622	+6.31%
Skilled commercial and administrational occupations	412.995	+20.01%
Managers	70.592	+17,05%

Source: "Establishment History Panel", authors' computation.

occupations in production and services decreased by 15-34%, the most skilled occupational groups experienced an increase of 51-106%. In administration, all groups have grown by 6-20% since 1975. Altogether, the calculations highlight that the occupational groups that require the highest qualifications levels (e.g. engineers, professions) are characterized by the highest employment growth rates.

Figure 2 illustrates the growth of service tasks within manufacturing establishments along with the growth of German foreign trade. The trade data are derived from the United Nations Commodity Trade Statistics Data Base (UN ComTrade) and contain all German imports and exports of goods between 1975 and 2010. The real trade volume of Germany in 2010 is almost five times higher than it was in 1975. By combining the increasing engagement of Germany in international trade with the growth of service occupations in Figure 2, it becomes clear that these two issues follow a very similar course.

To summarize, our data show a severe change in the composition of the German labor force. Service occupations, especially within manufacturing, grow rapidly. The shift of labor demand occurs either because manufacturers increasingly engage in

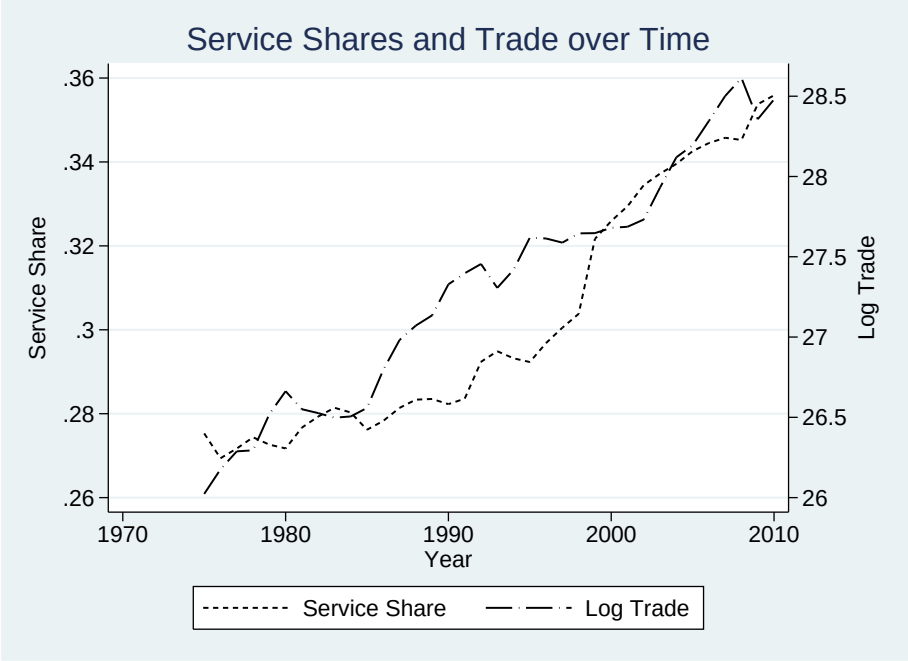

Figure 2:
Growth of Service Occupations and Trade
Source: "Establishment History Panel" and "UN Commodity Trade Statistics Data base", authors' computation.

complementary services or the international environment requires changes in the occupational mix.[7]

In the following section, we describe the data we use and the matching approach in more detail. Afterwards, we develop an empirical model that analyzes the causal relationship between the increasing engagement in international trade and the changing employment structure.

3 Empirical Setup

3.1 Data

We base our calculations on the "Establishment History Panel" (in German: Betriebs-Historik Panel (BHP)) provided by the Research Data Centre of the Ger-

[7]Kelle (2012) shows that an increasing number of manufacturers offer complementary services such as advertising, data processing, assembly and maintenance services. Biscourp & Kramarz (2007) find that the demand for engineering and managerial labor increases as an effect of rising imports. Davidson et al. (2013) argue that establishments that engage in international trade need to recruit more employees performing service tasks since exporting or receiving imports require additional operations such as logistics, marketing, information on foreign preferences, regulations or laws.

man Federal Employment Office.[8] The Establishment History Panel is a detailed micro-level data set that covers all establishments in Germany from 1975 to 2010 (for the 1975-1990 period, it includes only establishments in Western Germany) with at least one employee subject to social insurance contributions before June 30th of the respective year.[9] For our calculations, we are able to use a 50% random sample of the entire data set. The BHP builds on the Employee-History (in German: Beschäftigten-Historik (BeH)) of the IAB. It cumulates the individual data of the BeH to the establishment level and allocates individual establishment numbers ("artificial establishment number") to each business unit. Thus, it is possible to identify the establishments in subsequent years and create a panel data set for the entire 1975-2010 period. Because the Establishment History Panel is based on the Employee-History, it provides very detailed information on the general employment structure of each establishment, e.g. the total number of full-time and part-time employees, the share of female employees, the composition of employment regarding employees' educational and vocational qualifications, the wage structure, the age composition and the occupational status according to the Blossfeld occupational groups (Blossfeld (1987) and Appendix 1) that allows to distinguish between employees with service and production tasks. Furthermore, by reporting the number of engineers and scientists within an establishment, the BHP includes a proxy for investments in R&D. In addition, the data set also contains information on general establishment characteristics, such as the respective artificial establishment number, the first and last appearance of the respective establishment, the district code and the 3-digit classification of economic activities.[10] For this paper, we concentrate our empirical analysis on the manufacturing sector.

We match the BHP with a data set that contains constructed time-consistent industry codes, because the classification of economic activities changes several times within the 1975-2010 period.[11] Hence, we are able to control for industry-specific effects at the 3-digit level according to the classification of economic activities 93 (w93) in our regressions consistently.

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[8]For our research, we have access to the data via on-site use at the Research Data Centre of the German Federal Employment Agency at the Institute for Employment Research (in German: Institut für Arbeitsmarkt- und Berufsforschung (IAB)), at various external FDZ locations and via remote data access.

[9]Since 1999, there are also all establishments with at least one part-time employee included in the panel.

[10]For further information concerning the BHP see also Gruhl et al. (2012) (German Version) or Hethey-Maier & Seth (2010) (English Version).

[11]For a more detailed description concerning the construction of the data set see Eberle, Jacobebbinghaus, Ludsteck & Witter (2011).

Furthermore, because the BHP contains no information concerning any activities of establishments in international trade, we have to combine our core data set with sectoral trade data for German exports and imports. We obtain data from the United Nations Commodity Trade Statistics Data base (UN Comtrade data base) to create artificial variables of import and export intensities and import exposures for each industry over the period from 1975 to 2010.

3.2 Matching of Commodity Trade Data

To improve the matching process between the trade data in commodity classification and the BHP in industry classification, we develop a new approach. We argue that our allocation process highly improves the matching accuracy compared to standard literature approaches.

Instead of using conventional correspondence tables[12] to assign each trade commodity into the most similar industries[13], we distribute the trade flows according to the real input and output commodity shares within the German manufacturing sector.The available input-output tables for Germany are highly aggregated and only published for a short time period. Instead we use two related data sets that are provided by the German Federal Statistical Office to cover the entire 1975-2010 period of the BHP: The Input Statistics (in German: "Material- und Wareneingangserhebung im Verarbeitenden Gewerbe") to allocate the imports and generate the import intensities and the Survey of Production (in German: "Produktionserhebung im Bereich Verarbeitendes Gewerbe") to allocate German exports and generate the export intensities.

The Input Statistics is published every four years starting in 1978. It provides information on all incoming materials and commodities in Germany at the 2-digit or 3-digit level for all manufacturing industries at the 3-digit level. Hence, we are able to observe the number of products and the value each industry receives as inputs in detail. With this information we can derived the total annual value of every input commodity. Afterwards, we calculate the share each industry receives of this product.[14] Then, we allocate the import commodities according to these shares to the industries. The trade data do not distinguish between the usage of imports by recipient such as manufacturing inputs, service inputs or private and government

[12]For example correspondence tables that are provided by Eurostat or the UN Statistics Division: http://ec.europa.eu/eurostat/ramon/ or http://unstats.un.org/unsd/cr/registry.

[13]E.g. Altomonte et al. (2011) and Dauth, Findeisen & Südekum (2012) among many.

[14]For a detailed description of the data, the matching procedure and an overview over all classifications see Appendix 2.

consumption. Thus we weigh the commodity imports with the manufacturing share of these imports, before we allocate the commodity imports to the industries. Accordingly we avoid overestimating the importance of commodities mostly used by recipients other than manufacturing (e.g. consumer intensive goods such as textiles). By weighing the imports we additionally make sure that to a great extent only intermediates rather than final goods are accounted for.[15] The commodity specific import shares of manufacturing are obtained from the input-output tables provided by the German Federal Statistical Office.[16] Altogether, we derive the import intensity of inputs in the German manufacturing sector that looks as follows:

$$Imp_{it} = \sum_{c=1}^{N} \frac{x_{cit}}{x_{ct}} * \gamma_{ct} * Import_{ct} \tag{1}$$

where import intensity Imp_{it} is the calculated import flow into a specific industry i in year t. x_{cit} stands for the input of commodity c in this industry i in year t, x_{ct} is the total input of commodity c in year t. γ_{ct} is the share of commodity c in year t that is used as input factor in manufacturing and $Import_{ct}$ is the import flow for each commodity in a given year that the UN Comtrade data base provides. In summary, we are able to calculate the import of industry i in a given year t as the sum of all commodities that this industries receives - according to the actual share each commodity is used as input in this industry and corrected for the share of imports that is used for other purposes, e.g. private consumption.
In contrast to the "traditional" allocation process with standard correspondence tables between commodities and industries, our approach distributes the commodities much more precisely (see Appendix 3). For example, the Input Statistics show that goods of "Leather and Leather Manufactures" are used in 17 industries as an input factor. Therefore, we allocate the imports of leather proportionally to the value of leather inputs in these industries. Using a "standard" correspondence table instead,

[15] We believe that mostly recipients other than manufacturing use final good imports, whereas imports flowing into the manufacturing sector will mostly be intermediate goods. Accordingly final goods are filtered out if we only use the share of imports flowing into the manufacturing sector. The only cases in which final goods are distributed to the manufacturing sector are if either the product is used as capital input (e.g. machinery) or if the establishment is partly reselling final products. Establishments that mostly or purely resell are part of the service sector.

[16] Since the input-output tables for Germany are only available for the 1995-2010 period, we have to assume that the industry-specific input shares from 1975-1995 are constant. A comparison of later years shows that the input shares are rather stable. Therefore, our assumption seems to be appropriate.

we would essentially allocate leather imports to only four industries.[17]

To obtain the export intensities, we allocate the commodity exports using the Survey of Production. The Survey of Production reports all commodities at the 8-digit level that are produced in each industry at the 4-digit level for the 1995-2010 period.[18] Therefore, we have a very detailed insight into the output composition of each industry. The Survey of Production shows especially that most industries produce a wide range of products, including products that are typically related to other industries. The "traditional" matching procedure cannot account for this complex production structure which would lead to an incorrect allocation of trade flows to industries and therefore to a bias of any analysis that builds upon this matching approach. Analogously to our approach for the imports, we first derive the total output in terms of its value of each commodity over all industries in the German manufacturing sector. Then, we calculate the share that each industry contributes to the production of the respective good. Finally, we allocate the export values according to these shares to the industries. Thus, we calculate the export intensity in the following way:

$$Exp_{it} = \sum_{c=1}^{N} \frac{z_{cit}}{z_{ct}} * Export_{ct} \tag{2}$$

where export intensity Exp_{it} is the calculated export of industry i in year t, z_{cit} is the output of commodity c in this industry i and year t and z_{ct} stands for the total output of commodity c in year t. $Export_{ct}$ is the export flow for each commodity in a given year that we obtain by the UN Comtrade data base. Similar to the import flows, we are able to allocate the export commodities to industries on the basis of the actual production structure that the Survey of Production provides. As we mentioned previously for the import intensities, we are confident that our approach allocates the export flows much more precisely. Rather than assigning commodities to few industries primarily producing the good we distribute the export flows on the basis of the real composition of output of each industry.

Altogether, we are able to analyze the structure of the German economy in detail at the micro level and account for the intensity of each industry to international trade in a very precise way for the entire 1975-2010 period. In the following section, we introduce our empirical model to estimate the effects of an increasing openness to trade on the employment structure of German manufacturing establishments.

[17] The complete comparison of our approach to the "traditional" matching procedure is presented in Appendix 3 using the example of leather imports.

[18] We have to assume a constant output structure from 1975 to 1994 that is equal to the structure of 1995, because the survey starts only in 1995.

3.3 Estimation Strategy

This section provides a detailed discussion of our estimation strategy. In order to explain the effects of international trade on the composition of labor within German establishments, we use a fixed effects model to analyze our data set. As mentioned above, we are able to construct a very detailed panel data set of all German establishments for the 1975-2010 period.[19] We assign the respective establishment as the panel variable and thus we are able to control for a wide range of establishment heterogeneity and all establishment-specific characteristics that may also have an effect on the composition of employees. Furthermore, after matching the industry-level trade data, we can estimate the effects of international trade on the composition of labor within an establishment[20]. Our estimated fixed effects model looks as follows:

$$X_{jit} = \alpha + \beta_1 Imp_{it} + \beta_2 Exp_{it} + \delta' V_{jit} + \omega' Z_t + \lambda_i + \eta_t + \epsilon_{jit} \tag{3}$$

The dependent variable, X_{jit}, measures the share of employees in establishment j in industry i at time t that perform tasks that are attributed to services. It is constructed according to the Blossfeld classification of occupations[21] that is included in the BHP. The Blossfeld classification arranges each occupation into 12 groups regarding its qualification level and the economic sector it can be related to. Hence, we calculate the share of employees that perform tasks related to the service sector as the sum of all employees working in occupations with the occupational ranking "services" or "administration" over the total employment of the respective establishment. This indicator at the establishment-level provides a very detailed insight in the organization of work within the German manufacturing sector.
The first independent variables are Imp_{it} and Exp_{it} which measure the import and export intensities. The former variable contains the imports to Germany that we arrange according to the Input Statistics. The latter variable covers the exports of the German manufacturing industries that is matched with the help of the Survey

[19] The BHP assigns a randomly generated "artificial establishment number" to each establishment to ensure an anonymized data set but it allows us to identify the same establishments across different years. Therefore, we are able to match the yearly data and create a panel data set.

[20] Because the Survey of Production only captures establishments with at least 20 employees, we also concentrate our analysis on establishments with at least 20 employees.

[21] The classification distinguishes between occupations in production, services and administration. In addition, the occupations are ranked according to the skill level within the respective occupational category.
For further information see Blossfeld (1987).

of Production.[22] As a robustness check, we also estimate our regressions with both variables separately and with another proxy for the trade intensities, the share of imports and exports of the respective industry in relation to the total volume of trade. The estimated coefficients β_1 and β_2 show the effects on the occupational composition within establishments if the exposure of its associated industry to international trade changes.

V_{jit} is a vector of control variables at the establishment-level that control for further determinants that may affect the composition of labor, such as the establishment size, the expenditures for R&D and the share of high skilled workers.[23] Z_t is another vector of control variables. It captures further influences at the macro-level, e.g. the German GDP, a dummy variable accounting for the German reunification in 1991 and the level of education of the German population.[24]

We estimate our regression model by using a fixed-effects approach with industry-specific effects, λ_i. In addition we include year-specific effects, η_t, to account for any year specific influences such as business cycle effects or other global shocks. ϵ_{jit} represents the error term. To simplify the interpretation, we convert all variables into logarithms. Therefore, the estimated coefficients can be interpreted as elasticities.

4 Empirical Findings (Work in Progress)

This section provides our first regression results.

[22] For further information see Section 3.1 and Appendix 2 & 3.

[23] The size of an establishment is measured as the total number of full time employees and the number of engineers and scientists is a proxy for expenditures for R&D.

[24] The dummy variable controlling for the effects of the German reunification is equal to one after 1991 and equal to zero otherwise. In addition, we run our regressions separately for the years 1975-1990 and 1991-2010. The total level of education is measured as the share of citizens with post-secondary education.

Table 2: Effect of import intensity on high-skilled occupations

	Overall Effect	Effects in Sub Periods		
		1980-1989	1990-1999	2000-2010
	(1)	(2)	(3)	(4)
Import Intensity	0.0047***	-0.0015	0.0005	0.0021*
	(0.0007)	(0.0025)	(0.0011)	(0.0011)
R&D	0.1712***	0.1639***	0.1793***	0.1490***
	(0.0016)	(0.0045)	(0.0032)	(0.0032)
Plant Size	-0.1809***	-0.2308***	-0.2332***	-0.1823***
	(0.0019)	(0.0056)	(0.0039)	(0.0038)
Other Controls	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Adj. R^2	0.8747	0.9139	0.9178	0.9345
Root MSE	0.2707	0.2180	0.2134	0.2018
Prob > F	0.0000	0.0000	0.0000	0.0000
No. of Obs.	605.666	179.427	211.170	215.069

Dep. Variable: Share of high-skilled occupations

Notes: Robust standard errors in parentheses,
*** p<0.01, ** p<0.05, * p<0.1
All variables are logarithms, such that the coefficients can be interpreted as elasticities.

Table 3: Effect of import intensity on low-skilled occupations

	Overall Effect	Effects in Sub Periods		
		1980-1989	1990-1999	2000-2010
	(1)	(2)	(3)	(4)
Import Intensity	-0.0045***	0.0001	-0.0016***	0.0008
	(0.0004)	(0.0011)	(0.0006)	(0.0006)
R&D	-0.0654***	-0.0485***	-0.0615***	-0.0524***
	(0.0010)	(0.0021)	(0.0021)	(0.0026)
Plant Size	0.1201***	0.1038***	0.1370***	0.1276***
	(0.0014)	(0.0036)	(0.0033)	(0.0034)
Other Controls	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Adj. R^2	0.8984	0.9439	0.9356	0.9420
Root MSE	0.1364	0.0812	0.1014	0.1108
Prob > F	0.0000	0.0000	0.0000	0.0000
No. of Obs.	618.562	184.453	215.867	218.359

Dep. Variable: Share of high-skilled occupations

Notes: Robust standard errors in parentheses,
*** p<0.01, ** p<0.05, * p<0.1
All variables are logarithms, such that the coefficients can be interpreted as elasticities.

Table 4: Effect of export intensity on high-skilled occupations

	Overall Effect	Effects in Sub Periods		
		1980-1989	1990-1999	2000-2010
	(1)	(2)	(3)	(4)
Export Intensity	0.0048***	0.0065	-0.0010	0.0036***
	(0.0009)	(0.0065)	(0.0024)	(0.0010)
R&D	0.1667***	0.1628***	0.1779***	0.1497***
	(0.0016)	(0.0046)	(0.0032)	(0.0033)
Plant Size	-0.1727***	-0.2264***	-0.2299***	-0.1821***
	(0.0019)	(0.0057)	(0.0040)	(0.0288)
Other Controls	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Adj. R^2	0.8759	0.9128	0.9195	0.9361
Root MSE	0.2679	0.2146	0.2114	0.2004
Prob > F	0.0000	0.0000	0.0000	0.0000
No. of Obs.	562.138	161.857	195.797	204.484

Dep. Variable: Share of high-skilled occupations

Notes: Robust standard errors in parentheses,
*** p<0.01, ** p<0.05, * p<0.1
All variables are logarithms, such that the coefficients can be interpreted as elasticities.

Table 5: Effect of export intensity on low-skilled occupations

	Overall Effect	Effects in Sub Periods		
		1980-1989	1990-1999	2000-2010
	(1)	(2)	(3)	(4)
Export Intensity	-0.0031***	-0.0125***	-0.0037***	-0.0006
	(0.0005)	(0.0023)	(0.0013)	(0.0005)
R&D	-0.0656***	-0.0486***	-0.0618***	-0.0538***
	(0.0010)	(0.0021)	(0.0022)	(0.0026)
Plant Size	0.1188***	0.1044***	0.1373***	0.1294***
	(0.0015)	(0.0037)	(0.0035)	(0.0036)
Other Controls	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Adj. R^2	0.8936	0.9441	0.9360	0.9421
Root MSE	0.1376	0.0854	0.1045	0.1125
Prob > F	0.0000	0.0000	0.0000	0.0000
No. of Obs.	573.271	165.635	200.005	207.631

Dep. Variable: Share of high-skilled occupations

Notes: Robust standard errors in parentheses,
*** p<0.01, ** p<0.05, * p<0.1
All variables are logarithms, such that the coefficients can be interpreted as elasticities.

Table 6: Effect of export intensity on high-skilled occupations

	Overall Effect	Effects in Sub Periods	
		1995-1999	2000-2010
	(1)	(2)	
$\frac{\text{Export Intensity}}{\text{GDP}}$	0.0117***	-0.0037	0.0113***
	(0.0035)	(0.0169)	(0.0034)
R&D	0.1583***	0.1796***	0.1486***
	(0.0024)	(0.0058)	(0.0031)
Plant Size	-0.1908***	-0.2461***	-0.1839***
	(0.0027)	(0.0071)	(0.0038)
Other Controls	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Adj. R^2	0.9103	0.9376	0.9342
Root MSE	0.2341	0.1880	0.2038
Prob > F	0.0000	0.0000	0.0000
No. of Obs.	330.091	107.737	222.354

Dep. Variable: Share of high-skilled occupations

Notes: Robust standard errors in parentheses,
*** p<0.01, ** p<0.05, * p<0.1
All variables are logarithms, such that the coefficients can be interpreted as elasticities.

Table 7: Effect of export intensity on low-skilled occupations

	Overall Effect	Effects in Sub Periods	
		1995-1999	2000-2010
	(1)	(2)	
$\frac{\text{Export Intensity}}{\text{GDP}}$	-0.0125***	-0.0039	-0.0105***
	(0.0025)	(0.0111)	(0.0024)
R&D	-0.0560***	-0.0522***	-0.0526***
	(0.0017)	(0.0033)	(0.0026)
Plant Size	0.1357***	0.1392***	0.1314***
	(0.0024)	(0.0064)	(0.0034)
Other Controls	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Adj. R^2	0.9184	0.9544	0.9393
Root MSE	0.1308	0.0905	0.1166
Prob > F	0.0000	0.0000	0.0000
No. of Obs.	335.620	109.917	225.703

Dep. Variable: Share of high-skilled occupations

Notes: Robust standard errors in parentheses,
*** p<0.01, ** p<0.05, * p<0.1
All variables are logarithms, such that the coefficients can be interpreted as elasticities.

Table 8: Effect of import intensity on overall service occupations

	Overall Effect	Effects in Sub Periods		
		1980-1989	1990-1999	2000-2010
	(1)	(2)	(3)	(4)
Import Intensity	-0.0002	-0.0006	-0.0004**	0.0007***
	(0.0002)	(0.0005)	(0.0002)	(0.0002)
R&D	0.0085***	0.0087***	0.0135***	0.0123***
	(0.0005)	(0.0008)	(0.0007)	(0.0006)
Plant Size	-0.0262***	-0.0341***	-0.0383***	-0.0347***
	(0.0003)	(0.0014)	(0.0011)	(0.0009)
Other Controls	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Adj. R^2	0.9226	0.9577	0.9530	0.9612
Root MSE	0.0406	0.0271	0.0313	0.0302
Prob > F	0.0000	0.0000	0.0000	0.0000
No. of Obs.	359.447	87.392	127.395	144.660

Dep. Variable: Share of service and administration occupations

Notes: Robust standard errors in parentheses,
*** p<0.01, ** p<0.05, * p<0.1
All variables are logarithms, such that the coefficients can be interpreted as elasticities.

5 Appendix

Appendix 1: Structure of employees by Blossfeld occupational groups
(**Source:** Blossfeld (1987), Table 1: Classification of Occupations)

Name of Occupational Group	**Description of the Occupational Group**	**Examples**
Production		
Unskilled manual occupations (EMB)	All manual occupations that showed at least 60 percent unskilled workers in 1970	Miners, rock breakers, paper makers, wood industry occupations, printing industry occupations, welders, unskilled workers, road and railroad construction workers
Skilled manual occupations (QMB)	All manual occupations that showed at most 40 percent unskilled workers in 1970	Glassblowers, bookbinders, typesetters, locksmiths, precision instrument makers, electrical mechanics, coopers, brewers
Technicians (TEC)	All technically trained specialists	Machinery technicians, electrical technicians, construction technicians, mining technicians
Engineers (ING)	Highly trained specialists who solve technical and natural science problems	Construction engineering, electrical engineers, production designers, chemical engineers, physicists, mathematicians

Appendix 1 cont'd:

Name of Occupational Group	Description oth the Occupational Group	Examples
Service		
Unskilled services (EDB)	All unskilled personal services	Cleaners, security guards
Skilled Services (QDB)	Essentially order and security occupations as well as skilled service occupations	Locomotive engineers, registrars
Semiprofessions (SEMI)	Service positions which are characterized by professional specialization	Interpreters, Educators
Professions (PROF)	All liberal professions and service positions which require a university degree	Statisticians, economists, social scientist
Administration		
Unskilled commercial and administrational occupations (EVB)	Relatively unskilled office and commerce occupations	Postal occupations, office hands, typists
Skilled commercial and administrational occupations (QVB)	Occupations with medium and higher administrative and distributive functions	Credit and financial assistants, foreign trade assistants, data processing operators, book-keepers, goods traffic assistants
Managers (MAN)	Occupations which control factors of production as well as functionaries of organizations	Managers, business administrators, deputies, CEOs

Appendix 2:

Detailed Description of Matching Process of Commodity Trade Data

Index for Import Intensities

As the BHP is classified according to industries ("classification of economic activities") and does not contain information about firm production, we have to convert commodity import into industry import. To obtain accurate import data by industry, we use the Input Statistics to allocate import commodities obtained from the UN Comtrade Data base according to its real input shares of industry production. The Input Statistics show the use of commodity input at the 3- and 4-digit industry level.[25] Appendix 3 contains an example of the commodities "Leather and Leather Manufactures" to illustrate the allocation process.

The BHP covers the years 1975-2010 and the Input Statistics are published every four years starting in 1978. As both the product classification of the import data and of the input data vary over the years, we use correspondence tables to match import with input commodities. Table 2 shows the matching process. Column 2 and column 7 show the product classification of the UN Comtrade import data[26] and the Input Statistics respectively. Column 3 to 6 depicts the correspondence tables that we use to match the data. Partly the correspondence tables are incomplete. In these cases we directly allocate the import values into the correct Input Statistics classification "by hand" using Product Classifications for Production Statistics (in German: Güterverzeichnis für Produktionsstatistiken) provided by the German Federal Statistical Office.

As the analysis is restricted to the manufacturing sector, we additionally weigh the import data with input shares in manufacturing. Input-Output Tables[27] provided by the German Federal Statistical Office show import values by commodity according to its use. We calculate the share of imports by commodity that is used

[25] The level of commodity aggregation varies by industry. Hence we need to aggregate commodities at the 2-digit level before allocating the import values to the various industries.

[26] Import commodities are classified at the 5-digit level for both SITC classifications and at the 6-digit level for HS classifications. In case of the SITC classification import values are partly incomplete at the 5-digit level. Hence, we use 4-digit level import data (and 3-digit level import data for SITC1) for the remainder that is not included in the 5-digit data.

[27] The Input-Output Statistics are only available from 1995 onwards. For earlier years we also use the Input-Output table of 1995 and thus assume a constant pattern of import use for the years 1975-1995. A comparison of later years shows that import shares in manufacturing by commodity are rather stable. Thus it seems that our assumption is valid.

as manufacturing input to eliminate imports that are used for other purposes such as private, government or service consumption. On average we can match 99.18% of the imports.[28] After distributing the import values according to the input shares, we aggregate the import values by industry to obtain an index of import intensity for every industry. Finally, we convert the import intensity in the industry classification of the Input Statistics (Column 8) into the industry classification of the BHP (column 9).

Index for Export Intensities

The method to create export intensities is very similar to the import side. We use the Survey of Production to convert commodity exports into industry exports. The Survey of Production shows the output of industries at the 9-digit commodity level. We allocate the exports according to the real output shares of industry production. The matching process follows the method described above and is depicted in Table 3. Column interpretation is identical except that column 7 and 8 now show the Survey of Production rather than the Input Statistics. As the Survey of Production is only available from 1995 onwards, we also use the 1995 survey data to allocate exports for previous years. Thus we assume a constant output pattern until 1995. On average we can match 99.55% of the exports.[29]

[28] Before hand allocation we can successfully match 64.35% of the import values.

[29] Before hand allocation we can successfully match 63.14% of the export values.

Table 9: Matching Process for Import Data

Import Data		Correspondence Tables								Input Statistics				BHP	
(1)	(2)		(3)		(4)		(5)		(6)	(7)		(8)		(9)	
Year	Product Classification		Correspondence 1		Correspondence 2		Correspondence 3		Correspondence 4	Product Classification	Year	Industry Classification		Industry Classification	Year
1975	SITC1	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	WI75	1978	Sypro	to	WZ93	1975
1976	SITC1	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	WI75	1978	Sypro	to	WZ93	1976
1977	SITC1	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	WI75	1978	Sypro	to	WZ93	1977
1978	SITC2	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	WI75	1978	Sypro	to	WZ93	1978
1979	SITC2	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	WI75	1978	Sypro	to	WZ93	1979
1980	SITC2	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	GP82	1982	Sypro	to	WZ93	1980
1981	SITC2	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	GP82	1982	Sypro	to	WZ93	1981
1982	SITC2	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	GP82	1982	Sypro	to	WZ93	1982
1983	SITC2	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	GP82	1982	Sypro	to	WZ93	1983
1984	SITC2	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	GP82	1986	Sypro	to	WZ93	1984
1985	SITC2	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	GP82	1986	Sypro	to	WZ93	1985
1986	SITC2	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	GP82	1986	Sypro	to	WZ93	1986
1987	SITC2	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	GP82	1986	Sypro	to	WZ93	1987
1988	SITC2	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	GP89	1990	Sypro	to	WZ93	1988
1989	SITC2	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	GP89	1990	Sypro	to	WZ93	1989
1990	SITC2	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	GP89	1990	Sypro	to	WZ93	1990
1991	HS 1992	to	Prodcom95	to	Prodcom94	to	GP95	to		GP89	1990	Sypro	to	WZ93	1991
1992	HS 1992	to	Prodcom95	to	Prodcom94	to	GP95	to		GP89	1994	Sypro	to	WZ93	1992
1993	HS 1992	to	Prodcom95	to	Prodcom94	to	GP95	to		GP89	1994	Sypro	to	WZ93	1993
1994	HS 1992	to	Prodcom95	to	Prodcom94	to	GP95	to		GP89	1994	Sypro	to	WZ93	1994
1995	HS 1992	to	Prodcom95	to	Prodcom94	to	GP95	to		GP89	1994	Sypro	to	WZ93	1995
1996	HS 1992	to	Prodcom95	to	Prodcom94	to				GP95	1998	WZ93	to	WZ93	1996
1997	HS 1992	to	Prodcom95	to	Prodcom94	to				GP95	1998	WZ93	to	WZ93	1997
1998	HS 1992	to	Prodcom95	to	Prodcom94	to				GP95	1998	WZ93	to	WZ93	1998
1999	HS 1992	to	Prodcom95	to	Prodcom94	to				GP95	1998	WZ93	to	WZ93	1999
2000	HS 1992	to	Prodcom95	to	Prodcom94	to	GP95	to		GP02	2002	WZ93	to	WZ93	2000
2001	HS 1992	to	Prodcom95	to	Prodcom94	to	GP95	to		GP02	2002	WZ93	to	WZ93	2001
2002	HS 2002	to	Prodcom2002	to						GP02	2002	WZ93	to	WZ93	2002
2003	HS 2002	to	Prodcom2002	to						GP02	2002	WZ93	to	WZ93	2003
2004	HS 2002	to	Prodcom2002	to						GP02	2006	WZ03	to	WZ03	2004
2005	HS 2002	to	Prodcom2002	to						GP02	2006	WZ03	to	WZ03	2005
2006	HS 2002	to	Prodcom2002	to						GP02	2006	WZ03	to	WZ03	2006
2007	HS 2002	to	Prodcom2002	to						GP02	2006	WZ03	to	WZ03	2007
2008	HS 2007	to	Prodcom2008	to						GP09	2010	WZ08	to	WZ08	2008
2009	HS 2007	to	Prodcom2008	to						GP09	2010	WZ08	to	WZ08	2009
2010	HS 2007	to	Prodcom2008	to						GP09	2010	WZ08	to	WZ08	2010

Notes:

For 1975-1977: 3-level Matching: SITC 1 trade data at 5-digit level; remainder at 4-digit and 3-digit level.
For 1978-1990: 2-level Matching: SITC 1 trade data at 5-digit level; remainder at 4-digit level.

Table 10: Matching Process for Export Data

Export Data			Correspondence Tables					Survey of Production				BHP	
(1)	(2)		(3)		(4)		(5)	(6)		(7)		(8)	
Year	Product Classification		Correspondence 1		Correspondence 2		Correspondence 3	Product Classification	Year	Industry Classification		Industry Classification	Year
1975	SITC1	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	1995	WZ93	to	WZ93	1975
1976	SITC1	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	1995	WZ93	to	WZ93	1976
1977	SITC1	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	1995	WZ93	to	WZ93	1977
1978	SITC2	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	1995	WZ93	to	WZ93	1978
1979	SITC2	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	1995	WZ93	to	WZ93	1979
1980	SITC2	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	1995	WZ93	to	WZ93	1980
1981	SITC2	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	1995	WZ93	to	WZ93	1981
1982	SITC2	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	1995	WZ93	to	WZ93	1982
1983	SITC2	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	1995	WZ93	to	WZ93	1983
1984	SITC2	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	1995	WZ93	to	WZ93	1984
1985	SITC2	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	1995	WZ93	to	WZ93	1985
1986	SITC2	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	1995	WZ93	to	WZ93	1986
1987	SITC2	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	1995	WZ93	to	WZ93	1987
1988	SITC2	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	1995	WZ93	to	WZ93	1988
1989	SITC2	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	1995	WZ93	to	WZ93	1989
1990	SITC2	to	SITC3	to	Prodcom95	to	Prodcom94	to	GP95	1995	WZ93	to	WZ93	1990
1991	HS 1992	to	Prodcom94	to					GP95	1995	WZ93	to	WZ93	1991
1992	HS 1992	to	Prodcom94	to					GP95	1995	WZ93	to	WZ93	1992
1993	HS 1992	to	Prodcom94	to					GP95	1995	WZ93	to	WZ93	1993
1994	HS 1992	to	Prodcom94	to					GP95	1995	WZ93	to	WZ93	1994
1995	HS 1992	to	Prodcom94	to					GP95	1995	WZ93	to	WZ93	1995
1996	HS 1992	to	Prodcom94	to					GP95	1996	WZ93	to	WZ93	1996
1997	HS 1992	to	Prodcom94	to					GP95	1997	WZ93	to	WZ93	1997
1998	HS 1992	to	Prodcom94	to					GP95	1998	WZ93	to	WZ93	1998
1999	HS 1992	to	Prodcom94	to					GP95	1999	WZ93	to	WZ93	1999
2000	HS 1992	to	Prodcom94	to					GP95	2000	WZ93	to	WZ93	2000
2001	HS 1992	to	Prodcom94	to					GP95	2001	WZ93	to	WZ93	2001
2002	HS 2002	to	Prodcom2002	to					GP02	2002	WZ93	to	WZ93	2002
2003	HS 2002	to	Prodcom2002	to					GP02	2003	WZ03	to	WZ03	2003
2004	HS 2002	to	Prodcom2002	to					GP02	2004	WZ03	to	WZ03	2004
2005	HS 2002	to	Prodcom2002	to					GP02	2005	WZ03	to	WZ03	2005
2006	HS 2002	to	Prodcom2002	to					GP02	2006	WZ03	to	WZ03	2006
2007	HS 2002	to	Prodcom2002	to					GP02	2007	WZ03	to	WZ03	2007
2008	HS 2002	to	Prodcom2002	to					GP02	2008	WZ03	to	WZ03	2008
2009	HS 2007	to	Prodcom2008	to	Prodcom2009	to			GP09	2009	WZ08	to	WZ08	2009
2010	HS 2007	to	Prodcom2008	to	Prodcom2009	to			GP09	2010	WZ08	to	WZ08	2010

Notes:

For 1975-1977: 3-level Matching: SITC 1 trade data at 5-digit level; remainder at 4-digit and 3-digit level.
For 1978-1990: 2-level Matching: SITC 1 trade data at 5-digit level; remainder at 4-digit level.

Appendix 3:

This section provides a comparison between our matching approach and the "traditional" matching procedure of using a correspondence table between commodities and industries where each commodity is allocated to the industry that is the most similar one. By taking the Input Statistics into account, we are able to distribute the value of each imported commodity in a respective year over all industries exactly according to the Input Statistics. Here, we present the comparison using the example of imports of "Leather and Leather Manufactures" (in German: "Leder und Lederwaren") including footwear. It becomes obvious that we are able to distribute the commodities much more precisely. According to the Input Statistics, we allocate leather imports proportionately to 17 industries while the "traditional" matching procedure would assign only four industries to leather imports.

Allocation of Imports of "Leather and Leather Manufactures" to the Industries of the BHP

"Our Approach"

Figure 3 illustrates the allocation of leather imports to the industries of the BHP. All industries that receive less than 0.5% of the import values are summarized as "Rest".

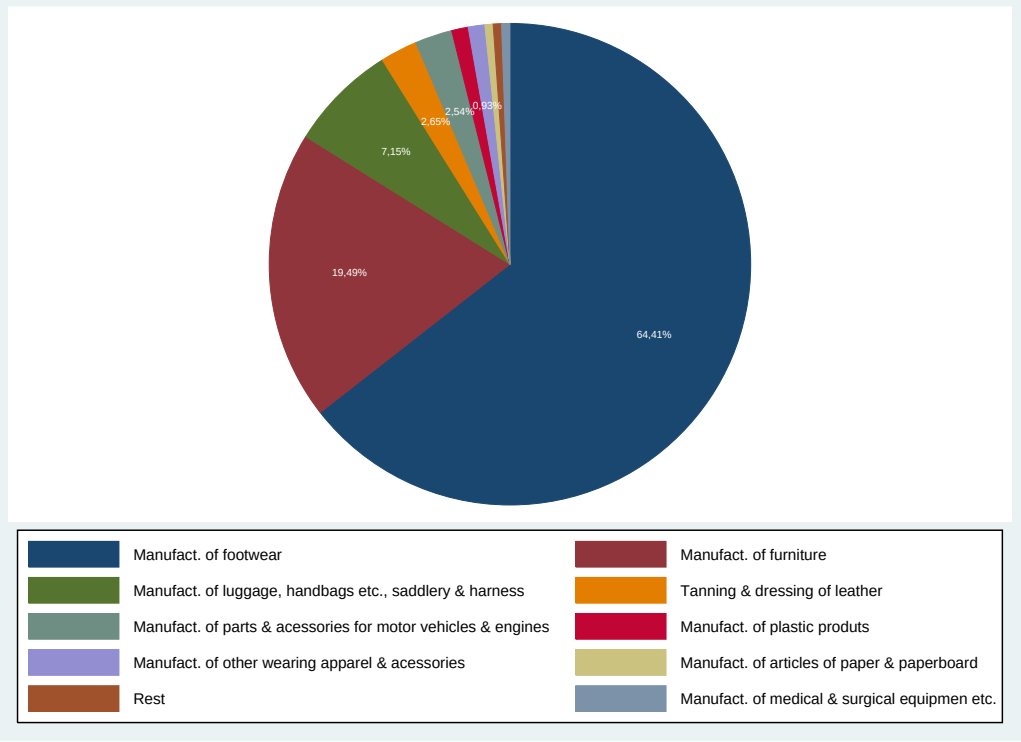

Figure 3:
Allocation of Leather Imports to the Industries of the BHP
Source: "UN Comtrade Database and Input Statistics."

Table 4 presents the allocation in more detail:

Table 11: Allocation of Leather Imports to the Industries of the BHP

GP 2002	WZ 1993	Share	Industry
19	102	0.00026313	Mining and agglomeration of lignite
19	174	0.00136164	Manufacture of made-up textile articles, except apparel
19	175	0.00033050	Manufacture of other textiles
19	182	0.00927598	Manufacture of other wearing apparel and acessories
19	191	0.02651121	Tanning and dressing of leather
19	192	0.07146845	Manufacture of luggage, handbags and the like, saddlery and harness
19	193	0.64408863	Manufacture of footwear
19	212	0.00616514	Manufacture of articles of paper and paperboard
19	221	0.00040870	Publishing
19	222	0.00072203	Printing and service activities related to printing
19	252	0.01072427	Manufacture of plastic produts
19	286	0.00135952	Manufacture of cutlery, tools and general hardware
19	331	0.00556807	Manufacture if medical and surgical equipment and orthopaedic appliances
19	343	0.02539422	Manufacture of parts and acessories for motor vehicles and their engines
19	361	0.19478314	Manufacture of furniture
19	365	0.00027423	Manufacture of games and toys
19	366	0.00130114	Miscellaneous manufacturing n.e.c.

Notes:

This example presents how we distribute leather imports (product classification "GP 2002" = 19)
to all industries that use leather as inputs according to the Input Statistics.

Source: "UN Comtrade Database and Input Statistics".

Allocation of Exports of "Leather and Leather Manufactures" to the Industries of the BHP

"Our Approach"

According to the Survey of Production, Figure 3 illustrates the allocation of leather exports to the industries of the BHP. All industries that produce less than 0.5% of the export values are summarized as "Rest". In addition, "Rest" also contains industries that are classified as confidential, i.e. the respective share of export values is unknown. These industries are classified as confidential since they include less than two firms that produce leather goods.

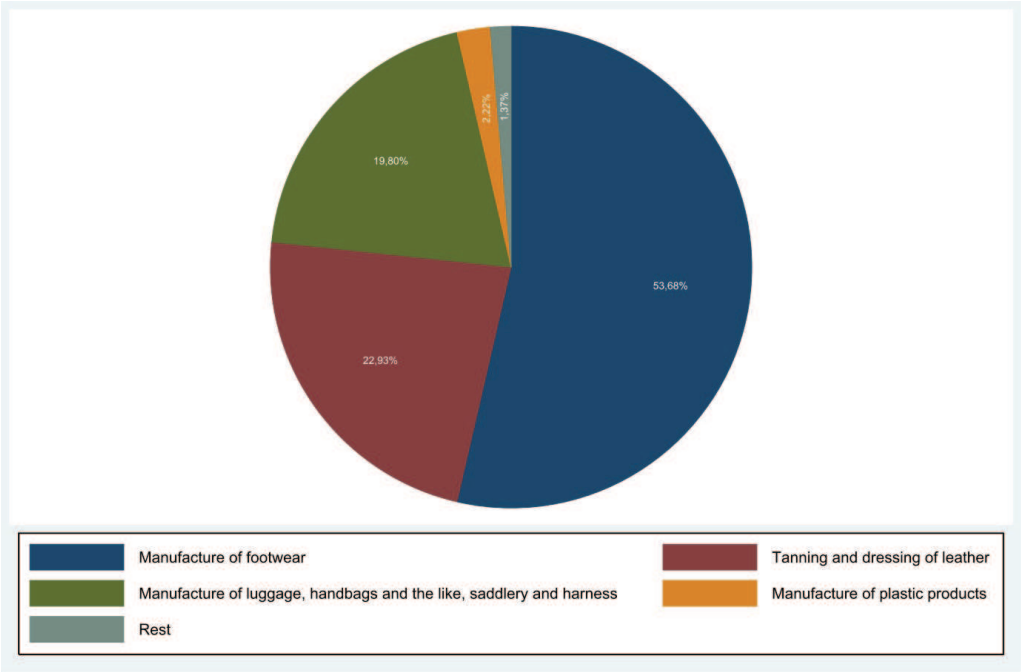

Figure 4:
Allocation of Leather Exports to the Industries of the BHP
Source: "UN Comtrade Database and Survey of Production."

Table 9 presents the allocation in more detail:

Table 12: Allocation of Leather Exports to the Industries of the BHP

GP 2002	WZ 1993	Share	Industry
19	174	.0024244	Manufacture of made-up textile articles, except apparel
19	175	.*	Manufacure of other textiles
19	177	.*	Manufacture if knitted and crocheted articles
19	182	.0003852	Manufacture of other wearing apparel and accessories
19	191	.2293406	Tanning and dressing of leather
19	192	.1979861	Manufacture of luggage, handbags and the like, saddlery and harness
19	193	.5367885	Manufacture of footwear
19	212	.000902	Manufacture of articles of paper and paperboard
19	221	.*	Publishing
19	222	.*	Printing and service activities related to printing
19	246	.*	Manufacture of other chemical products
19	247	.*	Manufacture of man-made fibers
19	251	.0003326	Manufacture of rubber products
19	252	.0222259	Manufacture of plastic products
19	261	.*	Manufacture of glass and glass products
19	291	.*	Manufacture if machinery for the production and use of mechanical power
19	292	.*	Manufacture of other general purpose machinery
19	295	.*	Manufacture of other special purpose machinery
19	331	.0006351	Manufacture of medical and surgical equipment and orthopaedic appliances
19	332	.*	Manufacture of instruments and appliances for measuring, navigating and other purposes
19	343	.*	Manufacture of parts and accessories for motor vehicles and their engines
19	354	.*	Manufacture of motorcycles and bicycles
19	361	.*	Manufacture of furniture
19	366	.*	Miscellaneous manufacturing n.e.c.

Notes:

This example presents how we distribute leather exports (product classification "GP 2002" = 19)
to all industries that produce leather goods according to the Survey of Production.

* 15 missing industries due to confidentiality (insufficient number of firms that produce leather goods within these industries).

Source: "UN Comtrade Database and Survey of Production".

"Traditional Approach"

Figure 4 shows the allocation of leather imports to the industries of the BHP if a single correspondence list (here from the UN Statistics Division) is used, as e.g. by Altomonte et al. (2011) and Dauth, Findeisen & Südekum (2012) among many.

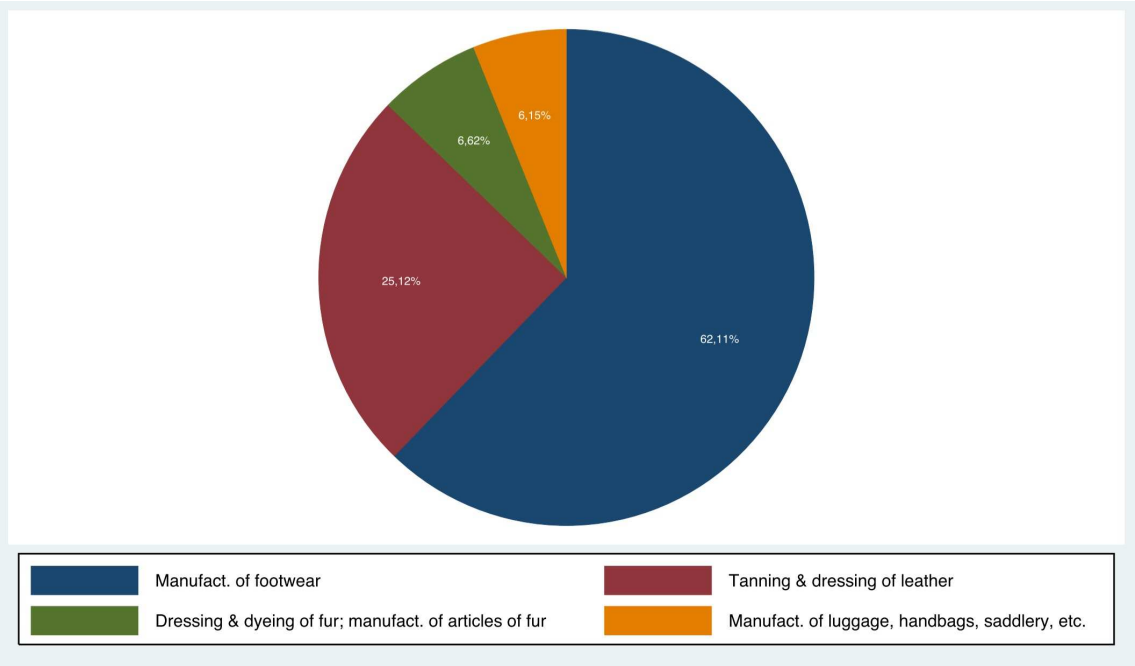

Figure 5:
Allocation of Leather Imports to the Industries of the BHP
Source: "UN Comtrade Database" and UN Statistics Division.

Table 5 presents the allocation in more detail. It becomes obvious that this approach would assign only four industries to all leather imports.

Table 13: Allocation of Leather Imports to the Industries of the BHP

SITC, Rev. 3	WZ 1993	Share	Industry
61 & 85	191	0.25124481	Tanning and dressing of leather
61 & 85	192	0.06148816	Manufacture of luggage, handbags and the like, saddlery and harness
61 & 85	183	0.06618976	Dressing and dyeing of fur; manufacture of articles of fur
61 & 85	193	0.62107728	Manufacture of footwear

Notes:

This example presents the "traditional" matching procedure of leather imports. Here, we combine the SITC, Rev. 3 commodity groups 61 ("Leather, Leather Manufactures, n.e.s., and dressed Furskins") and 85 ("Footwear"). Thus, this commodity group contains the same goods as the "GP 2002" group above.

Source: "UN Comtrade Database" and UN Statistics Division.

Table 14: Comparison of matched Commodity Trade Flows before and after Hand Allocation

Year	Imports		Exports	
	After Hand Allocation	**Before Hand Allocation**	**After Hand Allocation**	**Before Hand Allocation**
1975	98.54%	43.05%	97.88%	68.64%
1976	98.44%	42.75%	98.24%	68.75%
1977	98.21%	48.09%	98.42%	69.70%
1978	99.30%	45.67%	99.95%	54.81%
1979	99.38%	44.88%	99.95%	54.83%
1980	99.73%	43.97%	99.95%	54.39%
1981	99.76%	42.41%	99.92%	53.21%
1982	99.76%	42.34%	99.93%	52.33%
1983	99.75%	43.56%	99.94%	52.45%
1984	99.76%	44.35%	99.96%	52.36%
1985	99.74%	44.35%	99.95%	52.58%
1986	99.72%	48.79%	99.96%	53.17%
1987	99.73%	49.64%	99.96%	52.61%
1988	95.15%	48.44%	99.97%	53.48%
1989	95.45%	48.51%	99.97%	52.85%
1990	95.13%	47.48%	99.97%	52.98%
1991	99.89%	60.25%	100.00%	61.35%
1992	99.87%	61.08%	100.00%	60.92%
1993	99.89%	61.52%	100.00%	60.10%
1994	99.86%	62.31%	100.00%	61.16%
1995	99.88%	63.50%	100.00%	61.31%
1996	100.00%	78.86%	100.00%	60.85%
1997	100.00%	78.45%	100.00%	61.19%
1998	98.63%	80.69%	100.00%	61.50%
1999	100.00%	80.83%	100.00%	60.68%
2000	99.52%	78.28%	100.00%	58.88%
2001	99.49%	77.78%	100.00%	60.91%
2002	99.46%	93.36%	100.00%	76.70%
2003	99.48%	93.51%	100.00%	73.61%
2004	99.50%	93.78%	100.00%	73.32%
2005	99.54%	93.72%	100.00%	75.52%
2006	99.59%	93.67%	100.00%	74.75%
2007	99.56%	93.20%	100.00%	71.87%
2008	99.60%	79.86%	100.00%	71.67%
2009	99.56%	82.19%	94.99%	93.87%
2010	99.65%	81.38%	94.96%	93.84%
Average	99.18%	64.35%	99.55%	63.14%

Notes:

In the years from 2002 to 2010 we eliminate imports classified as HSCode 999999 "Commodities not specified according to kind" since we are not able to match these imports with commodities in the Input Statistics at all.

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