Trade Exposure of Western Europe to China and Eastern Europe: A spatial econometric analysis of the effects on regional manufacturing employment from 1991-2011

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Abstract

This study analyzes the effects of increased trade with China and Eastern Europe on manufacturing employment in 1,146 NUTS-3 regions of 17 Western European countries from 1991 to 2011. Building on Autor et al. (2013) we aim at identifying the causal effects of an increase in import and export exposure on regional manufacturing employment, thereby, explicitly accounting for labor and product market spillovers. Overall, our results support previous findings of a negative effect of increased import exposure from China for our sample of Western European countries, whereas spatial spillover effects turn out to be positive, slightly mitigating the quantitative impact without changing results quantitatively. Moreover, our cross-country study highlights the pronounced heterogeneity of the estimated effects of trade exposure on manufacturing employment across countries with respect to the trade balance.

Keywords: International Trade · Globalization · Western Europe · China · Eastern Europe · Employment

JEL Classification: F16 · J31 · R11

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1 Introduction

Since the early 1990s, manufacturing imports of Western European countries from China and Eastern Europe have increased almost tenfold. During the same period the number of employees in manufacturing and their share in overall employment fell significantly. In public debates, these two trends are often interpreted as being related with each other in a causal way. The present paper addresses the question of whether this prominent feature of globalization, namely the increase in imports from and exports to China and (wider) Eastern Europe, has in fact caused a significant change in manufacturing employment.

This study is hence related to a strand of the literature triggered by Autor et al. (2013), who estimate the effect of increased import competition from China on US regions' manufacturing employment (and various other outcome variables). Dauth et al. (2014) provide a similar analysis for German regions. This study follows closely the methodological approach by Autor et al. (2013), at the same time it complements and goes beyond previous studies in making the following contributions:

First, we provide an analysis of the employment effects of trade for a new dataset of 17 Western European countries[1] over the period 1991 to 2011. The sample comprises 1,146 NUTS-3 regions, as compared to 722 US commuting areas in Autor et al. (2013) and 413 German counties in Dauth et al. (2014). The use of several countries allows us to test for differences in the effect of import competition and then systematically explore the role of the trade balance in shaping the outcome. Second, unlike previous studies, we do not treat regions as isolated economies but estimate labor- and product market related spillover effects. Since all countries are part of the European Economic Area and thus highly integrated, we expect these spillovers to occur nationally and internationally and distinguish between these two types of spillovers in the estimation.[2]

The remainder of the paper is organized as follows: Section 2 introduces the dataset, comprising regions' employment, trade as well as socio-economic characteristics, and defines our key explanatory variables, import and export exposure. Section 3 discusses the basic empirical framework, the instrumental

[1] The countries include Germany as analyzed separately in Dauth et al. (2014).

[2] Autor et al. (2013) use commuting zones to define local labor markets; this addresses labor market spillovers, but not product market spillovers. Dauth et al. (2014) use NUTS3 regions, which are likely to be subject to both labor and product market spillovers (though they use commuting zones in the robustness analysis.

variable approach used in the estimation, and the potential role of spillover effects and their spatial econometric specification. 4 presents the estimation results, Section 5 concludes.

2 Data

2.1 Basic Data

The cross-section dimension of our sample comprises 1,146 regions from 17 Western European countries (see Table A1 in the Appendix). Data is observed for years around 1991, 2001 and 2011, part of it disaggregated into NACE 2- and 3-digit industries. Specifically, three groups of variables are required: i) regional employment by industry, ii) trade at the country level by industry, and iii) various control variables, describing the regions' socio-economic characteristics.

Trade data has been taken from UN ComTrade, data on regional employment and socio-economic characteristics has been collected and compiled from various sources, mainly from census data of the national statistical offices of the 17 Western European countries. Censuses took place approximately every 10 years, around 1991, 2001, and 2011, yielding two ten-year windows for each country.

For three countries (Germany, Italy, Netherlands), where the required census data is unavailable, we have referred to alternative sources: i) Germany (no census until 2011): Sample of Integrated Labour Market Biographies (SIAB) by the Institute for Employment Research (IAB), ii) Italy (no detailed industry data in population census): Business census, and iii) the Netherlands (only "virtual" census since 1971): CBS Enquete beroepsvolking.

The time dimension of our sample comprises three years (1991, 2001 and 2011), which are used as reference dates throughout the paper. For 9 countries[3], data is available for exactly these years, for the other countries, observation dates differ slightly from the reference years: for 4 countries[4], we have 1990, 2000, 2010; for 2 countries[5] 1993, 2003, 2013; for Ireland 1991, 2002, 2011 and France 1990, 1999, 2010. Table A1 in the Appendix gives an

[3]Austria, Belgium, Denmark, Greece, Italy, Portugal, Spain, Sweden and United Kingdom.
[4]Finland, Luxembourg, Norway and Switzerland
[5]Germany and Netherlands.

overview of the data sources and time frames for each country. The Online Appendix provides further details regarding the compilation of the data set.

The regional units of observation comprise 1,146 NUTS-3 regions (NUTS Version 2013) in Western Europe (see Table A1 in the Appendix). They represent the third layer of national regional administration and should be populated between 150,000 and 800,000 people. In Italy, e.g., these regions are the provinces, in France departements (”Arrondissements”), in Germany districts (”Kreise”) and in the United Kingdom districts and boroughs. The border of some NUTS-3 regions changed over the years. Wherever possible, consistent definitions have been obtained by aggregating previously split regions or calculating the values for the newly created regions based on smaller regional aggregates. For some regions, this turned out to be infeasible such that their regional boundaries change slightly over time.

Employment data is broken down at the 2-digit or 3-digit NACE industry level (NACE Version 1.0), the granularity depending on data availability. For most countries, the data source is a special extraction of census data. Some data is only available in different versions of the NACE classification or national classifications. They have all been transformed to a consistent classification based on correspondence tables (Eberle et al., 2014) or manual assignment. Thus, some industry codes may have slightly varying definitions over countries and time.[6]

National trade data by 3- to 5-digit SITC commodity codes (Rev 3.0) from UN ComTrade has been extracted for trade between the 17 Western European countries and China, plus, as defined in Dauth et al. (2014), the Eastern European Accession countries[7] and wider Eastern Europe[8]. Import and export data by commodity (3-digit to 5-digit SITC) has been assigned to NACE industries (2- and 3-digit NACE) using correspondence tables by the World Bank (2017). Furthermore, country- and import and export deflators, obtained from the AMECO database of the European Commission, and Euro-Dollar exchange rates from Eurostat are used to calculate real trade values in Euros (base year: 2010) To exclude trade which does not entail local labor,

[6]Eurostat publishes manufacturing employment numbers at the country-level for some of the countries and years in our sample. When aggregating our regional NUTS3-data, compiled from different sources, we match the Eurostat figures very closely.

[7]The group of the Eastern European Accession countries includes Bulgaria, Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania, Slovakia, Slovenia.

[8]The countries included in the wider Eastern Europe group are Azerbaijan, Belarus, Georgia, Kyrgyzstan, Kazakhstan, Moldova, Russia, Former USSR, Tajikistan, Turkmenistan, Ukraine, Uzbekistan.

re-exports and re-imports are subtracted from the trade figures. More details on the transformations with respect to trade data are available in the Online Appendix.

In our empirical analysis, several control variables will be used: shares of female, high- and low-skilled and foreign workers in total employment[9]. Wherever available, control variables have been extracted from the same database as the employment data. More details on the collection and transformations of the control variables can be found in the Online Appendix.

2.2 Import and Export Exposure

Patterns of industrial specialization differ substantially, both across countries and even more so across regions. Moreover, import exposure, which will be defined more precisely below, varies strongly across industries. This provides a valuable source of variation in the data for estimating the employment effects of import exposure, since regions should be affected differently by imports according to their industry structure. E.g., if there is an increase in overall imports of goods, in which a specific region is specialized in production, this region will experience a stronger increase in competition and be more affected.

To measure (the change of) the extent, to which a region is exposed to imports, we follow the approach suggested by Autor et al. (2013) and define the change in import exposure (ΔE^M) as the change in total imports (M) in industry j per employed person (L) in country i's region r coming from partner country (group) p. The change in imports is then assigned to country i's region r according to its share in country i's total employment in industry j. Overall import exposure ($E^M_{i_r pt}$) of region i_r from partner country p is then obtained by summing the import changes in industry j assigned to region i_r over all industries:

$$\Delta E^M_{i_r pt} = \sum_{j=1}^{J} \frac{L_{i_r jt}}{L_{ijt}} \frac{\Delta M^p_{ijt}}{L_{i_r t}} \tag{1}$$

where $L_{i_r jt}$ is employment of country i's region r in industry j in year t.

Autor et al. (2013) obtain import exposure as determinant of employment from a theoretical trade model with monopolistic competition and industry

[9]Because of data availability shares for some regions can also be shares of female, high- and low-skilled and foreign inhabitants in total regional population.

labor productivity differences across countries. In their transition to the empirical model, they assume that the share of the trade deficit in total expenditure (ρ_{i_r}) is constant across US regions and can hence be absorbed in a cross-section invariant factor of import exposure that is immaterial in the estimation. We stick with this assumption regarding the trade balance of regions within countries ($\rho_{i_r} = \rho_i$), but account for the observed variation in the trade deficit across countries (since generally, $\rho_i \neq \rho_j$ for $i \neq j$).

This leads to the following modified expression of the change in import exposure:

$$\Delta E^{\rho M}_{i_r pt} = -\rho^p_{it} \Delta E^M_{i_r pt} = -\rho^p_{it} \sum_{j=1}^{J} \frac{L_{i_r jt}}{L_{ijt}} \frac{\Delta M^p_{ijt}}{L_{i_r t}}, \tag{2}$$

where ρ^p_{it} is country i's trade deficit vis-a-vis country group p as a share of GDP in period t.

The theoretical model by Autor et al. (2013) suggests that growth in imports per worker is one but not the only mode of trade exposure. Consider the role of exports, a region specialized in products, whose overall exports increase, will benefit more from this increase relatively more than other regions. This yields a measure of Export Exposure ($E^X_{i_r pt}$), which is expected to have symmetric effects on regional manufacturing employment and defined in line with import exposure, distributing the change in total exports instead of imports per employed person across regions based on their respective employment shares:

$$\Delta E^{\rho X}_{i_r pt} = -\rho^p_{it} \sum_{j=1}^{J} \frac{L_{i_r jt}}{L_{ijt}} \frac{\Delta X^p_{ijt}}{L_{i_r t}}. \tag{3}$$

As in Autor et al. (2013), the change in export exposure $E^{\rho X}_{i_r pt}$ is then subtracted from the change in import exposure to define a measure of the change in net import exposure, which is given by $\Delta E^{\rho NM}_{i_r pt} = \Delta E^{\rho M}_{i_r pt} - \Delta E^{\rho X}_{i_r pt}$.

Alternatively, export exposure might be included as a separate variable as in Dauth et al. (2014), allowing to test for potential asymmetries in the effects of export and import exposure on employment.[10]

2.3 Key Descriptives

On average over our sample of 17 countries, the share of manufacturing employment (NACE codes 15-37) in working-age population declined by 3.4 percentage points from 1991 to 2011, with the largest decline being observed for Denmark, Austria, Luxembourg and Portugal and the smallest for Germany, Greece and Spain. Also within countries, there is substantial variation between regions. Across all regions the changes in manufacturing shares range from -20 percentage points in Ave (Portugal) to +16 percentage points in Schweinfurt (Germany). But the variation is large even within countries.

Across all countries we find an increase in the share of manufacturing employment in 244 regions, of which 163 are located in Germany and 30 in Spain. 11 countries have at least one region, which shows an increase. In 874 regions the share decreased and in Denmark, Ireland, Luxembourg, Norway, Sweden and Switzerland all regions show a decline. Table 1 shows the change in the manufacturing share by country over time and the two major categories of manufacturing with the largest changes. Across countries the largest declines were observed for the industries "Textiles" and "Pulp and Paper".

- Table 1 -

However, the decline in manufacturing employment should not necessarily be interpreted as a reduction in employment, but rather as a relocation from manufacturing to other sectors (services). Across all regions the share of total employment in working-age population increased by 10 percentage points over our sample period from 1991 to 2011.

Total real imports of manufacturing goods of the countries in our sample from China increased by 962 % from 1991 to 2011, from Eastern Europe by 696 %. During the same time period total real exports of manufacturing goods to China also increased by 1,163 % and to Eastern Europe by 704

[10] As argued by Autor et al. (2013), one reason why the effects might be asymmetric could be that China is often the final link, while the US (and European) producers tend to be located earlier in the production chain. Thus, Chinese imports more directly affect the demand for EU goods, while US (and EU) exports might not have a similarly strong effect Chinese goods.

%. The strongest increase of manufacturing imports from both regions could be observed in the categories "DM - Transport Equipment" (3,268%), "DL - Electrical and optical Equipment" (1,693%), "DH - Rubber and plastic products" (1,332%) and "DK - Machinery and equipment" (1,241 %). The categories with the strongest increase in manufacturing exports are "DM - Transport Equipment" (1,919 %), "DH - Rubber and plastic products"(1,408%), "DG - Chemicals, chemical products and manmade fibres" (1,067%) and "DJ - Basic metals and fabricated metal products" (1,028%).

The correlation between the national change in the share of employment in a specific manufacturing category (in working age population) and the corresponding change in imports (from both regions) of goods which can be assigned to the same category, is virtually zero (0.014). For the change in exports the same can be observed (0.040). And also the correlation with regional changes of the employment share on NUTS3-level is still very low (0.082 and 0.107 respectively). This does not necessarily imply that there is no relationship, but could also be due to the fact effects of trade are very concentrated and do not affect all regions equally. It underlines the importance of investigating the role of import and export expose at the regional level and taking each region's industry structure into account.

3 Empirical Framework

3.1 Baseline Model

In our empirical analysis, we estimate models of the following form:

$$\Delta V_{i_r t} = c_i + \beta_1 \Delta E^{\rho M}_{i_r pt} + \boldsymbol{C}^{\rho M}_{i_r t-1} \boldsymbol{\gamma} + \nu_t + \varepsilon_{i_r t}. \tag{4}$$

There panel data model given by equation (4) comprises 1,146 regions (from 17 countries) and two periods (1991-2001, 2001-2011), making a total of 2,292 observations. The key dependent variable is the change in regional manufacturing employment (V_{i_r}) in region i_r from time $t-1$ to t. Later on we will use other dependent variables such as the change in regional total employment, unemployment, employment in service sectors and working age population.

The explanatory variable of main interest is the change in import exposure ($\Delta E^{\rho M}_{i_r pt}$) over the same time period; we will also consider other trade exposure measures such as export exposure ($\Delta E^{\rho X}_{i_r pt}$) or net import exposure ($\Delta E^{\rho NM}_{i_r pt}$).

$\boldsymbol{C}$ is a vector of control variables, including the respective period's initial values of the following variables: share of manufacturing employment, female, high- and low-skilled and foreign workers in total employment.

In our multi-country panel data model, we include country-specific fixed effects (c_i) to control for country-specific factors influencing the change in manufacturing employment over time, e.g., demand side effects due to the state of the economy or effects of national industrial policies[11]. In Section 4.4 we will also consider models with country-specific parameters of our measures of trade exposure.

Finally, the parameters ν_t represent period fixed effects and $\varepsilon_{i_r t}$ is the idiosyncratic error term.

3.2 Identification

A concern in the estimation of equation (4) is that the change in European imports from China may be driven not only by China's increase supply capability (comparative advantage, trade costs), but also by European demand shocks also affecting employment. The implied endogeneity of our measures of trade exposure is addressed in line with Autor et al. (2013) and Dauth et al. (2014) using an instrumental variable approach.

It makes use of the fact that China's transition to a market economy, the fall of the Iron Curtain, and the break-up of the USSR and the trade implications represent a shock to all trading partners of China and Eastern European countries. Thus, 'other' trading partners' change in imports is used as an instrument to identify the exogenous component of the change in Western European import exposure, i.e.,

$$\Delta IE^{\rho M}_{oi_r t} = -\rho^p_{it} \sum_{j=1}^{J} \frac{L_{i_r jt}}{L_{ijt}} \frac{\Delta M_{opjt}}{L_{i_r t}}, \tag{5}$$

where imports of Western European countries have been replaced by (aggregate) imports of other countries (indexed by o). In our baseline estimations we use the same set of 'other' countries as Autor et al. (2013) and Dauth et al. (2014), but excluding the Western European countries included in our sample, such that the following countries remain: Australia, Canada,

[11]The need for the inclusion of countries dummies is also confirmed by Hausman-type test in all our models.

Japan, New Zealand and Singapore. We will also consider alternative instruments, including (part of/a subset of) the Western European countries of our sample.

The key identifying assumptions are that 'other' countries demand shocks (and other shocks affecting manufacturing employment in Western Europe) are uncorrelated with those of a specific Western European country and that China's and Eastern Europe's trade flows with these 'other' countries have no direct effect on manufacturing employment of the respective Western European country (i.e, they should be small enough to exert no significant influence on the world economy).

For the empirical models using export exposure, the respective instrumental variable is motivated and defined analogously:

$$\Delta IE^{\rho X}_{oi_r t} = \rho^p_{it} \sum_{j=1}^{J} \frac{L_{i_r jt-1}}{L_{ijt-1}} \frac{\Delta X_{opjt}}{L_{i_r t-1}}, \tag{6}$$

and net import exposure $\Delta E^{\rho NM}_{i_r pt} (= \Delta E^{\rho M}_{i_r pt} - \Delta E^{\rho X}_{i_r pt})$ is instrumented, as in Autor et al. (2013), using the difference between the instruments for import and export exposure.

3.3 Spillovers in Trade Exposure

Strictly speaking, equation (4) assumes that regions are 'closed' economies with perfectly segmented labor and product markets. As far as labor markets are concerned, this assumption may be violated for the following reasons: First, larger import exposure in region i_r might increase unemployment and thus increase labor market competition. This in turn could reduce wages across regions, thereby generating positive employment spillover effects for region $i'_{r'}$. Second, if workers in region i_r are strongly affected by import exposure they might look for new employment in neighboring regions $i'_{r'}$. They could e.g. move from an import-competing manufacturing industry in one region to an export-oriented industry in another region, filling job vacancies and increasing employment there.

Accordingly, one would expect employment spillovers from i_r to $i'_{r'}$ and vice versa, related to export exposure, e.g., when regions benefit from stronger exports, which attracts workers from neighboring regions.

These labor market induced spillover effects are addressed by Autor et al. (2013) and Dauth et al. (2014) (in their robustness analysis) through the use of commuting zones as regional units of observations in their studies. However, depending on labor mobility and the range of regional wage equalization mechanisms, even labor market related spillover effects may well go beyond the borders of commuting zones.

In the case of product markets the assumption of segmented markets might also be violated, as spillovers arise from the fact that regions are strongly interrelated through trade. Import exposure in region i_r may affect output (and hence employment) not only in region i_r, but also in region $i'_{r'}$. On the one hand this spillover effect could be negative, as e.g. a reduction in output in region i_r could lead to reduced demand for intermediate goods from other regions or reduced demand of final goods due to demand side (income) effects. On the other hand the effect could be positive, if imports lead to the exit of some firms in region i_r, but those firms also produced other goods for local markets which are not imported. Those could then be supplied by region $i'_{r'}$. Again, these spillovers from import exposure have their analog in spillovers from export exposure. This channel of interdependence has not been accounted for in the previous studies by Autor et al. (2013) and Dauth et al. (2014).

For the sample considered in the present paper, we expect spillover effects to be pronounced. First, our regional units of observations (NUTS3-regions) are defined along borders of jurisdictions or administration, which are quite arbitrary from an economic perspective. Moreover, the regions are relatively small and hence likely to be open to and interact with other regions. With all countries of our sample being part of the highly integrated EU Single Market (and with all countries but Switzerland being part of the European Economic Area), we expect these interactions between regions to take place not only within countries but also between countries, albeit to a smaller extent due to border effects.

As outlined above, both positive and negative spillover effects on employment are conceivable. Hence, whether spillovers overall increase or mitigate the effects of trade exposure is unclear a priori and has to be assessed empirically.

In order to account for the types of spillovers effects between regions in equation (4), we adopt a spatial econometric approach and include a spatial lag of the variable measuring import (and export) exposure. It is given by $\overline{\boldsymbol{E}_t^{\rho M}} = \boldsymbol{W}\hat{\boldsymbol{E}}_{\boldsymbol{t}}^{\rho M}$, where $E_t^{\rho M}$ is the vector of stacked observations for time period t, and the spatial weights $\boldsymbol{W}$ matrix is given by $\boldsymbol{W} = \{\omega_{i_r j_r}\}$. Its elements are defined as decreasing function of geographical distance, specifically $w_{i_r i'_{r'}} = 1/d^{\gamma}_{i_r i'_{r'}}$), where $d_{i_r i'_{r'}}$ denotes distance between regions i_r and $i'_{r'}$ and γ is the distance decay parameter. Alternative choices of γ will be considered and compared according to the so-called half-life distance, i.e., the distance after which spillover effects have been reduced to 50%. It is given by $d_{1/2} = d_{av} + \ln 2/\gamma$, where d_{av} is the average distance between centers of neighboring regions. Finally, the weights matrices are row-normalized as it is standard in the literature, but we will consider alternative normalizations in the sensitivity analysis. Furthermore, we will also test for differences in the strength of spillovers occurring within countries (intranational spillovers) and between countries (international spillovers).

4 Results

4.1 Basic Model

In a first step we estimate similar equations as in Autor et al. (2013) for our sample of 17 Western European countries with respect to trade with China. Table 2 presents the respective results.

- Table 2 -

Notice first that throughout the specifications the control variables are significant (except for the share of high-skilled employees) with the expected signs and similar to the coefficients reported in the literature. The change in the share of manufacturing employment is negatively associated with a higher regional share of manufacturing in total employment, as well as a larger share of female and foreign employees. While the share of high skilled employees is not significant, a larger share of low-skilled employees is positively associated with the change in manufacturing employment. As expected and confirmed by Hausman tests, country fixed effects are necessary in our setting.

Turning to the effects of import exposure, we find a significant negative effect. Given the mean of the change in the modified import exposure ($E^{\rho M}$) of -0.02 the coefficient in Column 3 represents on average a decline in the share of manufacturing employment of 0.26 percentage points between 1991 and 2011 due to imports from China across all regions in our sample. Given the overall average decline in manufacturing employment of 3.4 percentage points, this effect is relatively small compared to the estimates for the US in

Autor et al. (2013) or Germany in Dauth et al. (2014). However, the US and Germany are much more exposed to trade with China than many countries in our sample. Furthermore, heterogeneous effects on the country level are hidden behind the single coefficients; with a given coefficient the effects could theoretically be positive for some and negative for other countries, depending on the trade balance with China according to the theoretical model in Autor et al. (2013) as reflected in the modified import exposure variable; with a coefficient of -0.137, an increase in import exposure has a negative effect in countries with a trade deficit with China and a positive effect in countries with a trade surplus. However, as presented in Table A2 in our sample only Switzerland has a trade surplus with China throughout the sample period (and Belgium, Luxembourg and Finland at the beginning or end). We will explore this heterogeneity on the country level further in Section 4.4.

Using the net import exposure or adding the export exposure measure changes the coefficient only marginally, while the latter is not significant. Those results are well in line with the results by Autor et al. (2013) and also with the robustness check in Dauth et al. (2014).

All tests indicate a high level of instrument quality in our two-stage setting throughout the specifications and independently of using (net) import or export exposure. The F-test and coefficients of the first stage regression as well as the underidentification (Kleibergen-Paap rk LM statistic) and weak identification (Cragg-Donald Wald F-statistic) tests confirm the validity of the instruments at the highest level.

4.2 Spillover Effects

To account for spillovers, as discussed in Section 3.3, Table 3 presents the results for similar estimations as before, but taking into account the spatial lags of import and export exposure. Estimating the baseline coefficient and the spatial lag independently from each other is not feasible in our setting as both variables are highly correlated. Thus, we use the sum of the exposure measure with its spatial lag, i.e. $E_t^{\rho M} + WE_t^{\rho M}$ and $E_t^{\rho X} + WE_t^{\rho X}$ respectively[12].

- Table 3 -

[12]The instrumental variables also include their spatial lag, i.e. $IE_t^{\rho M} + WIE_t^{\rho M}$ and $IE_t^{\rho X} + WIE_t^{\rho X}$.

First we notice that the coefficient of import exposure remains negative and significant and the measures of instrument quality improve slightly. However, the estimated coefficient becomes smaller when taking the spatial lag into account, which means that we find positive spillover effects from import exposure. This finding persists also when changing the form of the decreasing function of geographical distance, changing the half-life distance $d_{1/2}$ or adding the export exposure measure (including the spatial lag). For the following exercises we will always use the combined exposure measures with their spatial lag.

4.3 Results by partner regions

So far all results with respect to the effect of trade with China confirmed the findings of Autor et al. (2013) and Dauth et al. (2014). However, the latter did not only analyze the effects of trade with China, but also with Eastern Europe. Their main result that the manufacturing share in Germany increased due to trade is mainly driven by exports to Eastern Europe. Thus, Table 4 presents the baseline estimations (including spatial spillovers) for trade with China and combined with Eastern Europe.

- Table 4 -

The results approximately resemble the findings of Dauth et al. (2014). When including import and export exposure with respect to all partner regions alongside each other, we find a significantly positive effect of export exposure and significantly negative effect of import exposure. Based on the point estimates and the respective means of the independent variables this suggests that on average the manufacturing share in Western Europe declined by 0.02 percentage points due the change in imports from China and Eastern Europe and increased by 0.08 percentage points due to the change in exports of those regions. The result that the effect is on average very close to zero, is a result of very heterogenous underlying country-specific effects. Calculating the percentage point change not for the mean but for 25 and 75 percentile we get different results with an overall increase of 0.40 percentage points and decrease of 0.34 percentage points respectively.

Although the instrument quality in the specification analyzing trade with China and Eastern Europe still seems fine, the various test statistics dropped significantly. Two reasons could be responsible for this: First, while the five countries included in our instrument group (Australia, Canada, Japan, New Zealand and Singapore) might resemble trade between Western Europe and China quite well, the trade of those countries with Eastern Europe differs considerably from the one between Eastern and Western Europe. Second, the trade patterns and dimensions of trade of Western European countries with China and Eastern Europe differ considerably. While some countries trade more intensively with China, others trade more with Eastern Europe. Thus both the import and export measures as well as the instruments might struggle to map those patterns properly.

4.4 Country-specific results

To investigate the possibility of heterogeneous effect of trade depending on the source and partner country, Table 5 presents the results of estimations based on interactions of the net import exposure measure with country (group) indicators. Some overall observations are worth noting: The effects vary considerably depending on source and partner countries. The estimated coefficients change significance, magnitudes and signs depending on the source country. Our instrument variables work very well for some country (groups) and only poorly for others. The lowest instrument quality can be observed for estimations analyzing trade with both partner regions, China and Eastern Europe, together.

- Table 5 -

As some countries only represent a very small fraction of observations, the smaller countries are grouped together to form larger country groups. We observe that Germany which experienced the smallest overall decline in the share of manufacturing from 1991 to 2011 has a significant negative coefficient. Consquently, trade with China caused the manufacturing share to decline, as Germany had a trade deficit with China (see Table A2). But together with the large trade surplus with Eastern Europe and China together, the estimations suggest that due to trade with both of those regions the share of manufacturing increased by 0.45 percentage points[13]. However, in countries with the largest trade deficits (both with China and with both regions together), i.e. France and UK (and Ireland), the positive coefficient suggests that trade caused a decline in the manufacturing share of -1.17 percentage points and -0.73 percentage points respectively.

5 Conclusions

This paper analyses the effect of increased trade on the share of manufacturing employment from 1991 to 2011. The analysis is based on regional data for 17 Western European countries and trade data of those countries with China and Eastern Europe. Spatial interdependencies are explicitly modeled to account for labor and product market spillovers.

Two main results from the literature are also found for the larger Western European sample and including spatial spillovers: i) Overall there seems to be a negative effect of imports from China on the manufacturing employment share. ii) Exports to Eastern Europe seem to overall have increased the manufacturing employment share. However, as this is the first study to include more than one country, the heterogeneity of the effects depending on the analyzed country and trading partner becomes visible. The effects vary considerably across countries.

Thus, a range of further exercises seems to be necessary to investigate what drives the heterogeneity of the effects among countries. Those include looking into the role of the trade balance, varying the countries included in the instrument variables, exploring regional trade balances, as well as different spatial spillover categories and looking at other dependent variables.

[13]In the sample of Dauth et al. (2014) from 1988 to 2008 the share of manufacturing employment in working-age population fell by about 4 percentage points. Overall they estimate the net increase due to trade with China and Eastern Europe at 1.65 percentage points. In our sample from 1993 to 2013 (for Germany) the share declined by only 1.21 percentage points. Thus, our estimated net effect of trade with China and Eastern Europe of 0.45 percentage is very similar in relative terms to the one in Dauth et al. (2014).

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Appendix

Table A1: Data Sources Overview - Employment data

Country	Years	NACE digits	NUTS3 Regions	Source
Austria	1991, 2001, 2011	2	35	Census, Statistics Austria
Belgium	1991, 2001, 2011	3	43	Census, StatBel & Industry register, National Social Security Office
Denmark	1991, 2001, 2011	2	11	Census & Register data, Statistics Denmark (DST)
Finland	1990, 2000, 2010	3	19	Census, Statistics Finland
France	1990, 1999, 2010	3	101	Census, Statistics France (INSEE)
Germany	1993, 2003, 2013	3	402	Sample of Integrated Labour Market Biographies, IAB
Greece	1991, 2001, 2013	2	52	Census, Statistics Greece
Ireland	1991, 2002, 2011	2	8	Census, Central Statistics Office
Italy	1991, 2001, 2011	3	110	Business Census, Italian National Institute of Statistics (Istat)
Luxembourg	1990, 2000, 2010	2	1	Eurostat
Netherlands	1993, 2003, 2013	2	40	Enquete beroepsvolking, Statistics Netherland (CBS)
Norway	1990, 2000, 2010	2	19	Census, Statistics Norway (SSB)
Portugal	1991, 2001, 2011	2	25	Census, Statistics Portugal (INE)
Spain	1991, 2001, 2011	2	57	Census, Spanish Statistical Office (INE)
Sweden	1991, 2001, 2011	2	21	Census, Statistics Sweden (SCB)
Switzerland	1991, 2001, 2011	2	26	Census, Federal Statistical Office (BFS)
United Kingdom	1991, 2001, 2011	2	173	Census, Office for National Statistics (ONS)

Table A2: Real trade deficits with China and Eastern Europe (Bn EUR)

	1991			2011		
	China	Eastern Europe	Both	China	Eastern Europe	Both
Austria	0.11	-1.22	-1.11	2.18	-6.64	-4.46
Belgium	-0.06	-0.06	-0.12	6.55	-4.79	1.76
Denmark	0.35	-0.54	-0.19	1.82	-0.75	1.07
Finland	0.05	-1.95	-1.90	-0.17	-3.24	-3.42
France	0.58	0.14	0.72	17.49	-2.70	14.79
Germany	2.63	-5.28	-2.65	4.30	-36.89	-32.59
Greece	0.28	0.68	0.96	1.92	-0.06	1.86
Ireland	0.10	-0.01	0.09	1.06	-1.27	-0.21
Italy	1.05	-1.26	-0.21	11.99	-13.03	-1.04
Luxembourg	-0.01	-0.05	-0.06	0.36	-0.45	-0.08
Netherlands	0.75	-0.56	0.19	8.09	-11.90	-3.81
Norway	0.03	0.10	0.13	2.10	2.13	4.23
Portugal	0.05	0.03	0.08	1.90	0.08	1.98
Spain	0.72	-0.11	0.62	8.67	-1.41	7.27
Sweden	0.33	0.04	0.37	0.56	-0.66	-0.09
Switzerland	-0.07	-0.88	-0.95	-1.69	-3.48	-5.17
United Kingdom	0.65	-0.23	0.42	23.22	2.22	25.44

Notes: Imports minus Exports with respect to partner region as noted in column heading. Real values (Base year: 2010) in Billion Euros.

Table 1: Change in employment share of manufacturing (in the working-age population) across countries

Country	Δ 1991-2001	Δ 2001-2011	Industry level[1]: largest Δ 1991-2011
AT	-4.32 pp	-2.00 pp	DB (Textiles): -1.2 pp, DN (Other): -0.9 pp
BE	-2.40 pp	-0.72 pp	DB (Textiles): -1.3 pp, DM (Transport): -0.8 pp
CH	-3.50 pp	-1.75 pp	DK (Machinery): -1.3 pp, DE (Pulp, Paper): -0.8 pp
DE	-1.25 pp	0.04 pp	DB (Textiles): -0.3 pp, DG (Chemicals): -0.2 pp
EL	-0.36 pp	-1.21 pp	DB (Textiles): -1.6 pp, DN (Other): -0.3 pp
ES	-0.77 pp	-0.80 pp	DB (Textiles): -1.1 pp, DJ (Metals): -0.5 pp
FI	-1.83 pp	-2.60 pp	DE (Pulp, Paper): -1.1 pp, DD (Wood): -1.0 pp
FR	-1.38 pp	-2.51 pp	DB (Textiles): -0.8 pp, DL (Electrical, Optical): -0.7 pp
IE	-1.65 pp	-2.99 pp	DA (Food, Beverages): -1.1 pp, DB (Textiles): -1.1 pp
IT	-0.78 pp	-2.62 pp	DB (Textiles): -1.2 pp, DM (Transport): -0.3 pp
LU	-3.51 pp	-2.73 pp	DH (Plastic): -1.9 pp, DI (Non-metallic minerals): -1.5 pp
NL	-0.93 pp	-2.01 pp	DN (Other): -1.2 pp, DE (Pulp, Paper): -0.8 pp
NO	-2.38 pp	-2.37 pp	DK (Machinery): -2.5 pp, DL (Electrical, Optical): -0.9 pp
PT	-2.04 pp	-4.05 pp	DB (Textiles): -3.4 pp, DC (Leather): -0.6 pp
SE	-2.11 pp	-2.84 pp	DE (Pulp, Paper): -0.9 pp, DM (Transport): -0.8 pp
UK	-1.29 pp	-3.88 pp	DM (Transport): -0.6 pp, DE (Pulp, Paper): -0.6 pp

Notes: Changes in percentage points of the share of employment in manufacturing (NACE 2-digit codes 15 to 37) as percentage of working-age population. [1] Two main category industries with the largest changes in employment share from around 1991 to around 2011.

Table 2: Baseline Results - Trade with China

	(1)	(2)	(3)	(4)
Import Exposure	-0.084^{**}	-0.137^{***}		-0.133^{***}
($E_t^{\rho M}$)	(0.040)	(0.047)		(0.050)
Net Import Exposure			-0.137^{**}	
($E_t^{\rho NM}$)			(0.054)	
Export Exposure				-0.008
($E_t^{\rho X}$)				(0.088)
Share Manufacturing	-0.108^{***}	-0.111^{***}	-0.110^{***}	-0.111^{***}
	(0.019)	(0.019)	(0.019)	(0.019)
Share Female		-0.041^{**}	-0.042^{**}	-0.041^{**}
		(0.017)	(0.017)	(0.017)
Share Foreign		-0.035^{***}	-0.036^{***}	-0.035^{***}
	(0.010)	(0.010)	(0.010)	
Share High-skilled		-0.006	-0.001	-0.006
		(0.014)	(0.013)	(0.0133)
Share Low-skilled		0.040^{***}	0.043^{***}	0.040^{***}
		(0.006)	(0.005)	(0.006)
First stage, Dep. Var.: Import Exposure ($E_t^{\rho M}$)			*Net Imp. Exp. ($E_t^{\rho NM}$)*	*Imp. Exp. ($E_t^{\rho M}$)*
Import Exposure	0.058^{***}	0.053^{***}	0.104^{***}	0.090^{***}
(Instrument, $IE_t^{\rho M}$)	(0.005)	(0.005)	(0.013)	(0.012)
Export Exposure			-0.061^{***}	-0.030^{***}
(Instrument, $IE_t^{\rho X}$)			(0.009)	(0.009)
F-Test	119.15	110.70	44.17	95.23
First stage, Dep. Var.: Export Exposure ($E_t^{\rho X}$)				
Import Exposure				-0.014
(Instrument, $IE_t^{\rho M}$)				(0.010)
Export Exposure				0.031^{***}
(Instrument, $IE_t^{\rho X}$)				(0.009)
F-Test				17.63
Country fixed effects	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Underidentification Test[1]	54.387^{***}	60.115^{***}	18.167^{***}	14.857^{***}
Weak Identification Test[2]	$2,069.568^{***}$	$1,597.575^{***}$	801.810^{***}	319.504^{***}
N	2,236	2,035	2,035	2,035

Notes: Two-stage Least Squares estimations. Dependent variable: 10 year change of share of employment in manufacturing in working age population. First stage regressions also include controls and fixed effects as in second stage. Robust standard errors in parentheses. ***, **, * indicates significance at the 1%, 5% and 10% level. [1] Kleibergen-Paap rk LM statistic. [2] Cragg-Donald Wald F statistic.

Table 3: Results with Spatial Lags - Trade with China

	(1)	(2)	(3)	(4)	(5)	(6)
Functional Form:		Inverse	Exponential	Inverse		Inverse
Distance Decay (km):		250	250	1000		250
Import Exposure	-0.137^{***}				-0.133^{***}	
($E_t^{\rho M}$)	(0.047)				(0.050)	
Imp. Exp. incl. Spatial Lag		-0.100^{**}	-0.093^{**}	-0.122^{***}		-0.109^{**}
($E_t^{\rho M} + WE_t^{\rho M}$)		(0.043)	(0.042)	(0.046)		(0.047)
Export Exposure					0.009	
($E_t^{\rho X}$)					(0.089)	
Exp. Exp. incl. Spatial Lag						0.022
($E_t^{\rho X} + WE_t^{\rho NM}$)						(0.089)
First stage, Dep. Var.: Import Exposure		*... incl. Spatial Lag*			*Imp. Exp.*	*incl. Spatial*
($E_t^{\rho M}$)		($E_t^{\rho M} + WE_t^{\rho M}$)			($E_t^{\rho M}$)	($E_t^{\rho M} + WE_t^{\rho M}$)
Import Exposure	0.053^{***}				0.090^{***}	
(Instrument, $\hat{IE}_t^{M}$)	(0.005)				(0.012)	
Imp. Exp. incl. Spatial Lag		0.056^{***}	0.051^{***}	0.054^{***}		0.096^{***}
(Instrument, $IE_t^{\rho M} + WIE_t^{\rho M}$)		(0.006)	(0.004)	(0.005)		(0.012)
Export Exposure					-0.030^{***}	
(Instrument, $IE_t^{\rho X}$)					(0.009)	
Exp. Exp. incl. Spatial Lag						-0.033^{***}
(Instrument, $IE_t^{\rho X} + WIE_t^{\rho X}$)						(0.009)
F-Test	110.17	136.13	145.73	116.58	94.84	117.44
First stage, Dep. Var.: Export Exposure		*... incl. Spatial Lag*			*Exp. Exp.*	*incl. Spatial*
($E_t^{\rho X}$)		($E_t^{\rho X} + WE_t^{\rho X}$)			($E_t^{\rho X}$)	($E_t^{\rho X} + WE_t^{\rho X}$)
Import Exposure					-0.014	
(Instrument, $IE_t^{\rho M}$)					(0.010)	
Imp. Exp. incl. Spatial Lag						-0.010
(Instrument, $IE_t^{\rho M} + WIE_t^{\rho M}$)						(0.010)
Export Exposure					0.031^{***}	
(Instrument, $IE_t^{\rho X}$)					(0.009)	
Exp. Exp. incl. Spatial Lag						0.028^{***}
(Instrument, $IE_t^{\rho X} + WIE_t^{\rho X}$)						(0.009)
F-Test					17.44	22.30
Underidentification Test[1]	59.987^{***}	72.985^{***}	80.130^{***}	63.325^{***}	14.850^{***}	14.003^{***}
Weak Identification Test[2]	$1,580.182^{***}$	$1,711.242^{***}$	$1,337.786^{***}$	$1,617.741^{***}$	316.653^{***}	270.131^{***}
N	2,019	2,019	2,019		2,019	2,019

Notes: Controls, Country fixed effects, Year fixed effect included. Two-stage Least Squares estimations. Dependent variable: 10 year change of share of employment in manufacturing in working age population. First stage regressions also include controls and fixed effects as in second stage. Robust standard errors in parentheses. ***, **, * indicates significance at the 1%, 5% and 10% level. [1] Kleibergen-Paap rk LM statistic. [2] Cragg-Donald Wald F statistic.

Table 4: Results by Partner Region

	(1)	(2)	(3)	(4)
Partner Region:				
China	✓	✓	✓	✓
Eastern Europe		✓		✓
Import Exposure incl. Spatial Lag	-0.100^{***}	-0.001	-0.109^{**}	-0.101^{**}
$(E_t^{\rho M} + WE_t^{\rho M})$	(0.043)	(0.016)	(0.047)	(0.050)
Export Exposure incl. Spatial Lag			0.022	0.139^{**}
$(E_t^{\rho X} + WE_t^{\rho X})$			(0.089)	(0.063)
First Stage F-Tests:				
Import Exp. incl. Spatial Lag $(E_t^{\rho M} + WE_t^{\rho M})$	136.13	43.89	117.44	25.41
Export Exp. incl. Spatial Lag $(E_t^{\rho X} + WE_t^{\rho X})$			22.30	11.14
Underidentification Test[1]	72.985^{***}	4.133^{**}	14.003^{***}	12.850^{***}
Weak Identification Test[2]	$1,711.242^{***}$	$1,705.594^{***}$	270.131^{***}	110.861^{***}
N	2,019	2,019	2,019	2,019

Notes: Controls, Country fixed effects, Year fixed effect included. Two-stage Least Squares estimations. Dependent variable: 10 year change of share of employment in manufacturing in working age population. Spatial lags based on inverse function, decay distance: 250km. First stage regressions also include controls and fixed effects as in second stage. Robust standard errors in parentheses. ***, **, * indicates significance at the 1%, 5% and 10% level. [1] Kleibergen-Paap rk LM statistic. [2] Cragg-Donald Wald F statistic.

Table 5: Results by Country (Groups) and Partner Regions

	(1)	(2)
Partner Region:	China	Both
Net Import Exposure incl. Spatial Lag ($E_t^{\rho NM} + WE_t^{\rho NM}$) interacted with Dummy for ...		
Germany	-5.163^{***}	-1.523^{***}
	(1.789)	(0.455)
France	0.806^{***}	1.444^{***}
	(0.182)	(0.213)
Italy	2.361^{***}	0.626
	(0.513)	(0.547)
Benelux countries	-0.165^{***}	-0.214^{**}
(BE, NL, LU)	(0.059)	(0.096)
Scandinavian countries	0.169	−0.030
(DK, FI, NO, SE)	(0.260)	(0.053)
Austria and Switzerland	-2.441^{***}	0.005
	(0.669)	(0.092)
United Kingdom and Ireland	0.891^{***}	0.719^{***}
	(0.227)	(0.102)
Spain, Portugal and Greece	−0.390	-0.584^{*}
	(0.390)	(0.317)
First Stage F-Tests:		
Germany	19.98	125.34
France	738.47	143.53
Italy	267.72	4.83
Benelux countries	17.25	6.91
Skandinavian countries	28.48	5.15
Austria and Switzerland	14.02	12.03
United Kingdom and Ireland	63.59	190.88
Spain, Portugal and Greece	98.64	31.82
Underidentification Test[1]	79.282^{***}	35.252^{***}
Weak Identification Test[2]	9.011^{***}	36.102^{***}
N	2,019	2,019

Notes: Two-stage Least Squares estimations. Dependent variable: 10 year change of share of employment in manufacturing in working age population. Spatial lags based on inverse function, decay distance: 250km. First stage regressions also include controls and fixed effects as in second stage. Robust standard errors in parentheses. ***, **, * indicates significance at the 1%, 5% and 10% level. [1] Kleibergen-Paap rk LM statistic. [2] Cragg-Donald Wald F statistic.