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FULL ARTICLE

The continental divide? Economic exposure to Brexit in regions and countries on both sides of The Channel

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Abstract

In this paper we employ an extension of the World Input-Output Database (WIOD) with regional detail for EU countries to study the degree to which EU regions and countries are exposed to negative trade-related consequences of Brexit. We develop an index of this exposure, which incorporates all effects due to geographically fragmented production processes within the UK, the EU and beyond. Our findings demonstrate that UK regions are far more exposed than regions in other countries. Only regions in the Republic of Ireland face exposure levels similar to some UK regions, while the next most affected regions are in Germany, The Netherlands, Belgium and France. This imbalance may influence the outcomes of the negotiations between the UK and the EU.

KEYWORDS

Brexit, input-output analysis, regional differences, trade, value chains

1 | INTRODUCTION

Since the UK decided in 2016 by referendum to leave the European Union there has been a large and growing body of material explaining the reasons for the decision in both the academic arena as well as in the popular press. In contrast, there has been much less post-referendum material emerging regarding the likely long-term impacts of this decision, and there are probably two main reasons for this. First, there were various forecasts produced by different organizations prior the

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referendum which predicted a rapid UK recession immediately following the decision to leave, and this has simply not transpired. Although there is now emerging evidence of the effects of a devalued Sterling on UK inflation and living standards (*Financial Times*, 2017a), as well as a fragile trade balance even under currency depreciation, the fact that no UK recession has so far materialized (*The Economist*, 2017) probably makes many forecasters rather loathe to speculate any further. Second, and more importantly, Brexit has not yet actually happened, and it is very difficult to speculate in detail about the likely long-run impacts of Brexit until the specific outlines of the new UK–EU trading relationships become clear.

What we aim to analyse here is the exposure of regions in the UK and the EU to Brexit, via an analysis of the nature and scale of their trade linkages. Other potential advantages and disadvantages, for example as a consequence of the relocation of UK subsidiaries of multinational firms or the redistribution of subsidies to regions are not considered.[1] In this study, we intend to quantify the shares of regional and national GDP and labour income (in the UK and the EU) that are at risk due to Brexit. The extent to which these risks will actually materialize, for example via tariffs and non-tariff barriers to trade between the EU and the UK, will depend on the final agreements reached (if any).[2]

Simple measures of gross exports and imports tell us very little about the potential impacts of Brexit on a nation or region, because both the back-and-forth trade in raw materials, parts and components and business services (often within the boundaries of multinational enterprises) typical of global value-chains obscures the links between local value-added and trade (Baldwin, 2016). In order to overcome these problems, we develop a measure of regional exposure to Brexit building upon a flourishing strand of literature using global input-output tables to link trade to value added (see, e.g., Johnson & Noguera, 2012; Koopman, Wang, & Wei, 2014; Timmer, Los, Stehrer, & de Vries, 2013). The measure gives the share of regional GDP or labour income contained in trade flows between EU exporters and UK importers, and vice versa. We apply the novel measure by employing a version of the World Input-Output Database (WIOD), in which the larger EU countries are geographically disaggregated into regions at the NUTS 2 level.[3]

Our results demonstrate that almost all UK regions are systematically more vulnerable to Brexit than regions in any other country. Due to their longstanding trade integration with the UK, Irish regions have levels of Brexit exposure, which are similar to those of the UK regions with the lowest levels of exposure, namely London and northern parts of Scotland. Meanwhile, the other most risk-exposed EU regions are all in southern Germany, with levels of risk which are typically half that of any UK or Irish region, and one third of that displayed by many UK regions. There is also a very noticeable economic geography logic to the levels of exposure with north-western European regions typically being the most exposed to Brexit, while regions in southern and eastern Europe are barely affected at all by Brexit, at least in terms of the trade linkages. Gravity thus plays its well-known role. Overall, the UK is far more exposed to Brexit risks than the rest of the EU.

The rest of the paper is organized as follows. In Section 2 we explain the construction of the exposure index. In Section 3 we outline the way in which the geographical disaggregation of the EU-part of WIOD as required for this study has been attained. Section 4 provides our results and Section 5 provides some brief conclusions.

2 | METHODOLOGY

We propose to use a bilateral version of the domestic value added in exports (*DVAiX*) indicator proposed by Koopman et al. (2014) in order to measure economic exposure to Brexit. They split gross exports of a country into domestic value added, foreign value added and some (empirically small) "pure double-counting" terms. This decomposition linking trade to value

[1]Despite this partial nature of our measurement of the exposure to Brexit, we will throughout this paper refer to our estimates as estimates of the exposure to Brexit, to avoid lengthy repetitions of adjectives delineating the scope of our measure.

[2]Dhingra et al. (2017) provide GDP effects for the national UK economy for 'optimistic' and 'pessimistic' scenarios. The term 'exposure' has been borrowed from Autor, Dorn, and Hanson (2013), who analysed the extent to which labour in US localities became exposed to competition from China.

[3]These data have already been used elsewhere (Los et al., 2017) to demonstrate that the UK regions which are most dependent on EU consumption and investment demand tended also to be those with larger than average shares of votes to leave the EU. The reasons for these rather counter-intuitive observations are complex, and involve cultural or political aspects as well as economic influences (Becker, Fetzer, & Novy, 2017).

added relies on global input-output tables. In a comment on this article, Los, Timmer, and de Vries (2016) provided rather simple formulas to compute the domestic value added in bilateral exports to one or more specific countries, using the same type of data. Using various extensions of the general formula proposed by Los et al. (2016), we can obtain estimates of DVA in Exports of EU regions to the UK and of DVA in exports of UK regions to the EU. When divided by regional GDP, we arrive at indicators of the share of GDP exposed to Brexit, for all regions relevant in this study.[4] It is important to emphasize that this method does not aim at quantifying the actual changes in regional GDP due to Brexit. First, such an analysis would require information about the ultimate outcome of the negotiations between the UK and the EU (which can range between trade according to WTO rules – the 'no deal' scenario – and the UK having full access to the Single Market – the 'softest' Brexit possible). Second, assumptions on the strength of interregional and international substitution patterns should be made. To what extent will industries and consumers in the UK continue to purchase products from the EU (and vice versa), after the Brexit-related trade barriers have become effective? And will trade be largely diverted to non-EU countries, or will industries on both sides of the Channel substitute imported products by domestic purchases? One could rely on trade elasticities, feeding these into a general equilibrium model. This is actually the approach adopted by Dhingra et al. (2017) in their study of the effects of Brexit on value added creation in industries in the UK. In our view, it is unclear whether such elasticities will describe behavioural changes as a consequence of Brexit well, since they have been estimated on the basis of data in a period of (generally small) reductions in trade barriers. In contrast, the UK's already deep integration in European supply chains means that Brexit might well constitute a dramatic increase in trade barriers for both the UK and the EU including barriers that are hard to quantify related to rules of origin, market regulations, administrative procedures, resurfacing cultural differences and the like. Given these problems, we opt for a different approach. Our approach should be seen as an accounting exercise, in which value added in regions is split into: (i) a part that is embodied at least once (in downstream stages of value chains, or when final products are delivered) in trade between the UK and the EU; and (ii) a part that does not cross UK–EU borders. These parts are computed using the proportionality assumptions that are common in input-output analysis. We define part (i) as regional value added that is exposed to Brexit.

Let us assume that the world economy consists of C countries ($c = 1,\ldots, C$).[5] Each country consists of a (variable) number of regions R_c (≥ 1 for all c), and each region is comprised of N industries. The number of industries is assumed to be identical across regions and countries. All industries in all regions in all countries could sell to each other (deliveries of intermediate products), or to final users in all regions in all countries.[6] The structure of such a global economy can be captured by a global input-output table as presented in a stylized way in Figure 1.

The square matrix $\mathbf{Z}$ is the core of an input-output table. It contains the values of intermediate input deliveries and has $N(R_1 + R_2 + \ldots + R_C)$ rows and columns.[7] Rows represent selling industries, while columns indicate purchasing industries. For the purposes of the present analysis, it is useful to consider as many as 25 submatrices of $\mathbf{Z}$, each with different dimensions. Let us focus on the blocks on the main diagonal (shaded) first. $\mathbf{Z}^{rr}$ is an $N \times N$-matrix of which the typical element z_{ij}^{rr} represents the value of sales by industry i in the focal region r to industry j in the same region. $\mathbf{Z}^{cc}$ has $N(R_c\ \text{-}1)$ rows and $N(R_c\ \text{-}1)$ columns. The elements refer to the values of sales by industries in other regions of the country of which r is a part, to industries in other regions than r in the same country. If, for example, r refers to Île-de-France, $\mathbf{Z}^{cc}$ contains deliveries of industries in Rhône-Alpes to industries in Rhône-Alpes itself, but also to industries in Auvergne and Corse (Corsica). Since we are interested in the exposure of regional GDP to Brexit, and Brexit implies that trade barriers between the regions in EU countries and regions in the UK are likely to be introduced, we split the set of countries to which the focal region r does not belong to (regions in) other EU countries, regions in the

[4]We do not only focus on shares of regional GDP exposed to Brexit, but also on regional labour income. The line of reasoning as presented for value added in this section can also be applied to obtain indicators related to labour income.

[5]One of these countries could be a 'super-country', the 'Rest of the World'.

[6]Final products can be sold to households, governments, companies (as capital goods) and be held as stocks.

[7]As is common in the input-output literature, matrices are indicated by bold capitals, (column) vectors by bold lowercases and scalars (including elements of matrices/vectors) by italic lowercases. Diagonal matrices are indicated by a hat over the vector containing the elements on the main diagonal. Primes indicate transposition.

	Focal region in EU	Other regions in country of focal region	Regions in other EU countries	Regions in the UK	Countries outside the EU	Focal region in EU	Other regions in country of focal region	Regions in other EU countries	Regions in the UK	Countries outside the EU	Gross output
Focal Region in EU	$\mathbf{Z}^{rr}$	$\mathbf{Z}^{rc}$	$\mathbf{Z}^{re}$	$\mathbf{Z}^{ru}$	$\mathbf{Z}^{ro}$	$\mathbf{f}^{rr}$	$\mathbf{F}^{rc}$	$\mathbf{F}^{re}$	$\mathbf{F}^{ru}$	$\mathbf{F}^{ro}$	$\mathbf{x}^{r}$
Other regions in country of focal region	$\mathbf{Z}^{cr}$	$\mathbf{Z}^{cc}$	$\mathbf{Z}^{ce}$	$\mathbf{Z}^{cu}$	$\mathbf{Z}^{ce}$	$\mathbf{f}^{cr}$	$\mathbf{F}^{cc}$	$\mathbf{F}^{ce}$	$\mathbf{F}^{cu}$	$\mathbf{F}^{co}$	$\mathbf{x}^{c}$
Regions in other EU countries	$\mathbf{Z}^{er}$	$\mathbf{Z}^{ec}$	$\mathbf{Z}^{ee}$	$\mathbf{Z}^{eu}$	$\mathbf{Z}^{eo}$	$\mathbf{f}^{er}$	$\mathbf{F}^{ec}$	$\mathbf{F}^{ee}$	$\mathbf{F}^{eu}$	$\mathbf{F}^{eo}$	$\mathbf{x}^{e}$
Regions in the UK	$\mathbf{Z}^{ur}$	$\mathbf{Z}^{uc}$	$\mathbf{Z}^{ue}$	$\mathbf{Z}^{uu}$	$\mathbf{Z}^{uo}$	$\mathbf{f}^{ur}$	$\mathbf{F}^{uc}$	$\mathbf{F}^{ue}$	$\mathbf{F}^{uu}$	$\mathbf{F}^{uo}$	$\mathbf{x}^{u}$
Countries outside the EU	$\mathbf{Z}^{or}$	$\mathbf{Z}^{oc}$	$\mathbf{Z}^{oe}$	$\mathbf{Z}^{ou}$	$\mathbf{Z}^{oo}$	$\mathbf{f}^{or}$	$\mathbf{F}^{oc}$	$\mathbf{F}^{oe}$	$\mathbf{F}^{ou}$	$\mathbf{F}^{oo}$	$\mathbf{x}^{o}$
Value added	$\mathbf{w}^{r'}$	$\mathbf{w}^{c'}$	$\mathbf{w}^{e'}$	$\mathbf{w}^{r'}$	$\mathbf{w}^{o'}$						
Gross output	$\mathbf{x}^{r'}$	$\mathbf{x}^{c'}$	$\mathbf{x}^{e'}$	$\mathbf{x}^{u'}$	$\mathbf{x}^{o'}$						

FIGURE 1 Stylized global input-output table with regional detail

UK, and non-EU countries. $\mathbf{Z}^{ee}$ contains the values of all transactions between industries in regions of EU countries to which *r* does not belong. Continuing our example for Île-de-France, this matrix provides quantitative information about the values of intermediate input flows between Navarra (a region in a different EU country) and Alentejo (also a region in an EU country other than France), among many other flows. $\mathbf{Z}^{uu}$ is the part of the matrix that contains the values of intermediate input flows between industries in the regions of the UK. Finally, the matrix $\mathbf{Z}^{oo}$ represents values of intermediate flows among industries in countries that do not belong to the EU. Deliveries of Chinese manufacturers of components used by car manufacturing plants in the US, for example, are included in this part.

The off-diagonal blocks within **Z** refer to trade in intermediate inputs between industries in different types of geographical entities. The elements in $\mathbf{Z}^{rc}$, for example, indicate the values of intermediate input sales by industries in the focal region *r* to industries in other regions in the same country. Hence, it quantifies linkages between suppliers in Île-de-France and users of intermediate inputs in, for example, Rhône-Alpes. In a similar vein, $\mathbf{Z}^{re}$ presents values of intermediate input sales by industries in Île-de-France to regions in other EU countries, such as Stuttgart or Stockholm. $\mathbf{Z}^{er}$ contains flows in the opposite direction, intermediate inputs imports of the focal region from regions elsewhere in the EU.

The matrices and vectors in the block labelled **F** have a similar interpretation in terms of the regions and countries involved, but refer to deliveries of final products. In our analysis, we do not distinguish between final uses, as a consequence of which consumption demand by households, government consumption, gross fixed capital formation and changes in inventories for the output of industries in regions/countries have been aggregated into single numbers. This is reflected by the fact that final demand as exerted in region *r* is represented by column vectors $\mathbf{f}^{r}$, rather than by matrices with multiple columns.

Row-wise summation of deliveries for intermediate use and for final use gives gross output of industries in all regions, represented by the last column, **x**. Double-entry bookkeeping ensures that the values in the bottom row are equal to the values in this rightmost column: payments by an industry for the intermediate inputs and for production factors (value added, including profits) in the corresponding column equal the value of sales by that industry. Value added by industries in each of the regions and countries is contained in the row vectors $\mathbf{w}'$.[8]

[8]Miller and Blair (2009) provide an excellent, comprehensive discussion of input-output analysis, including explanations regarding interregional input-output tables.

The well-known static input-output model assumes that gross output levels for each of the industries **x** are the consequence of the interplay of two sets of exogenous variables, the intermediate input coefficients and the final demand levels for the output of each of the industries:

$$\mathbf{x} = \mathbf{Ax} + \mathbf{Fi} \Longleftrightarrow \mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{Fi}. \quad (1)$$

In (1), **i** stands for the summation vector that adds the elements in the final demand block **F** in row-wise fashion, and the square matrix **A** contains the input coefficients a_{ij}^{rs}, which are obtained as $a_{ij}^{rs} = z_{ij}^{rs}/x_j^s$. These input coefficients thus indicate how many cents of industry *i* in region/country *r* is required by industry *j* in region/country *s* in order to produce one euro of gross output. Thus, **A** gives a quantitative description of the world production structure. This is not only determined by technological input requirements, but also by interregional and international trade patterns. The square matrix $(\mathbf{I} - \mathbf{A})^{-1}$ is known as the (global) Leontief inverse. Denoting it by **L**, its typical element l_{ij}^{rs} gives the gross output of industry *i* in region/country *r* required to produce one unit of final demand for the output of industry *j* in region/country *s*.

We pre-multiply (1) by a (row) vector **v′**, of which the typical element $v_j^s = w_j^s/x_j^s$ is the value added coefficient of industry *j* in region/country *s*. This leads to:

$$\mathbf{w}'\mathbf{i} = \mathbf{v}'(\mathbf{I} - \mathbf{A})^{-1}\mathbf{Fi}. \quad (2)$$

The left-hand side of (2) equals the summation of value added in all industries in the world, which equals world GDP. The right-hand side of this equation shows that world GDP can be attributed to demand for final products by specific countries. We could, for example, specify a hypothetical final demand block $\widetilde{\mathbf{F}}$ that consists of demand by final users in Stuttgart for output produced in Rhône-Alpes, and zeros elsewhere. This yields the part of world GDP that can be attributed to exports of final products from Rhône-Alpes to Stuttgart explicitly considering that these final products from Rhône-Alpes might well require economic activities in the production of intermediate inputs in Île-de-France or other regions in France and elsewhere in the world.

In this study, we are interested in the extent to which GDP of regions is exposed to Brexit. This implies that we will not focus on world GDP, but on GDP in a focal region *r*. As Los et al. (2016) show, (2) can easily be modified to attain this. The only change that is required is replacing the vector **v** with a vector $\mathbf{v}^r$, which is a vector of equal length, but in which all value added coefficients apart from those for the industries in the focal region *r* have been set to zero:

$$GDP^r = \mathbf{v}^{r'}(\mathbf{I} - \mathbf{A})^{-1}\mathbf{Fi}. \quad (3)$$

Continuing our line of reasoning in the discussion of (2), (3) allows us to compute the part of Île-de-France's GDP that can be attributed to final demand for the output of Rhône-Alpes by final users in the Stuttgart region. These indirect linkages can be empirically sizable, in particular in view of the increasing international (and probably also interregional) fragmentation of production processes (see Los, Timmer, & de Vries, 2015): financial services firms in Paris might well be dependent on the performance of machinery manufacturing firms in Rhône-Alpes exporting to Stuttgart. By virtue of the use of the Leontief inverse, (3) takes such indirect effects into account.

If one is not so much interested in the specific channels through which GDP in region *r* depends on final demand in region or country *s*, the approach pioneered in an intercountry context by Johnson and Noguera (2012) can be used. In order to contrast this approach with the perspective that we adopt in this study to quantify regional exposure to Brexit, it is useful to extend the exposition using partitioned matrices in Los et al. (2016). Continuing the use of superindices in Figure 1, we can write:

$$\mathbf{A}=\begin{bmatrix}\mathbf{A}^{rr} & \mathbf{A}^{rc} & \mathbf{A}^{re} & \mathbf{A}^{ru} & \mathbf{A}^{ro}\\ \mathbf{A}^{cr} & \mathbf{A}^{cc} & \mathbf{A}^{ce} & \mathbf{A}^{cu} & \mathbf{A}^{co}\\ \mathbf{A}^{er} & \mathbf{A}^{ec} & \mathbf{A}^{ee} & \mathbf{A}^{eu} & \mathbf{A}^{eo}\\ \mathbf{A}^{ur} & \mathbf{A}^{uc} & \mathbf{A}^{ue} & \mathbf{A}^{uu} & \mathbf{A}^{uo}\\ \mathbf{A}^{or} & \mathbf{A}^{oc} & \mathbf{A}^{oe} & \mathbf{A}^{ou} & \mathbf{A}^{oo}\end{bmatrix} \text{ and } \mathbf{F}=\begin{bmatrix}\mathbf{f}^{rr} & \mathbf{F}^{rc} & \mathbf{F}^{re} & \mathbf{F}^{ru} & \mathbf{F}^{ro}\\ \mathbf{f}^{cr} & \mathbf{F}^{cc} & \mathbf{F}^{ce} & \mathbf{F}^{cu} & \mathbf{F}^{co}\\ \mathbf{f}^{er} & \mathbf{F}^{ec} & \mathbf{F}^{ee} & \mathbf{F}^{eu} & \mathbf{F}^{eo}\\ \mathbf{f}^{ur} & \mathbf{F}^{uc} & \mathbf{F}^{ue} & \mathbf{F}^{uu} & \mathbf{F}^{uo}\\ \mathbf{f}^{or} & \mathbf{F}^{oc} & \mathbf{F}^{oe} & \mathbf{F}^{ou} & \mathbf{F}^{oo}\end{bmatrix}$$

If our aim would be to quantify the part of GDP in region *r* on final demand (for all products from all regions/countries) in UK regions, we can attain it by first hypothetically extracting final demand by UK regions:[9]

$$GDP^{r\,\#} == \mathbf{v}^{r'}(\mathbf{I}-\mathbf{A})^{-1}\mathbf{F}^{\#}\mathbf{i}, \tag{4}$$

with:

$$\mathbf{F}^{\#}=\begin{bmatrix}\mathbf{f}^{rr} & \mathbf{F}^{rc} & \mathbf{F}^{re} & \mathbf{O} & \mathbf{F}^{ro}\\ \mathbf{f}^{cr} & \mathbf{F}^{cc} & \mathbf{F}^{ce} & \mathbf{O} & \mathbf{F}^{co}\\ \mathbf{f}^{er} & \mathbf{F}^{ec} & \mathbf{F}^{ee} & \mathbf{O} & \mathbf{F}^{eo}\\ \mathbf{f}^{ur} & \mathbf{F}^{uc} & \mathbf{F}^{ue} & \mathbf{O} & \mathbf{F}^{uo}\\ \mathbf{f}^{or} & \mathbf{F}^{oc} & \mathbf{F}^{oe} & \mathbf{O} & \mathbf{F}^{oo}\end{bmatrix}$$

In this expression, **O** stands for a matrix of appropriate dimension filled with zeros. Region *r*'s domestic value added that can be attributed to final demand in the UK can now be computed as:

$$DVA^{r}_{F\_UK} = GDP^{r} - GDP^{r\,\#}. \tag{5}$$

This is the method that Los, McCann, Springford, and Thissen (2017) used to compute the dependency of UK regions on final demand in EU countries and regions. It gives quantitative indications of the extent to which these UK regions are exposed to reductions in (or even collapses of) consumption and investment demand in the EU. It serves to show how important this European final demand is for value added generation in British regions, even in sectors that do not sell much of their output to customers in the EU, such as many business and financial services firms. It does not give a good indication of the share of regional GDP that is exposed to Brexit, however, which is the aim of this paper. For example, if Île-de-France would export parts and components to China and these would be embodied in a final product exported from China to a UK region, part of Île-de-France's trade with China would depend on final demand exerted in the UK. Still, Brexit-related trade barriers between the EU and the UK do not play a role in these France-to-China and China-to-UK trade flows. Furthermore, some trade flows that will actually be hampered by these trade barriers are not taken into account. Consider a case in which Île-de-France exports parts and components to a plant in the UK, which integrates these into final products sold to the US. In this situation GDP of Île-de-France is not dependent on final demand in the UK (because the final users are located in the US), but part of its GDP is exposed to Brexit as a consequence of its exports of intermediate inputs.

In their comment on Koopman et al. (2014), Los et al. (2016) provide an approach based on hypothetical extraction, which can be used to compute domestic value added in bilateral exports. This is the measure most relevant for computing the exposure of regional GDP to Brexit, because it focuses on value added that actually crosses bilateral borders, contained in both intermediate and final products. Starting from the expressions of Los et al. (2016), it is rather straightforward to come up with the required equations:

$$DVA^{r}_{Brexit} = GDP^{r} - GDP^{r^{*}}, \tag{6}$$

[9]Hypothetical extraction was introduced as a tool in input-output analysis by Paelinck, de Caevel, and Degueldre (1965) and Strassert (1968). For a more recent contribution, see e.g. Dietzenbacher and Lahr (2013).

with:

$$GDP^{r^*} == \mathbf{v}^{r'}(\mathbf{I}-\mathbf{A}^*)^{-1}\mathbf{F}^*\mathbf{i}, \tag{6a}$$

and:

$$\mathbf{A}^* = \begin{bmatrix} \mathbf{A}^{rr} & \mathbf{A}^{rc} & \mathbf{A}^{re} & \mathbf{O} & \mathbf{A}^{ro} \\ \mathbf{A}^{cr} & \mathbf{A}^{cc} & \mathbf{A}^{ce} & \mathbf{O} & \mathbf{A}^{co} \\ \mathbf{A}^{er} & \mathbf{A}^{ec} & \mathbf{A}^{ee} & \mathbf{O} & \mathbf{A}^{eo} \\ \mathbf{A}^{ur} & \mathbf{A}^{uc} & \mathbf{A}^{ue} & \mathbf{A}^{uu} & \mathbf{A}^{uo} \\ \mathbf{A}^{or} & \mathbf{A}^{oc} & \mathbf{A}^{oe} & \mathbf{A}^{ou} & \mathbf{A}^{oo} \end{bmatrix} \text{ and } \mathbf{F}^* = \begin{bmatrix} \mathbf{f}^{rr} & \mathbf{F}^{rc} & \mathbf{F}^{re} & \mathbf{O} & \mathbf{F}^{ro} \\ \mathbf{f}^{cr} & \mathbf{F}^{cc} & \mathbf{F}^{ce} & \mathbf{O} & \mathbf{F}^{co} \\ \mathbf{f}^{er} & \mathbf{F}^{ec} & \mathbf{F}^{ee} & \mathbf{O} & \mathbf{F}^{eo} \\ \mathbf{f}^{ur} & \mathbf{F}^{uc} & \mathbf{F}^{ue} & \mathbf{F}^{uu} & \mathbf{F}^{uo} \\ \mathbf{f}^{or} & \mathbf{F}^{oc} & \mathbf{F}^{oe} & \mathbf{F}^{ou} & \mathbf{F}^{oo} \end{bmatrix} \tag{6b}$$

(6a) and (6b) yield value added in region *r* (part of an EU country) in the hypothetical situation in which none of the EU countries exports products to UK regions. The use of the Leontief inverse based on $\mathbf{A}^*$ in 6a ensures that indirect effects are also taken into account, both in a regional and an interregional sense. Even if Île-de-France's services industry does not export to the UK, part of its GDP is exposed to Brexit; some of its services might be supplied to industries in Île-de-France which do export to the UK, and other parts of its services might be sold to industries exporting to the UK from other French regions or regions elsewhere in the EU.[10] Our index for the regional GDP exposure to Brexit is now given by:

$$GDP\_Exp^r_{Brexit} = DVA^r_{Brexit}/GDP^r. \tag{7}$$

In the empirical section, we present results for some extensions of this general case. First, we will not only quantify the exposure of EU regions to Brexit, but also the exposure to Brexit of UK regions. In this case, the global input-output tables in Figure 1 would have a slightly different setup. Region *r* would be one of the UK regions and the superindex *u* would refer to the other UK regions.[11] Next, the parts of the derived matrices **A** and **F** labelled $\mathbf{A}^{rc}$, $\mathbf{A}^{re}$, $\mathbf{A}^{uc}$, $\mathbf{A}^{ue}$, $\mathbf{F}^{rc}$, $\mathbf{F}^{re}$, $\mathbf{F}^{uc}$ and $\mathbf{F}^{ue}$ are set to zero.

Second, we will make a distinction between 'direct' and 'total' GDP exposure to Brexit. The total indicator is based on the matrices in (6b). The direct indicator, however, focuses on region *r*'s value added contained in its own exports to UK regions. It does not include the part of *r*'s GDP contained in exports to the UK by other (domestic and foreign) EU regions. Hence, the direct indicator cannot be larger than the total indicator. It is obtained in a way similar to equations (6–6b), but only the blocks $\mathbf{A}^{ru}$ and $\mathbf{F}^{ru}$ are set to zero. Finally, we will not only report results for aggregate regional economies, but also for broad sectors within these. The results are obtained by modifying the vector $\mathbf{v}^r$ in (3) and in (6a). Only the value added coefficients corresponding to region *r*'s industries that are part of the broad sector considered are retained, all other elements of $\mathbf{v}^r$ are set to zero.

3 | DATA CONSTRUCTION

The results reported in this paper have been obtained on the basis of data combining data from two types of sources. First, the world input-output tables of the WIOD 2013 release, in which 40 countries (accounting for about 85% of world GDP) plus a composite 'super-country' labelled 'Rest of the World' are represented (Timmer, Dietzenbacher,

[10](6b) hypothetically extracts trade from regions in the EU to UK regions, mimicking a situation in which UK users do not purchase EU products anymore. In our computations, we do not consider a second channel causing GDP exposure of EU regions to Brexit. EU regions might export to non-EU countries like China and the US, which export more downstream products to UK regions, which in their turn export even more downstream products to EU regions. In this last step, the initial value added contribution by an EU region might disappear due to UK industries not exporting to the EU anymore. The corresponding results can be obtained by also setting $\mathbf{A}^{ur}$, $\mathbf{A}^{uc}$ and $\mathbf{A}^{ue}$, $\mathbf{f}^{ur}$, $\mathbf{F}^{uc}$ and $\mathbf{F}^{ue}$ to zero. We will not report on these results, since the differences to the numbers found using (6-6b) are extremely minor.

[11]In this case, the blocks with the superindices *c* and *e* could be aggregated.

Los, Stehrer, & de Vries, 2015). All 27 EU member states as of 2009 are included. These WIOD data have been merged with the second type of data, from regional sources: Data from Eurostat's regional economic accounts, a number of survey-based regional supply and use tables or input-output tables produced in a subset of countries, and estimates of interregional goods and services trade based on freight and airline business passenger statistics (Thissen, van Oort, Diodato, & Ruijs, 2013). The merging of the information contained in these data sources allows us to incorporate regional details regarding production structure and trade at the NUTS 2-level for all major EU-countries in global input-output tables for 2000–2010. 245 NUTS 2 European regions are represented and 14 industries can be identified for all regions and countries. All transactions (in current prices) have been converted to euro values, using market exchange rates. A detailed description of the construction methodology can be found in Thissen, Los, Lankhuizen, Van Oort, and Diodato (2017), so here we will just provide a brief account of its main characteristics.

The inter-country trade flows in WIOD's international SUTs have only been adjusted to include the actual origin and destination of so-called re-exports. The existing trade patterns between countries were used to determine the trade patterns of the re-exports. In order to be able to regionalize these national SUTs they also have been trade-linked, thus the exports to a specific country equal the imports of that country on the commodity level (see Thissen, Lankhuizen, & Jonkeren, 2015, for more details).

In order to construct the interregional trade flows, regional SUTs (supply and use tables) were created which were subsequently combined into regional IO tables using the 'industry technology' (Miller & Blair, 2009). This method was chosen because the SUTs have unequal numbers of commodities and industries.[12] The reason for regionalizing SUTs instead of IO tables is that the different sources of regional information used are both commodity (i.e. information on trade) and industry based (i.e. information on industry value added). The multiregional IO tables are an update from the perspective of interregional trade where multiregional trade data from the PBL Netherlands Environmental Assessment Agency (based on freight data and business class travel data) is used as prior information in the estimation (Thissen et al., 2013). An important feature of the data is that no a-priori gravity-type interaction behaviour is imposed (Thissen et al., 2015).

The multiregional IO-tables were then constructed in several steps. In the first step, following Isard (1953), the SUTs are regionalized using additional information from Eurostat regional accounts on value added and regional income and demand. In the second step these regionalized national coefficients are used as prior information for the subsequent non-linear optimization estimation of the multiregional NUTS 2 SUTs. Information on regional coefficients of the SUTs is added by using available regional tables for Italy, Scotland and Wales (NUTS 1), Spain (NUTS 2) and Finland (NUTS 3). These were the only regional tables available to us that were survey-based and not derived from a regionalization of national tables. In those cases information for which only a few years were available, the coefficients of the closest available year are used as a proxy. It proved important to use the regional information as additional prior information only, and not to impose the absolute regional values, because using the absolute numbers in the regional tables commonly would have resulted in extreme deviations from national coefficients in regions from the same country without regional tables. This is due to inconsistencies between regional and national tables. To complete the prior information, the multiregional trade patterns from the PBL interregional trade data were added.

The prior information has been preserved as much as possible in a constrained quadratic minimization process, under constraints posed by national totals and totals on bilateral international trade taken from the adapted international SUTs from WIOD (see Thissen et al., 2017, for details). In the final step, the global SUTs with

[12]We distinguish commodities in the 2-digit CPA (the Eurostat Statistical Classification of Products by Activity) classification. At the regional level, we use data for the following industries: agriculture; mining quarrying and energy supply; food beverages and tobacco; textiles and leather; coke, refined petroleum, nuclear fuel and chemicals; electrical, optical and transport equipment; other manufacturing; construction; distribution; hotels and restaurant; transport storage and communication; financial intermediation; real estate renting and business activities; and non-market services.

interregional detail were converted to global input-output tables with regional detail, using the methods described in Dietzenbacher, Los, Stehrer, Timmer, and de Vries (2013).

As far as we are aware, this database is the first one that provides geographical disaggregation of multiple countries within global input-output tables.[13] Still, the database has its weaknesses. Ideally, the tables would have had more industry detail, since indicators derived from relatively aggregated tables tend to be affected by aggregation bias (see Miller & Blair, 2009). Based on current knowledge of aggregation biases, we cannot judge whether our indicators are biased in a specific direction. Another weakness is related to the fact that computations based on the database implicitly assume that exporters and non-exporters in a specific industry share the same technology. Bernard, Eaton, Jensen, and Kortum (2003) showed that technologies are often quite different (see Tybout, 2003, for an overview article). At this stage of the development of global input-output tables, it is impossible to come up with well-founded speculations about the magnitude and direction of biases. One of the reasons for this is that differences between exporters and non-exporters are not confined to input requirements per unit of output, but also relate to prices paid for production factors. These differences interact in a myriad of ways, affecting the cost shares represented by the elements of the matrix **A**.

The results as reported in the rest of the paper are based on the tables for 2010. Currently these are the most recent data available. As Timmer, Los, Stehrer, and de Vries (2016) show, the international fragmentation of production processes has been rather modest since 2011, which suggests that our results are likely to be not too distant from what we would find for 2017 if the data would have been available.

4 | RESULTS

In this section we present the regional results primarily in the form of maps, and the detailed regional data underlying each of the maps are reported in Tables A1, A2, A3, A4 in the Appendix.

Figure 2 depicts the GDP exposure to Brexit of European regions. The highest levels are found for many of the UK's non-core regions in the Midlands and the North of England, many of which voted for Brexit. For London and Scottish regions, the exposure rates are still much higher than for regions outside the UK, but clearly lower than for most of the UK. These results are in line with the results based on UK regions' dependency on EU consumption and investment demand reported by Los et al. (2017).[14]

Figure 2 also shows that regions in Ireland are the only other ones as exposed to Brexit as some UK regions. UK regions typically exhibit Brexit trade-related risks exposure of the order of 10–17 per cent of regional GDP, with Irish regions also displaying values of the order of 10 per cent of GDP. The Irish regions therefore have levels of Brexit-related risk exposure which are similar to the UK regions with the lowest levels of Brexit exposure, namely London and parts of Northern Scotland.

The patterns in Figure 2 are also largely visible in Figure 3, in which we consider regional labour incomes (rather than GDP) exposed to Brexit-related risks in all EU regions.

[13]Dietzenbacher, Guilhoto, and Imori (2012) included Brazilian regions in WIOD, and Cherubini and Los (2012) did the same for Italian regions. Wang, Geschke, and Lenzen (2017) disaggregated China in a geographical sense in the Eora global input-output database. Meng and Yamano (2017) present analytical results based on regional disaggregation of China and Japan (in turns, not simultaneously) within the OECD's Trade in value added data framework.

[14]For UK regions, the values of the exposure to Brexit index are typically between 2 and 4 percentage points higher than the levels of economic dependency on EU markets reported in Los et al. (2017). The new index also includes the effect of UK exports which are then embodied in exports in the opposite direction (from the EU to the UK), and UK exports to the EU which are then embodied in exports to third countries, like the US or China. As opposed to the dependence indicator used by Los et al. (2017), exports from UK regions to third countries, which are then embodied in exports to the EU are not included in the exposure to Brexit measure.

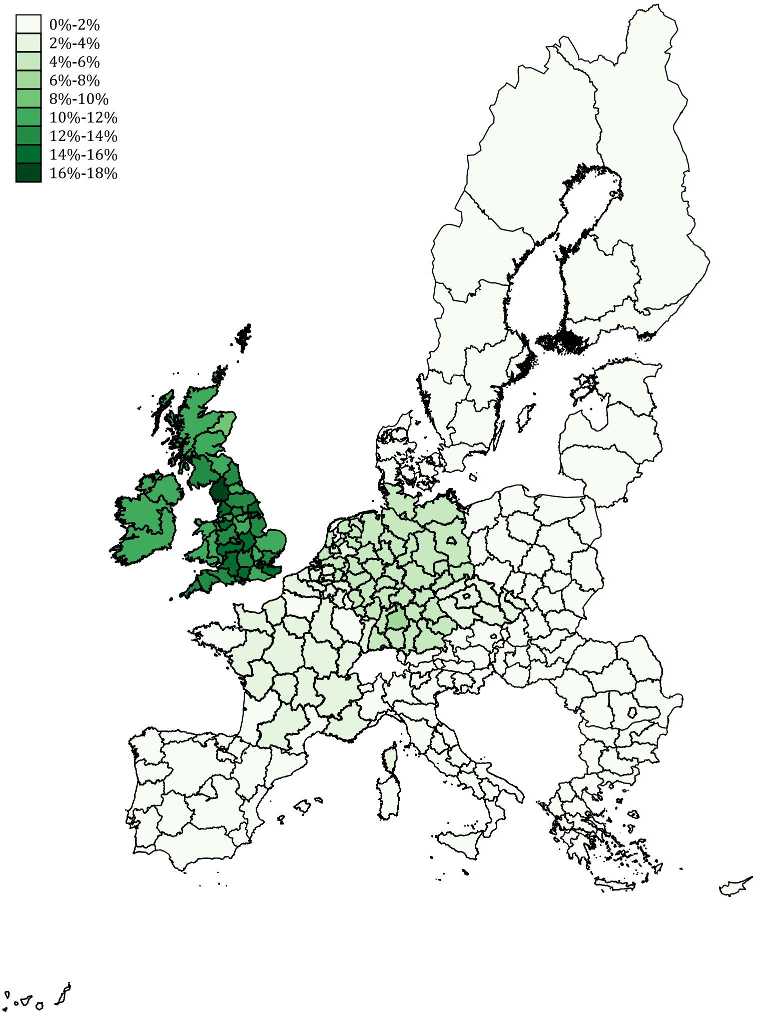

FIGURE 2 Regional shares of local GDP exposed to Brexit

In Figure 4 and 5 we depict the exposure to Brexit related risks for EU regions, regarding GDP and labour income, respectively. In these maps, we excluded all the UK regions in order to allow for a more fine-grained observation of the impacts on the non-UK regions. We see that, after Irish regions, German regions are the next most exposed regions, with Brexit risks exposure levels of the order of 4.5 per cent–6.4 per cent of regional GDP (with southern German regions[15] in particular displaying the higher levels), followed by regions in The Netherlands (3.5%–5% of regional GDP) and regions in Belgium (2.8%–4% of regional GDP), and in France (1.8%–2.7% of regional GDP).

If we consider regional labour incomes rather than GDP, we see that the Brexit exposure patterns and orders of magnitude across EU regions are generally very similar indeed. The notable exceptions are Irish regions, where the labour income exposure levels are some 2.5 percentage points below their GDP exposure levels. This result mainly relates to the strong presence of FDI-related activities in Ireland, which have a much higher capital income to labour income ratio than regular activities. In terms of labour income, Irish regions are typically half as exposed to Brexit as the typical UK region.

[15]Some of which are major automobile producing regions

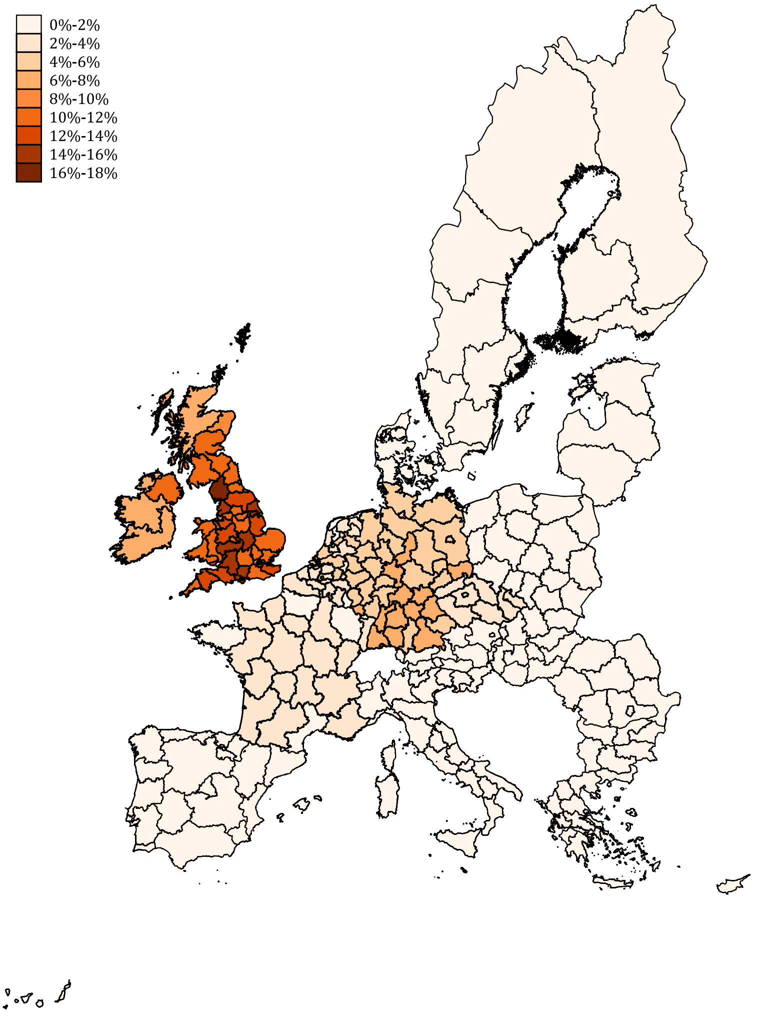

FIGURE 3 Regional shares of local labour income exposed to Brexit

These regional differences are also reflected in the national levels of exposure to Brexit. As can be seen in Table 1, the Republic of Ireland's national level of Brexit trade-related risk exposure is over 10 per cent of GDP, Germany's level of exposure is just over 5 per cent of GDP, the exposure of The Netherlands is just over 4 per cent of GDP, and that of Belgium is 3.5 per cent of GDP.[16] The other three large EU economies, namely France, Spain and Italy, face a level of GDP exposure to Brexit of only just over 2 per cent, just over 0.7 per cent and 0.5 per cent, respectively. Apart from tiny Malta, the rest of the EU member states face levels of Brexit exposure which are below that of France.

Figure 4 shows that there is considerable variation in regional GDP exposure to Brexit within countries. The region Stuttgart, for example, has an index of 6.4 per cent, which is considerably larger than the German average of just below 5.5 per cent. At the other end of the spectrum in Germany, we find the Eastern regions like

[16]The national levels of exposure have been computed by aggregating the regional results. This avoids the spatial aggregation bias (Miller & Blair, 2009) that would affect the results if the regionalized input-output tables would be aggregated up to the national level before the computations are done.

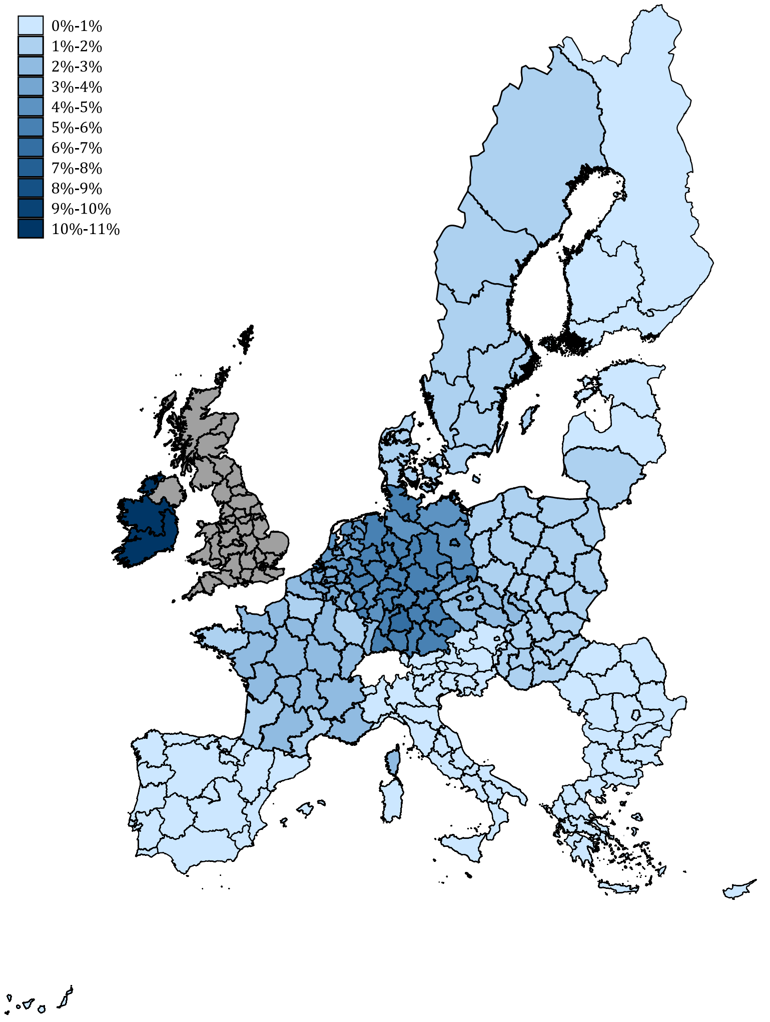

FIGURE 4 Regional shares of local GDP exposed to Brexit (excluding the UK)

Brandenburg-Nordost and Mecklenburg-Vorpommern, with exposure levels of around 4.5 per cent. The rightmost column in Table 1 presents the within-country population standard deviation of GDP exposure to Brexit levels for those countries for which regional detail is available. Besides Germany, The Netherlands and Belgium appear to be heterogeneous. In the Netherlands, Zeeland and Groningen have the highest exposure levels, probably as a consequence of the energy produced in these regions. In Belgium, Brabant-Wallonne and Limburg are most dependent on trade between the EU and the UK.

So far, we have presented results for 'total' GDP and labour income exposure to Brexit levels. These intentionally incorporate all effects related to value chains that span regions and countries. Banks based in Inner London, for example, might not be exporting a lot of their financial services directly, but might offer lots of services to manufacturing firms all over the UK, which might be active in exporting to the EU. Such effects would not enter the analysis if the interregional input-output structure would not play a role in the analysis and we would only focus on 'direct' exports. In Section 2, we explained how we can compute 'direct' exposure to Brexit, by computing how much domestic value added and labour income are contained in the exports to the EU of the UK region itself (or in the exports to the UK of the European region itself). This implies that intra-regional input-output linkages are taken

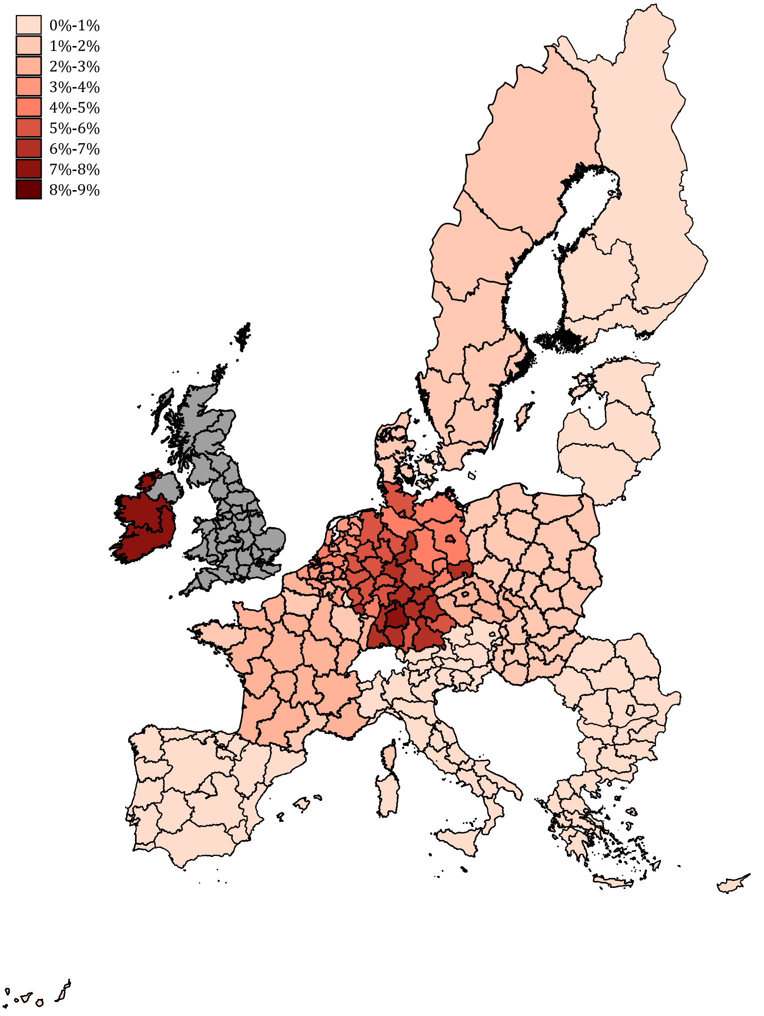

FIGURE 5 Regional shares of local labour income exposed to Brexit (excluding the UK)

into account, but interregional linkages and international linkages within the EU are not. The differences between the 'total' and 'direct' exposure levels are sizable. On average, the total GDP exposure levels are more than 68 per cent higher than the direct exposure levels for non-UK regions in the EU and more than 33 per cent higher for UK regions. The differences are most marked for many Polish and Italian regions, while the differences for Irish regions are relatively modest.

Finally, these national and regional differences in Brexit risk exposure also imply large exposure differences between the UK and the rest of the EU. The UK's national level of Brexit exposure is 12.2 per cent of UK GDP and 11.3 per cent of UK labour income. In contrast, the rest of EU in aggregate face an exposure to Brexit, which is only 2.64 per cent of their combined GDP and 2.62 per cent of their combined labour income. In other words, the Brexit trade-related exposure of the UK economy is 4.6 times greater than that of the rest of the EU.[17]

[17]Given that the nominal GDP of the rest of the EU is just over 5.1 larger than that of the UK economy, our results imply that the total GDP exposure levels to Brexit of the rest of the EU are some 10 per cent higher than that of the UK, and are therefore consistent with the findings of Vandenbussche, Connell, and Simons (2017). However, relative to the size of the economy the Brexit-related exposure risks are 4.6 times greater for the UK economy than for the rest of the EU.

TABLE 1 National levels of exposure to Brexit and regional heterogeneity

Country	DVAiX_s	Reg. SD
AUT	0.77%	0.04%
BEL	3.50%	0.37%
BGR	0.44%	NA
CYP	0.52%	NA
CZE	2.14%	0.07%
DNK	1.49%	0.02%
ESP	0.77%	0.12%
EST	0.85%	NA
FIN	0.80%	0.08%
FRA	2.19%	0.24%
GER	5.48%	0.41%
GRC	0.75%	0.06%
HUN	1.71%	0.15%
IRL	10.12%	0.01%
ITA	0.55%	0.07%
LTU	1.02%	NA
LUX	1.05%	NA
LVA	0.86%	NA
MLT	5.08%	NA
NLD	4.39%	0.47%
POL	1.31%	0.06%
PRT	0.67%	0.04%
ROU	0.56%	NA
SVK	1.31%	0.09%
SVN	0.42%	NA
SWE	1.68%	0.30%
EU	2.64%	
UK	12.20%	

Note: DVAiX_s: GDP exposure to Brexit, Reg. SD: Unweighted standard deviation of regional GDP exposures to Brexit within the country; NA: No regional detail available.

5 | DISCUSSION AND CONCLUSIONS

The figures reported here suggest three major points. First, the UK and its regions are far more vulnerable to trade-related risks of Brexit than other EU member states and their regions. Our results also mirror the broad thrust of the arguments of other analyses (Dhingra et al., 2017). As such, the UK is far more dependent on a relatively seamless and comprehensive free trade deal than the other EU member states. Mercantilist arguments popular in the UK media, which posit that the UK trade deficit with the rest of Europe implies that on economic grounds other EU member states will be eager to agree a free trade deal with the UK, are not correct. When we consider the real trade-demand impacts on the EU member states and their regions, allowing for both domestic and international input-output relationships which capture the complex global value-chains which crisscross borders many times (Bailey & De Propris, 2017), the emerging picture is very different. The UK's exposure to Brexit is some 4.6 times greater than that of the rest of other EU as a whole, and the UK regions are far more exposed to Brexit risks than regions in other EU countries, except for those in Ireland. As such, in all likelihood the potential impacts of either no deal (Springford &

Tilford, 2017) between the UK and the EU or a bad deal whereby the UK's access to the Single Market and the Customs Union is heavily curtailed, are far more damaging for the UK than for the rest of the EU.

Second, it is many of the UK's economically weaker regions which are especially exposed to Brexit. Third, across Europe there is a strong core-periphery type of economic geography to these patterns with the highly urbanized regions in northern and western Europe being more exposed to Brexit risks than regions in southern or eastern Europe. This is also reflected in the national levels of Brexit related risks exposure. As such, our analysis suggests that on purely economic grounds at least, the Republic of Ireland, Germany, the Netherlands and Belgium, will have more to gain from a relatively seamless and comprehensive UK–EU free trade deal than will other EU countries.

Finally, we can ask whether our analytical approach, which essentially involves setting all UK–EU trade linkages to zero, represents an upper bound for the potential Brexit-related exposure risks faced by regions. On this point, the evidence on the 'no-deal' scenario (HoC, 2017) suggests that the legal basis of many of the UK's cross-border exchanges (Dunt, 2016; UKICE, 2017) including all air travel (*Guardian*, 2017), sea-borne logistics, and even health and energy systems, will become insecure (UKICE, 2017), while the EU rules of origin will make UK–EU high value-added just-in-time systems in manufacturing and retail all but impossible to maintain (Bailey & De Propris, 2017). In all likelihood most existing and complex UK–EU supply chains, which also tend to be in knowledge-intensive and high value-adding sectors, will be either heavily disrupted or completely severed. From these perspectives our analytical approach would appear to be very realistic. Moreover, our analysis has not even considered the impacts on foreign direct investment, human capital-migration, and the additional trade disruptions or complications related to the UK's commercial relationships which do not directly cross any UK-EU borders. The fact that the EU also has some 40 or so different trade or cooperation agreements with third countries[18] means that in total the UK will need to negotiate well over 700 new trade agreements (*Financial Times*, 2017b). In our analysis we have treated these relationships as being unaffected by Brexit. Yet, the evidence regarding the likely impacts of 'no deal' allied with the additional complications related to the UK's non-EU trade relationships suggests that our analysis may not represent an upper bound, and that the actual Brexit-related exposure risks facing the UK and its regions are even greater than those reported here.

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[18]http://ec.europa.eu/trade/policy/countries-and-regions/agreements/index_en.htm

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APPENDIX

TABLE A1 UK regional shares of local GDP exposed to Brexit

		Primary Industries	Manufacturing	Construction	Services	Aggregate Economy
code	region	DVAiX_s	DVAiX _s	DVAiX _s	DVAiX_s	DVAiX_s
UKC1	Tees_Valley_and_Durham	21.8%	31.4%	2.7%	8.2%	11.9%
UKC2	Northumberland_Tyne_and_Wear	22.0%	35.5%	3.1%	8.4%	12.2%
UKD1	Cumbria	23.0%	37.8%	2.8%	9.3%	16.3%
UKD2	Cheshire	22.8%	38.4%	1.3%	9.9%	14.5%
UKD3	Greater_Manchester	33.0%	33.8%	4.8%	8.3%	11.3%
UKD4	Lancashire	25.6%	39.0%	3.1%	8.9%	15.0%
UKD5	Merseyside	23.7%	31.4%	2.4%	7.6%	10.4%
UKE1	East_Riding_and_North_Lincolnshire	22.2%	39.0%	2.3%	9.2%	15.8%
UKE2	North_Yorkshire	21.3%	34.2%	2.3%	8.7%	13.4%
UKE3	South_Yorkshire	24.7%	34.7%	2.0%	8.1%	11.8%
UKE4	West_Yorkshire	22.0%	31.0%	3.1%	8.9%	12.1%
UKF1	Derbyshire_and_Nottinghamshire	20.7%	29.5%	2.4%	8.0%	11.4%
UKF2	Leicestershire_Rutland_and_Northants	23.1%	36.8%	2.9%	10.0%	15.4%
UKF3	Lincolnshire	20.2%	31.8%	1.6%	8.4%	13.1%
UKG1	Herefordshire_Worcestershire_and_Warks	20.7%	34.3%	2.3%	9.2%	14.3%
UKG2	Shropshire_and_Staffordshire	22.4%	34.5%	2.6%	9.0%	13.9%
UKG3	West_Midlands	25.5%	32.3%	4.0%	8.9%	12.2%
UKH1	East_Anglia	19.4%	30.5%	3.4%	8.5%	11.9%
UKH2	Bedfordshire_Hertfordshire	22.9%	33.9%	1.8%	8.3%	11.3%
UKH3	Essex	23.2%	34.4%	2.5%	8.6%	12.1%
UKI1	Inner_London	25.6%	51.6%	5.9%	9.2%	10.3%
UKI2	Outer_London	22.4%	37.8%	1.5%	7.9%	10.2%
UKJ1	Berkshire_Bucks_and_Oxfordshire	21.8%	37.7%	3.9%	8.9%	12.5%
UKJ2	Surrey_East_and_West_Sussex	20.6%	38.3%	3.8%	8.5%	11.8%
UKJ3	Hampshire_and_Isle_of_Wight	24.7%	38.6%	4.5%	9.9%	14.7%
UKJ4	Kent	22.9%	43.5%	3.4%	9.0%	14.3%
UKK1	Gloucestershire_Wiltshire_and_North_Somerset	25.6%	36.8%	4.8%	10.7%	15.6%
UKK2	Dorset_and_Somerset	21.5%	33.8%	2.9%	8.5%	13.3%
UKK3	Cornwall_and_Isles_of_Scilly	21.2%	33.4%	1.9%	8.8%	12.7%
UKK4	Devon	20.9%	35.9%	2.8%	8.4%	13.0%
UKL1	West_Wales_and_The_Valleys	23.6%	30.5%	3.3%	7.7%	11.7%
UKL2	East_Wales	22.1%	29.2%	2.9%	8.0%	11.7%
UKM5	North_Eastern_Scotland	19.3%	30.9%	0.8%	6.2%	9.8%
UKM2	Eastern_Scotland	19.0%	31.9%	3.9%	8.0%	11.5%
UKM3	South_Western_Scotland	16.7%	36.6%	4.3%	9.7%	12.5%
UKM6	Highlands_and_Islands	18.4%	28.4%	0.4%	5.8%	10.2%
UKN0	Northern_Ireland	19.1%	32.0%	1.4%	8.0%	11.7%

TABLE A2 EU Regional shares of local GDP exposed to brexit

Code	Region	Primary Industries DVAiX_s	Manufacturing DVAiX_s	Construction DVAiX_s	Services DVAiX_s	Aggregate Economy DVAiX_s
AT11	Burgenland	0.92%	1.13%	0.32%	0.64%	0.72%
AT12	Niederosterreich	0.92%	1.14%	0.32%	0.67%	0.75%
AT13	Wien	1.29%	1.08%	0.43%	0.74%	0.78%
AT21	Karnten	1.04%	1.17%	0.40%	0.67%	0.76%
AT22	Steiermark	0.94%	1.16%	0.36%	0.66%	0.76%
AT31	Oberosterreich	0.97%	1.15%	0.34%	0.64%	0.74%
AT32	Salzburg	1.12%	1.12%	0.37%	0.77%	0.81%
AT33	Tirol	1.06%	1.13%	0.40%	0.66%	0.74%
AT34	Vorarlberg	1.15%	1.19%	0.39%	0.77%	0.86%
BE10	Region_de_BruxellesCapitale	3.48%	10.27%	2.54%	2.28%	2.78%
BE21	Prov_Antwerpen	6.16%	8.92%	2.18%	2.27%	3.54%
BE22	Prov_Limburg_B	6.81%	9.12%	1.68%	2.60%	4.02%
BE23	Prov_OostVlaanderen	4.51%	8.56%	1.53%	2.47%	3.32%
BE24	Prov_Vlaams_Brabant	5.70%	9.08%	2.15%	3.12%	3.96%
BE25	Prov_WestVlaanderen	7.02%	8.78%	1.57%	2.39%	3.84%
BE31	Prov_Brabant_Wallon	5.69%	9.45%	2.12%	2.96%	4.14%
BE32	Prov_Hainaut	5.43%	8.98%	1.83%	2.65%	3.48%
BE33	Prov_Liege	4.41%	9.03%	1.89%	2.43%	3.67%
BE34	Prov_Luxembourg_B	7.73%	9.14%	1.88%	2.66%	3.86%
BE35	Prov_Namur	6.28%	8.70%	1.69%	2.38%	3.37%
CZ01	Praha	2.68%	4.61%	0.76%	1.70%	2.07%
CZ02	Stredni_Cechy	2.24%	3.82%	0.84%	1.55%	2.22%
CZ03	Jihozapad	2.15%	4.17%	0.62%	1.51%	2.25%
CZ04	Severozapad	1.91%	3.88%	0.40%	1.45%	2.06%
CZ05	Severovychod	2.22%	3.92%	0.59%	1.48%	2.20%
CZ06	Jihovychod	2.21%	4.00%	0.72%	1.34%	2.09%
CZ07	Stredni_Morava	2.26%	3.87%	0.58%	1.48%	2.18%
CZ08	Moravskoslezko	2.03%	3.89%	0.66%	1.47%	2.10%
DE11	Stuttgart	4.37%	14.49%	1.02%	3.54%	6.42%
DE12	Karlsruhe	5.04%	13.28%	0.89%	3.19%	5.73%
DE13	Freiburg	4.15%	12.71%	0.75%	2.79%	5.48%
DE14	Tubingen	4.01%	13.61%	0.73%	3.17%	5.98%
DE21	Oberbayern	4.84%	14.98%	1.47%	3.40%	5.95%
DE22	Niederbayern	5.09%	13.49%	1.07%	2.97%	5.54%
DE23	Oberpfalz	4.73%	13.04%	0.61%	3.01%	5.70%
DE24	Oberfranken	4.93%	13.60%	0.81%	2.94%	5.72%
DE25	Mittelfranken	5.07%	13.40%	0.80%	3.05%	5.71%
DE26	Unterfranken	4.63%	14.01%	0.82%	3.07%	5.82%
DE27	Schwaben	4.65%	13.03%	0.76%	2.96%	5.41%
DE30	Berlin	5.75%	17.15%	1.92%	3.39%	5.33%
DE41	Brandenburg__Nordost	4.74%	13.63%	1.07%	2.55%	4.51%
DE42	Brandenburg__Sudwest	5.63%	15.58%	3.63%	3.13%	5.40%

(Continues)

TABLE A2 (Continued)

Code	Region	Primary Industries DVAiX_s	Manufacturing DVAiX_s	Construction DVAiX_s	Services DVAiX_s	Aggregate Economy DVAiX_s
DE50	Bremen	5.35%	14.88%	1.44%	3.49%	5.93%
DE60	Hamburg	5.45%	17.49%	1.12%	3.26%	5.30%
DE71	Darmstadt	5.48%	16.21%	1.82%	3.60%	5.72%
DE72	Giessen	4.94%	13.53%	0.67%	2.79%	5.42%
DE73	Kassel	4.56%	14.04%	0.59%	2.91%	5.45%
DE80	MecklenburgVorpommern	5.66%	15.00%	1.61%	2.84%	4.67%
DE91	Braunschweig	4.29%	14.01%	0.94%	3.18%	5.87%
DE92	Hannover	5.07%	14.46%	1.37%	3.06%	5.39%
DE93	Luneburg	5.05%	13.59%	1.68%	2.43%	4.49%
DE94	WeserEms	5.24%	13.57%	1.44%	2.90%	5.23%
DEA1	Dusseldorf	4.64%	16.65%	2.13%	2.96%	5.41%
DEA2	Koln	4.77%	16.75%	1.80%	3.01%	5.33%
DEA3	Munster	5.05%	15.03%	1.46%	2.76%	5.01%
DEA4	Detmold	5.51%	13.36%	1.04%	2.94%	5.47%
DEA5	Arnsberg	3.94%	14.54%	0.93%	2.57%	5.24%
DEB1	Koblenz	4.49%	13.44%	1.33%	2.61%	4.82%
DEB2	Trier	5.95%	13.35%	1.37%	2.71%	5.11%
DEB3	RheinhessenPfalz	4.12%	14.88%	1.83%	2.75%	4.95%
DEC0	Saarland	4.34%	13.01%	1.07%	2.95%	5.50%
DED1	Chemnitz	4.49%	15.00%	1.12%	2.78%	4.93%
DED2	Dresden	4.69%	13.81%	0.73%	3.03%	5.52%
DED3	Leipzig	4.88%	14.43%	1.28%	2.87%	4.75%
DEE1	Dessau	5.26%	14.77%	1.48%	3.14%	5.43%
DEE2	Halle	5.74%	15.99%	1.84%	2.75%	4.88%
DEE3	Magdeburg	5.61%	15.56%	1.42%	2.72%	4.92%
DEF0	SchleswigHolstein	4.88%	16.07%	1.06%	2.83%	5.27%
DEG0	Thuringen	5.16%	13.63%	0.89%	2.86%	5.26%
DK01	Hovedstadsreg	8.41%	3.32%	0.88%	0.88%	1.50%
DK02	Ost_for_Storebelt	6.16%	2.81%	0.85%	0.78%	1.46%
DK03	West_for_Storebelt	5.28%	3.04%	0.76%	0.85%	1.49%
EE00	Eesti	1.37%	1.80%	0.64%	0.63%	0.85%
ES11	Galicia	1.45%	0.94%	0.11%	0.45%	0.57%
ES12	Principado_de_Asturias	1.70%	1.29%	0.09%	0.56%	0.70%
ES13	Cantabria	2.11%	1.23%	0.08%	0.57%	0.71%
ES21	Pais_Vasco	2.65%	1.12%	0.19%	0.58%	0.72%
ES22	Comunidad_Foral_de_Navarra	1.95%	1.07%	0.07%	0.63%	0.75%
ES23	La_Rioja	1.59%	1.22%	0.06%	0.70%	0.79%
ES24	Aragon	1.56%	0.93%	0.11%	0.50%	0.60%
ES30	Comunidad_de_Madrid	1.92%	1.26%	0.25%	0.96%	0.94%
ES41	Castilla_y_Leon	1.25%	0.90%	0.10%	0.43%	0.54%
ES42	Castilla la_Mancha	1.19%	1.07%	0.06%	0.54%	0.62%
ES43	Extremadura	1.12%	0.80%	0.06%	0.62%	0.62%

(Continues)

TABLE A2 (Continued)

Code	Region	Primary Industries DVAiX_s	Manufacturing DVAiX_s	Construction DVAiX_s	Services DVAiX_s	Aggregate Economy DVAiX_s
ES51	Cataluna	3.07%	1.46%	0.18%	0.81%	0.95%
ES52	Comunidad_Valenciana	3.02%	1.44%	0.03%	0.73%	0.87%
ES53	Illes_Balears	2.06%	1.05%	0.09%	0.57%	0.62%
ES61	Andalucia	1.94%	0.82%	0.02%	0.50%	0.60%
ES62	Region_de_Murcia	2.01%	1.05%	0.06%	0.66%	0.76%
ES63	Ciudad_Autonoma_de_Ceuta_ES	1.76%	1.04%	0.14%	0.73%	0.72%
ES64	Ciudad_Autonoma_de_Melilla_ES	1.42%	1.18%	0.15%	0.76%	0.74%
ES70	Canarias_ES	1.67%	0.73%	0.17%	0.45%	0.51%
FI13	ItaSuomi	1.11%	1.72%	0.02%	0.53%	0.79%
FI18	EtelaSuomi	0.94%	1.78%	0.29%	0.58%	0.79%
FI19	LansiSuomi	1.04%	1.70%	0.22%	0.56%	0.80%
FI1A	PohjoisSuomi	0.99%	1.99%	0.03%	0.59%	0.91%
FI20	Aland	1.07%	1.43%	0.00%	0.54%	0.64%
FR10	Ile_de_France	2.94%	10.65%	0.51%	1.58%	2.07%
FR21	ChampagneArdenne	3.24%	5.77%	0.23%	1.55%	2.37%
FR22	Picardie	3.15%	6.16%	0.30%	1.36%	1.94%
FR23	HauteNormandie	3.57%	6.95%	0.29%	1.79%	2.62%
FR24	Centre	3.28%	7.68%	0.18%	1.47%	2.23%
FR25	BasseNormandie	3.67%	7.07%	0.22%	1.63%	2.47%
FR26	Bourgogne	3.79%	7.55%	0.17%	1.54%	2.28%
FR30	Nord__PasdeCalais	3.15%	7.69%	0.34%	1.53%	2.13%
FR41	Lorraine	3.18%	6.25%	0.20%	1.19%	1.78%
FR42	Alsace	3.19%	6.81%	0.31%	1.56%	2.25%
FR43	FrancheComte	3.94%	8.53%	0.20%	1.61%	2.67%
FR51	Pays_de_la_Loire	3.36%	7.30%	0.15%	1.56%	2.24%
FR52	Bretagne	3.13%	6.92%	0.08%	1.34%	1.91%
FR53	PoitouCharentes	2.96%	7.63%	0.12%	1.44%	2.12%
FR61	Aquitaine	3.79%	7.72%	0.19%	1.37%	1.98%
FR62	MidiPyrenees	3.59%	8.72%	0.12%	1.52%	2.27%
FR63	Limousin	3.85%	8.83%	0.20%	1.59%	2.38%
FR71	RhoneAlpes	3.89%	8.05%	0.24%	1.74%	2.57%
FR72	Auvergne	3.89%	5.84%	0.10%	1.59%	2.43%
FR81	LanguedocRoussillon	3.88%	6.17%	0.22%	1.30%	1.96%
FR82	ProvenceAlpesCote_d_Azur	3.93%	6.92%	0.37%	1.60%	2.31%
FR83	Corse	4.09%	5.89%	0.60%	1.81%	2.05%
GR11	Anatoliki_Makedonia_Thraki	0.36%	0.37%	0.05%	0.87%	0.72%
GR12	Kentriki_Makedonia	0.41%	0.36%	0.05%	0.85%	0.72%
GR13	Dytiki_Makedonia	0.34%	0.30%	0.10%	0.78%	0.62%
GR14	Thessalia	0.35%	0.22%	0.05%	0.83%	0.68%
GR21	Ipeiros	0.36%	0.19%	0.05%	0.85%	0.69%
GR22	Ionia_Nisia	0.45%	0.37%	0.12%	1.01%	0.87%

(Continues)

TABLE A2 (Continued)

Code	Region	Primary Industries DVAiX_s	Manufacturing DVAiX_s	Construction DVAiX_s	Services DVAiX_s	Aggregate Economy DVAiX_s
GR23	Dytiki_Ellada	0.35%	0.12%	0.03%	0.83%	0.67%
GR24	Sterea_Ellada	0.45%	0.16%	0.03%	0.93%	0.69%
GR25	Peloponnisos	0.35%	0.42%	0.04%	0.94%	0.75%
GR30	Attiki	0.58%	0.56%	0.06%	0.86%	0.79%
GR41	Voreio_Aigaio	0.41%	0.19%	0.03%	0.97%	0.81%
GR42	Notio_Aigaio	0.53%	0.34%	0.26%	0.94%	0.77%
GR43	Kriti	0.43%	0.30%	0.16%	0.86%	0.73%
HU10	KozepMagyarorszag	1.53%	3.95%	0.51%	1.17%	1.75%
HU21	KozepDunantul	0.95%	4.30%	0.38%	0.90%	1.88%
HU22	NyugatDunantul	1.11%	4.39%	0.62%	0.93%	1.82%
HU23	DelDunantul	0.86%	4.31%	0.31%	0.81%	1.45%
HU31	eszakMagyarorszag	0.87%	4.12%	0.51%	0.81%	1.60%
HU32	eszakAlfold	0.92%	3.99%	0.36%	0.83%	1.53%
HU33	DelAlfold	0.95%	3.73%	0.48%	1.06%	1.65%
IE01	Border_Midlands_and_Western	30.06%	18.02%	1.72%	5.94%	10.13%
IE02	Southern_and_Eastern	23.80%	18.82%	2.39%	6.39%	10.12%
ITC1	Piemonte	0.98%	1.33%	0.15%	0.47%	0.63%
ITC2	Valle_dAosta_Vallee_dAoste	0.37%	0.89%	0.07%	0.39%	0.42%
ITC3	Liguria	0.65%	1.17%	0.06%	0.28%	0.41%
ITC4	Lombardia	0.86%	1.27%	0.25%	0.45%	0.62%
ITD1	Provincia_Autonoma_BolzanoBozen	0.53%	0.95%	0.04%	0.26%	0.33%
ITD2	Provincia_Autonoma_Trento	0.75%	1.25%	0.06%	0.36%	0.48%
ITD3	Veneto	0.84%	1.28%	0.13%	0.40%	0.57%
ITD4	FriuliVenezia_Giulia	0.92%	1.25%	0.05%	0.38%	0.52%
ITD5	EmiliaRomagna	0.78%	1.32%	0.11%	0.42%	0.59%
ITE1	Toscana	0.74%	1.39%	0.10%	0.39%	0.55%
ITE2	Umbria	0.78%	1.30%	0.05%	0.34%	0.49%
ITE3	Marche	0.84%	1.33%	0.05%	0.32%	0.54%
ITE4	Lazio	0.84%	1.56%	0.26%	0.42%	0.55%
ITF1	Abruzzo	0.77%	1.15%	0.06%	0.35%	0.49%
ITF2	Molise	0.70%	1.06%	0.08%	0.36%	0.47%
ITF3	Campania	0.82%	1.32%	0.16%	0.35%	0.48%
ITF4	Puglia	0.65%	1.32%	0.14%	0.34%	0.48%
ITF5	Basilicata	0.78%	1.10%	0.08%	0.35%	0.45%
ITF6	Calabria	0.72%	1.43%	0.05%	0.39%	0.49%
ITG1	Sicilia	0.61%	1.36%	0.11%	0.35%	0.49%
ITG2	Sardegna	0.69%	1.38%	0.08%	0.40%	0.53%
LT00	Lietuva	1.52%	3.62%	0.19%	0.43%	1.02%
LU00	Luxembourg_GrandD	2.08%	2.15%	0.18%	1.00%	1.05%
LV00	Latvija	1.29%	3.50%	0.43%	0.51%	0.86%
MT00	Malta	4.54%	4.47%	1.21%	5.40%	5.08%

(Continues)

TABLE A2 (Continued)

Code	Region	Primary Industries DVAiX_s	Manufacturing DVAiX_s	Construction DVAiX_s	Services DVAiX_s	Aggregate Economy DVAiX_s
NL11	Groningen	8.57%	10.19%	2.49%	3.18%	4.99%
NL12	Friesland	9.08%	8.37%	1.98%	3.27%	4.30%
NL13	Drenthe	8.29%	8.98%	1.81%	3.22%	4.45%
NL21	Overijssel	10.97%	10.00%	1.86%	2.77%	4.56%
NL22	Gelderland	11.37%	7.83%	1.69%	2.63%	3.72%
NL23	Flevoland	12.31%	10.53%	1.46%	3.16%	4.93%
NL31	Utrecht	10.36%	9.13%	2.00%	2.78%	3.67%
NL32	NoordHolland	12.32%	10.15%	2.33%	3.02%	4.06%
NL33	ZuidHolland	11.14%	11.43%	1.96%	2.97%	4.88%
NL34	Zeeland	9.61%	9.60%	2.13%	3.18%	5.16%
NL41	NoordBrabant	12.20%	7.91%	2.13%	3.36%	4.62%
NL42	Limburg_NL	11.39%	7.63%	2.34%	3.05%	4.24%
PL11	Lodzkie	1.72%	2.41%	0.98%	0.98%	1.30%
PL12	Mazowieckie	2.14%	2.58%	1.12%	1.02%	1.35%
PL21	Malopolskie	1.73%	2.54%	0.84%	0.95%	1.24%
PL22	Slaskie	1.58%	2.49%	0.84%	0.90%	1.24%
PL31	Lubelskie	1.73%	2.53%	0.87%	0.91%	1.30%
PL32	Podkarpackie	1.72%	2.64%	0.79%	0.80%	1.18%
PL33	Swietokrzyskie	1.73%	2.52%	0.70%	0.89%	1.30%
PL34	Podlaskie	1.96%	2.46%	0.91%	1.08%	1.35%
PL41	Wielkopolskie	1.92%	2.39%	0.83%	0.95%	1.37%
PL42	Zachodniopomorskie	1.78%	2.63%	0.87%	0.98%	1.29%
PL43	Lubuskie	1.81%	2.43%	0.85%	1.09%	1.38%
PL51	Dolnoslaskie	1.69%	2.53%	0.91%	0.96%	1.29%
PL52	Opolskie	1.78%	2.48%	0.84%	0.98%	1.38%
PL61	KujawskoPomorskie	1.87%	2.38%	0.85%	0.97%	1.28%
PL62	WarminskoMazurskie	1.86%	2.52%	0.82%	0.95%	1.37%
PL63	Pomorskie	1.79%	2.52%	0.84%	0.99%	1.31%
PT11	Norte	0.68%	1.24%	0.13%	0.62%	0.69%
PT15	Algarve	0.67%	1.11%	0.17%	0.61%	0.61%
PT16	Centro_PT	0.61%	1.07%	0.17%	0.57%	0.62%
PT17	Lisboa	0.75%	1.44%	0.20%	0.62%	0.69%
PT18	Alentejo	0.62%	1.20%	0.13%	0.55%	0.65%
SE11	Stockholm	2.58%	4.36%	0.87%	1.29%	1.74%
SE12	ostra_Mellansverige	1.91%	4.56%	0.49%	1.06%	1.88%
SE22	Sydsverige	2.01%	3.00%	0.75%	1.23%	1.60%
SE31	Norra_Mellansverige	1.83%	2.54%	0.15%	0.90%	1.15%
SE32	Mellersta_Norrland	1.28%	3.26%	0.14%	0.57%	1.23%
SE33	ovre_Norrland	1.78%	2.77%	0.38%	0.95%	1.31%
SE21	Smaland_med_oarna	2.16%	4.81%	0.87%	1.38%	1.98%
SE23	Vastsverige	2.20%	3.09%	1.31%	1.52%	1.79%

(Continues)

TABLE A2 (Continued)

Code	Region	Primary Industries DVAiX_s	Manufacturing DVAiX_s	Construction DVAiX_s	Services DVAiX_s	Aggregate Economy DVAiX_s
SI00	Slovenija	0.59%	0.88%	0.19%	0.30%	0.42%
SK01	Bratislavsky_kraj	1.04%	2.40%	0.49%	1.35%	1.39%
SK02	Zapadne_Slovensko	0.72%	2.52%	0.30%	1.20%	1.38%
SK03	Stredne_Slovensko	0.77%	2.32%	0.30%	1.06%	1.21%
SK04	Vychodne_Slovensko	0.77%	2.45%	0.35%	0.99%	1.19%
BGR	Bulgaria	1.00%	0.57%	0.15%	0.35%	0.44%
ROU	Roumania	0.62%	0.97%	0.11%	0.46%	0.56%
CYP	Cyprus	2.54%	1.14%	0.47%	0.35%	0.52%

TABLE A3 UK regional shares of local labour income exposed to Brexit

Code	Region	Primary Industries DLIiX_s	Manufacturing DLIiX_s	Construction DLIiX_s	Services DLIiX_s	Aggregate Economy DLIiX_s
UKC1	Tees_Valley_and_Durham	21.8%	31.3%	2.7%	6.6%	10.7%
UKC2	Northumberland_Tyne_and_Wear	21.8%	35.9%	3.1%	6.6%	11.1%
UKD1	Cumbria	22.6%	37.8%	2.8%	7.9%	16.8%
UKD2	Cheshire	21.0%	37.5%	1.3%	8.7%	13.0%
UKD3	Greater_Manchester	33.5%	34.4%	4.8%	6.9%	10.5%
UKD4	Lancashire	24.2%	38.6%	3.1%	7.4%	14.5%
UKD5	Merseyside	24.4%	31.8%	2.4%	6.1%	9.1%
UKE1	East_Riding_and_North_Lincolnshire	22.0%	38.6%	2.3%	7.5%	15.1%
UKE2	North_Yorkshire	20.9%	34.6%	2.3%	7.4%	12.9%
UKE3	South_Yorkshire	24.7%	35.1%	2.0%	6.5%	11.1%
UKE4	West_Yorkshire	22.1%	31.4%	3.1%	7.3%	11.1%
UKF1	Derbyshire_and_Nottinghamshire	20.6%	30.0%	2.4%	6.5%	10.6%
UKF2	Leicestershire_Rutland_and_Northants	22.8%	36.8%	2.9%	8.8%	14.8%
UKF3	Lincolnshire	20.3%	32.1%	1.6%	7.0%	13.0%
UKG1	Herefordshire_Worcestershire_and_Warks	19.7%	34.3%	2.3%	8.0%	14.4%
UKG2	Shropshire_and_Staffordshire	21.2%	34.5%	2.6%	7.6%	13.7%
UKG3	West_Midlands	25.5%	32.7%	4.0%	7.2%	11.3%
UKH1	East_Anglia	18.6%	31.1%	3.4%	7.1%	11.3%
UKH2	Bedfordshire_Hertfordshire	22.6%	34.3%	1.8%	7.0%	10.8%
UKH3	Essex	22.1%	34.4%	2.5%	7.1%	11.7%
UKI1	Inner_London	26.2%	51.0%	5.9%	8.3%	9.2%
UKI2	Outer_London	23.0%	38.7%	1.5%	6.8%	9.3%
UKJ1	Berkshire_Bucks_and_Oxfordshire	21.9%	37.9%	3.9%	7.7%	11.6%
UKJ2	Surrey_East_and_West_Sussex	20.3%	38.5%	3.8%	7.0%	11.4%
UKJ3	Hampshire_and_Isle_of_Wight	23.9%	38.8%	4.5%	8.5%	14.3%
UKJ4	Kent	19.7%	43.4%	3.4%	7.4%	13.4%
UKK1	Gloucestershire_Wiltshire_ and_North_Somerset	24.7%	37.1%	4.8%	9.2%	14.7%

(Continues)

TABLE A3 (Continued)

Code	Region	Primary Industries DLIiX_s	Manufacturing DLIiX_s	Construction DLIiX_s	Services DLIiX_s	Aggregate Economy DLIiX_s
UKK2	Dorset_and_Somerset	20.0%	34.1%	2.9%	6.8%	12.8%
UKK3	Cornwall_and_Isles_of_Scilly	20.0%	33.8%	1.9%	6.8%	11.9%
UKK4	Devon	19.3%	36.3%	2.8%	6.5%	12.0%
UKL1	West_Wales_and_The_Valleys	20.7%	30.6%	3.3%	5.9%	11.1%
UKL2	East_Wales	20.4%	29.7%	2.9%	6.3%	10.8%
UKM5	North_Eastern_Scotland	17.4%	31.3%	0.8%	4.8%	8.5%
UKM2	Eastern_Scotland	18.9%	32.6%	3.9%	6.4%	10.3%
UKM3	South_Western_Scotland	14.4%	37.5%	4.3%	8.8%	10.8%
UKM6	Highlands_and_Islands	13.4%	28.6%	0.4%	4.0%	8.0%
UKN0	Northern_Ireland	18.5%	32.8%	1.4%	5.9%	10.6%

TABLE A4 EU regional shares of local labour income exposed to Brexit

Code	Region	Primary Industries DLIiX_s	Manufacturing DLIiX_s	Construction DLIiX_s	Services DLIiX_s	Aggregate Economy DLIiX_s
AT11	Burgenland	1.00%	1.10%	0.32%	0.51%	0.6%
AT12	Niederosterreich	1.05%	1.10%	0.32%	0.56%	0.7%
AT13	Wien	1.32%	1.07%	0.43%	0.63%	0.7%
AT21	Karnten	1.15%	1.13%	0.40%	0.57%	0.7%
AT22	Steiermark	1.11%	1.12%	0.36%	0.53%	0.7%
AT31	Oberosterreich	1.15%	1.11%	0.34%	0.54%	0.7%
AT32	Salzburg	1.17%	1.08%	0.37%	0.60%	0.7%
AT33	Tirol	1.12%	1.09%	0.40%	0.53%	0.6%
AT34	Vorarlberg	1.18%	1.15%	0.39%	0.64%	0.8%
BE10	Region_de_BruxellesCapitale	3.47%	10.03%	2.54%	2.01%	2.4%
BE21	Prov_Antwerpen	5.94%	8.78%	2.18%	1.97%	3.4%
BE22	Prov_Limburg_B	6.57%	9.04%	1.68%	2.22%	4.0%
BE23	Prov_OostVlaanderen	4.25%	8.47%	1.53%	2.02%	3.0%
BE24	Prov_Vlaams_Brabant	5.64%	8.98%	2.15%	2.79%	3.7%
BE25	Prov_WestVlaanderen	6.27%	8.71%	1.57%	1.98%	3.8%
BE31	Prov_Brabant_Wallon	5.17%	9.32%	2.12%	2.64%	3.5%
BE32	Prov_Hainaut	3.93%	8.84%	1.83%	2.14%	3.2%
BE33	Prov_Liege	3.70%	8.99%	1.89%	2.05%	3.5%
BE34	Prov_Luxembourg_B	6.56%	9.07%	1.88%	2.15%	3.5%
BE35	Prov_Namur	5.31%	8.64%	1.69%	1.94%	2.9%
CZ01	Praha	2.69%	4.59%	0.76%	1.70%	2.0%
CZ02	Stredni_Cechy	2.25%	3.84%	0.84%	1.55%	2.3%
CZ03	Jihozapad	2.20%	4.20%	0.62%	1.50%	2.3%
CZ04	Severozapad	1.93%	3.88%	0.40%	1.42%	2.1%
CZ05	Severovychod	2.26%	3.92%	0.59%	1.46%	2.3%

(Continues)

TABLE A4 (Continued)

Code	Region	Primary Industries DLIiX_s	Manufacturing DLIiX_s	Construction DLIiX_s	Services DLIiX_s	Aggregate Economy DLIiX_s
CZ06	Jihovychod	2.26%	4.02%	0.72%	1.30%	2.1%
CZ07	Stredni_Morava	2.30%	3.89%	0.58%	1.46%	2.2%
CZ08	Moravskoslezko	2.08%	3.90%	0.66%	1.42%	2.1%
DE11	Stuttgart	3.91%	14.64%	1.02%	3.18%	7.2%
DE12	Karlsruhe	4.74%	13.42%	0.89%	2.80%	6.2%
DE13	Freiburg	3.76%	12.80%	0.75%	2.42%	6.0%
DE14	Tubingen	3.67%	13.77%	0.73%	2.74%	6.7%
DE21	Oberbayern	4.31%	15.12%	1.47%	3.02%	6.4%
DE22	Niederbayern	4.71%	13.66%	1.07%	2.58%	5.5%
DE23	Oberpfalz	4.56%	13.15%	0.61%	2.59%	6.1%
DE24	Oberfranken	4.44%	13.72%	0.81%	2.73%	6.2%
DE25	Mittelfranken	4.75%	13.49%	0.80%	2.81%	6.2%
DE26	Unterfranken	4.31%	14.15%	0.82%	2.58%	6.4%
DE27	Schwaben	4.29%	13.21%	0.76%	2.66%	5.8%
DE30	Berlin	5.78%	17.43%	1.92%	2.93%	5.2%
DE41	Brandenburg__Nordost	4.91%	13.88%	1.07%	2.16%	4.2%
DE42	Brandenburg__Sudwest	5.57%	15.90%	3.63%	2.77%	5.1%
DE50	Bremen	5.38%	15.02%	1.44%	2.84%	6.2%
DE60	Hamburg	5.42%	17.57%	1.12%	2.82%	5.7%
DE71	Darmstadt	5.52%	16.46%	1.82%	3.42%	5.9%
DE72	Giessen	4.74%	13.67%	0.67%	2.48%	5.9%
DE73	Kassel	4.44%	14.18%	0.59%	2.58%	6.1%
DE80	MecklenburgVorpommern	5.69%	15.19%	1.61%	2.31%	4.6%
DE91	Braunschweig	4.20%	14.27%	0.94%	2.80%	6.0%
DE92	Hannover	5.05%	14.73%	1.37%	2.69%	5.7%
DE93	Luneburg	4.95%	13.73%	1.68%	1.99%	4.8%
DE94	WeserEms	5.18%	13.76%	1.44%	2.40%	5.6%
DEA1	Dusseldorf	4.81%	16.83%	2.13%	2.57%	5.5%
DEA2	Koln	4.78%	16.85%	1.80%	2.55%	5.8%
DEA3	Munster	5.01%	15.16%	1.46%	2.47%	5.2%
DEA4	Detmold	5.36%	13.55%	1.04%	2.62%	5.9%
DEA5	Arnsberg	3.95%	14.59%	0.93%	2.28%	5.7%
DEB1	Koblenz	4.42%	13.63%	1.33%	2.19%	5.1%
DEB2	Trier	5.61%	13.48%	1.37%	2.40%	5.4%
DEB3	RheinhessenPfalz	4.14%	14.94%	1.83%	2.42%	4.9%
DEC0	Saarland	4.33%	13.08%	1.07%	2.51%	6.1%
DED1	Chemnitz	4.85%	15.24%	1.12%	2.40%	4.4%
DED2	Dresden	4.85%	13.98%	0.73%	2.68%	6.3%
DED3	Leipzig	5.14%	14.68%	1.28%	2.61%	4.5%
DEE1	Dessau	5.17%	14.94%	1.48%	2.54%	4.9%
DEE2	Halle	5.94%	16.11%	1.84%	2.19%	4.2%

(Continues)

TABLE A4 (Continued)

Code	Region	Primary Industries DLIiX_s	Manufacturing DLIiX_s	Construction DLIiX_s	Services DLIiX_s	Aggregate Economy DLIiX_s
DEE3	Magdeburg	5.82%	15.67%	1.42%	2.19%	4.3%
DEF0	SchleswigHolstein	4.81%	16.12%	1.06%	2.40%	6.0%
DEG0	Thuringen	5.38%	13.82%	0.89%	2.41%	5.4%
DK01	Hovedstadsreg	7.80%	3.32%	0.88%	0.73%	1.0%
DK02	Ost_for_Storebelt	4.67%	2.82%	0.85%	0.61%	1.0%
DK03	West_for_Storebelt	4.69%	3.04%	0.76%	0.68%	1.2%
EE00	Eesti	1.37%	1.77%	0.64%	0.56%	0.8%
ES11	Galicia	1.44%	0.91%	0.11%	0.35%	0.5%
ES12	Principado_de_Asturias	1.33%	1.23%	0.09%	0.46%	0.6%
ES13	Cantabria	1.89%	1.16%	0.08%	0.46%	0.6%
ES21	Pais_Vasco	2.15%	1.07%	0.19%	0.48%	0.6%
ES22	Comunidad_Foral_de_Navarra	1.61%	1.03%	0.07%	0.51%	0.6%
ES23	La_Rioja	1.52%	1.20%	0.06%	0.57%	0.7%
ES24	Aragon	1.37%	0.89%	0.11%	0.40%	0.5%
ES30	Comunidad_de_Madrid	1.96%	1.19%	0.25%	0.90%	0.9%
ES41	Castilla_y_Leon	1.10%	0.86%	0.10%	0.32%	0.4%
ES42	Castillala_Mancha	1.15%	1.03%	0.06%	0.44%	0.5%
ES43	Extremadura	1.13%	0.80%	0.06%	0.49%	0.5%
ES51	Cataluna	2.64%	1.37%	0.18%	0.76%	0.8%
ES52	Comunidad_Valenciana	2.70%	1.38%	0.03%	0.66%	0.8%
ES53	Illes_Balears	2.00%	1.02%	0.09%	0.45%	0.5%
ES61	Andalucia	2.02%	0.80%	0.02%	0.42%	0.5%
ES62	Region_de_Murcia	2.10%	1.06%	0.06%	0.54%	0.6%
ES63	Ciudad_Autonoma_de_Ceuta_ES	2.33%	1.04%	0.14%	0.54%	0.6%
ES64	Ciudad_Autonoma_de_Melilla_ES	1.75%	1.15%	0.15%	0.61%	0.6%
ES70	Canarias_ES	2.11%	0.71%	0.17%	0.36%	0.4%
FI13	ItaSuomi	1.10%	1.66%	0.02%	0.37%	0.7%
FI18	EtelaSuomi	0.96%	1.74%	0.29%	0.44%	0.7%
FI19	LansiSuomi	1.03%	1.71%	0.22%	0.40%	0.7%
FI1A	PohjoisSuomi	1.00%	1.95%	0.03%	0.47%	0.8%
FI20	Aland	1.09%	1.32%	0.00%	0.49%	0.6%
FR10	Ile_de_France	2.74%	10.91%	0.51%	1.47%	2.1%
FR21	ChampagneArdenne	3.14%	6.01%	0.23%	1.38%	2.4%
FR22	Picardie	3.02%	6.38%	0.30%	1.19%	1.9%
FR23	HauteNormandie	3.30%	7.18%	0.29%	1.62%	2.6%
FR24	Centre	2.85%	7.92%	0.18%	1.30%	2.3%
FR25	BasseNormandie	3.46%	7.26%	0.22%	1.42%	2.6%
FR26	Bourgogne	3.47%	7.78%	0.17%	1.34%	2.3%
FR30	Nord__PasdeCalais	2.86%	8.07%	0.34%	1.40%	2.1%
FR41	Lorraine	2.84%	6.35%	0.20%	1.02%	1.7%
FR42	Alsace	2.95%	7.05%	0.31%	1.46%	2.3%

(Continues)

TABLE A4 (Continued)

Code	Region	Primary Industries DLIiX_s	Manufacturing DLIiX_s	Construction DLIiX_s	Services DLIiX_s	Aggregate Economy DLIiX_s
FR43	FrancheComte	3.66%	8.84%	0.20%	1.38%	2.8%
FR51	Pays_de_la_Loire	3.19%	7.63%	0.15%	1.39%	2.3%
FR52	Bretagne	3.01%	7.38%	0.08%	1.17%	2.0%
FR53	PoitouCharentes	2.87%	8.01%	0.12%	1.26%	2.2%
FR61	Aquitaine	3.73%	8.02%	0.19%	1.23%	2.0%
FR62	MidiPyrenees	2.98%	8.99%	0.12%	1.37%	2.4%
FR63	Limousin	3.70%	9.14%	0.20%	1.36%	2.4%
FR71	RhoneAlpes	3.50%	8.27%	0.24%	1.58%	2.7%
FR72	Auvergne	3.46%	5.98%	0.10%	1.36%	2.4%
FR81	LanguedocRoussillon	3.58%	6.35%	0.22%	1.15%	2.0%
FR82	ProvenceAlpesCote_d_Azur	3.77%	7.18%	0.37%	1.46%	2.4%
FR83	Corse	4.16%	5.90%	0.60%	1.65%	1.9%
GR11	Anatoliki_Makedonia_Thraki	0.33%	0.26%	0.05%	0.53%	0.5%
GR12	Kentriki_Makedonia	0.47%	0.36%	0.05%	0.60%	0.5%
GR13	Dytiki_Makedonia	0.34%	0.41%	0.10%	0.47%	0.4%
GR14	Thessalia	0.38%	0.24%	0.05%	0.46%	0.4%
GR21	Ipeiros	0.44%	0.20%	0.05%	0.45%	0.4%
GR22	Ionia_Nisia	0.55%	0.35%	0.12%	0.47%	0.4%
GR23	Dytiki_Ellada	0.37%	0.13%	0.03%	0.48%	0.4%
GR24	Sterea_Ellada	0.46%	0.17%	0.03%	0.44%	0.4%
GR25	Peloponnisos	0.35%	0.41%	0.04%	0.55%	0.5%
GR30	Attiki	0.64%	0.54%	0.06%	0.53%	0.5%
GR41	Voreio_Aigaio	0.43%	0.21%	0.03%	0.48%	0.4%
GR42	Notio_Aigaio	0.60%	0.31%	0.26%	0.41%	0.4%
GR43	Kriti	0.51%	0.29%	0.16%	0.49%	0.5%
HU10	KozepMagyarorszag	1.54%	3.58%	0.51%	1.10%	1.5%
HU21	KozepDunantul	0.97%	3.83%	0.38%	0.76%	1.7%
HU22	NyugatDunantul	1.12%	3.77%	0.62%	0.79%	1.5%
HU23	DelDunantul	0.88%	3.87%	0.31%	0.66%	1.4%
HU31	eszakMagyarorszag	0.88%	3.65%	0.51%	0.65%	1.5%
HU32	eszakAlfold	0.96%	3.59%	0.36%	0.66%	1.4%
HU33	DelAlfold	1.02%	3.50%	0.48%	0.85%	1.5%
IE01	Border_Midlands_and_Western	20.20%	18.43%	1.72%	4.75%	7.7%
IE02	Southern_and_Eastern	18.41%	19.31%	2.39%	5.48%	7.4%
ITC1	Piemonte	0.92%	1.34%	0.15%	0.37%	0.6%
ITC2	Valle_dAosta_Vallee_dAoste	0.50%	0.92%	0.07%	0.25%	0.4%
ITC3	Liguria	0.60%	1.17%	0.06%	0.21%	0.4%
ITC4	Lombardia	0.83%	1.28%	0.25%	0.37%	0.6%
ITD1	Provincia_Autonoma_BolzanoBozen	0.49%	0.99%	0.04%	0.18%	0.3%
ITD2	Provincia_Autonoma_Trento	0.73%	1.28%	0.06%	0.28%	0.4%
ITD3	Veneto	0.84%	1.29%	0.13%	0.30%	0.6%

(Continues)

TABLE A4 (Continued)

Code	Region	Primary Industries DLIiX_s	Manufacturing DLIiX_s	Construction DLIiX_s	Services DLIiX_s	Aggregate Economy DLIiX_s
ITD4	FriuliVenezia_Giulia	0.99%	1.26%	0.05%	0.31%	0.5%
ITD5	EmiliaRomagna	0.78%	1.34%	0.11%	0.34%	0.6%
ITE1	Toscana	0.74%	1.41%	0.10%	0.30%	0.5%
ITE2	Umbria	0.75%	1.32%	0.05%	0.26%	0.5%
ITE3	Marche	0.84%	1.33%	0.05%	0.23%	0.6%
ITE4	Lazio	0.86%	1.56%	0.26%	0.33%	0.5%
ITF1	Abruzzo	0.76%	1.17%	0.06%	0.24%	0.5%
ITF2	Molise	0.68%	1.09%	0.08%	0.26%	0.4%
ITF3	Campania	0.85%	1.34%	0.16%	0.24%	0.4%
ITF4	Puglia	0.65%	1.34%	0.14%	0.22%	0.4%
ITF5	Basilicata	0.79%	1.14%	0.08%	0.24%	0.4%
ITF6	Calabria	0.78%	1.48%	0.05%	0.30%	0.4%
ITG1	Sicilia	0.68%	1.40%	0.11%	0.24%	0.4%
ITG2	Sardegna	0.72%	1.41%	0.08%	0.32%	0.5%
LT00	Lietuva	1.52%	3.53%	0.19%	0.36%	0.9%
LU00	Luxembourg_GrandD	1.97%	2.20%	0.18%	0.88%	0.9%
LV00	Latvija	1.34%	3.14%	0.43%	0.43%	0.8%
MT00	Malta	4.63%	4.26%	1.21%	5.63%	5.2%
NL11	Groningen	12.10%	8.07%	2.49%	3.00%	3.4%
NL12	Friesland	9.87%	7.62%	1.98%	3.04%	3.7%
NL13	Drenthe	9.36%	8.06%	1.81%	3.07%	3.9%
NL21	Overijssel	11.46%	9.09%	1.86%	2.60%	4.1%
NL22	Gelderland	12.13%	7.25%	1.69%	2.39%	3.3%
NL23	Flevoland	12.66%	10.12%	1.46%	2.91%	4.4%
NL31	Utrecht	11.48%	8.20%	2.00%	2.58%	3.1%
NL32	NoordHolland	13.59%	9.18%	2.33%	2.78%	3.5%
NL33	ZuidHolland	12.27%	10.42%	1.96%	2.77%	4.0%
NL34	Zeeland	10.97%	8.76%	2.13%	3.01%	4.2%
NL41	NoordBrabant	13.28%	7.18%	2.13%	3.11%	4.1%
NL42	Limburg_NL	12.88%	6.82%	2.34%	2.74%	3.7%
PL11	Lodzkie	1.64%	2.41%	0.98%	0.79%	1.2%
PL12	Mazowieckie	2.00%	2.57%	1.12%	0.92%	1.2%
PL21	Malopolskie	1.66%	2.53%	0.84%	0.80%	1.1%
PL22	Slaskie	1.50%	2.48%	0.84%	0.76%	1.2%
PL31	Lubelskie	1.67%	2.53%	0.87%	0.72%	1.2%
PL32	Podkarpackie	1.70%	2.63%	0.79%	0.61%	1.1%
PL33	Swietokrzyskie	1.65%	2.52%	0.70%	0.71%	1.2%
PL34	Podlaskie	1.93%	2.46%	0.91%	0.86%	1.2%
PL41	Wielkopolskie	1.86%	2.39%	0.83%	0.80%	1.3%
PL42	Zachodniopomorskie	1.77%	2.62%	0.87%	0.78%	1.2%
PL43	Lubuskie	1.80%	2.43%	0.85%	0.88%	1.3%

(Continues)

TABLE A4 (Continued)

Code	Region	Primary Industries DLIiX_s	Manufacturing DLIiX_s	Construction DLIiX_s	Services DLIiX_s	Aggregate Economy DLIiX_s
PL51	Dolnoslaskie	1.67%	2.52%	0.91%	0.83%	1.2%
PL52	Opolskie	1.74%	2.47%	0.84%	0.80%	1.3%
PL61	KujawskoPomorskie	1.84%	2.38%	0.85%	0.74%	1.1%
PL62	WarminskoMazurskie	1.83%	2.52%	0.82%	0.76%	1.3%
PL63	Pomorskie	1.79%	2.51%	0.84%	0.85%	1.2%
PT11	Norte	0.67%	1.24%	0.13%	0.54%	0.6%
PT15	Algarve	0.67%	1.08%	0.17%	0.50%	0.5%
PT16	Centro_PT	0.61%	1.10%	0.17%	0.45%	0.5%
PT17	Lisboa	0.79%	1.45%	0.20%	0.56%	0.6%
PT18	Alentejo	0.62%	1.22%	0.13%	0.42%	0.5%
SE11	Stockholm	2.57%	3.36%	0.87%	1.15%	1.5%
SE12	ostra_Mellansverige	1.88%	3.69%	0.49%	0.87%	1.5%
SE22	Sydsverige	2.01%	2.85%	0.75%	1.02%	1.5%
SE31	Norra_Mellansverige	1.89%	2.47%	0.15%	0.73%	1.1%
SE32	Mellersta_Norrland	1.30%	2.68%	0.14%	0.40%	1.0%
SE33	ovre_Norrland	1.78%	2.57%	0.38%	0.78%	1.2%
SE21	Smaland_med_oarna	2.13%	3.75%	0.87%	1.15%	1.5%
SE23	Vastsverige	2.08%	2.91%	1.31%	1.34%	1.5%
SI00	Slovenija	0.63%	0.88%	0.19%	0.26%	0.4%
SK01	Bratislavsky_kraj	1.04%	2.45%	0.49%	1.36%	1.4%
SK02	Zapadne_Slovensko	0.75%	2.53%	0.30%	1.25%	1.5%
SK03	Stredne_Slovensko	0.77%	2.34%	0.30%	1.08%	1.4%
SK04	Vychodne_Slovensko	0.78%	2.46%	0.35%	0.96%	1.2%
BGR	Bulgaria	1.09%	0.56%	0.15%	0.37%	0.4%
ROU	Roumania	0.63%	1.16%	0.11%	0.34%	0.6%
CYP	Cyprus	2.50%	1.23%	0.47%	0.31%	0.4%

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Resumen. En este artículo se emplea una extensión de la Base de Datos Mundial de Input-Output (WIOD, por sus siglas en inglés) con detalles regionales para los países de la UE, con el fin de estudiar en qué medida están expuestas las regiones y los países de la UE a las consecuencias negativas de *Brexit* relacionadas con el comercio. Se desarrolla un índice de esta exposición, que incorpora todos los efectos debidos a los procesos de producción fragmentados geográficamente dentro del Reino Unido, la UE y el resto del mundo. Los hallazgos demuestran que las regiones del Reino Unido están mucho más expuestas que las regiones de otros países. Tan solo las regiones de la República de Irlanda se enfrentan a niveles de exposición similares a algunas de las regiones del Reino Unido, mientras que las siguientes regiones más afectadas se encuentran en Alemania, los Países Bajos, Bélgica y Francia. Este desequilibrio puede influir en los resultados de las negociaciones entre el Reino Unido y la UE.

抄録: 本稿では、EU加盟国の地域の詳細情報を加えた、拡張版World Input - Output Database (WIOD) を使用して、EU内の地域およびEU加盟国が、貿易に関してブレグジッド(Brexit: イギリスのEU離脱)の悪影響をどの程度受けているかを検討する。本稿では、イギリス国内、EU内、さらに広範囲に地理的に分断されている生産プロセスによるあらゆる効果を組み込んだ、ブレグジッドの影響の程度を示す指標を作成する。結果から、イギリスの地域は他の国の地域よりも悪影響をはるかに大きく受けていることが示される。アイルランド共和国の地域のみが、イギリスの一部の地域に近いレベルで悪影響を受けており、ドイツ、オランダ、ベルギー、フランス、以上の各国の地域がこれに続く。この不均衡はイギリスとEU間の交渉の結果に影響する可能性がある。

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