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A research note on the Brexit referendum and regional unemployment in the UK: a synthetic control method approach

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Abstract

Purpose – In the 2016 Brexit referendum the electorate decided that the UK would leave the European Union (EU), the first country to do so. The decision to leave the EU was a controversial choice, especially because of the geographical divide over the decision. In some regions, an overwhelming majority voted to stay within the EU, while in others the electorate displayed a marked preference to leave.
Design/methodology/approach – We employ the synthetic control method to examine the short-term impacts of the Brexit referendum on unemployment in the 12 UK regions.
Findings – Our results show that the impact has been modest and that there is no clear relationship between voting in favour of Brexit and the level of unemployment after the referendum.
Originality/value – Our contribution is the first study to estimate the short-term impacts of Brexit on unemployment in the UK regions and is a topical and timely contribution to the debate on the future of the European Union.

Keywords Unemployment, Brexit, Regional impact, Synthetic control method
Paper type Research paper

1. Introduction

On 23 June 2016, the "leavers" prevailed over the "remainers" in the Brexit Referendum and the United Kingdom (UK) decided to leave the European Union (EU). The referendum was the culmination of an acrimonious debate with leavers claiming that the EU represented a burden on sovereignty, with the UK losing internal control of its own legislation and policies (with negative repercussions for living standards and unemployment (Mortiaux, 2018). The Economists for Brexit report, led by Professor Patrick Minford at Cardiff, envisioned that the "output would be higher, the City of London would thrive, unemployment would fall, and the trade deficit would narrow" in the case of an exit from the EU [1]. Remainers countered that leaving the EU would have dire impacts on the economy as a result of losing access to the EU single market. Professor Catherine Barnard at Cambridge stated: "Since we project that Brexit would lead to a decline in economic activity, we naturally expect that Brexit would lead to job loss too". She was echoed by Dr Steve Coulter, an economist at the London School of Economics, who agreed that "Brexit would lead to a fall in growth, jobs and investment in almost all scenarios" [2] [3].

The referendum showed a substantial geographical divide reflecting different attitudes towards the EU and diversity in expectations regarding how Brexit would play out. The way

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citizens voted in different UK regions shows a mild correlation with the recorded unemployment rates. On the one hand, the East and West Midlands and Northeast regions showed a remarkable preponderance of leavers –approximately 59% of the voters and among the highest level of unemployment in the country (4.4, 5.4 and 7.8%, respectively). On the other hand, Scotland and London were the most pro-EU regions with respectively only 38% and 40% of voters supporting Brexit, despite a relatively high unemployment rate (6.1 and 6.3%, respectively).

Brexit is a contentious policy experiment since the UK is the first country to leave the EU and its (short-term) impact remains to be assessed, especially since the geographic divide reflected in the referendum might also imply geographically diverse impacts. Early estimates of the impacts of Brexit focused on GDP loss (Born *et al.*, 2019; Celebi, 2021; Fetzer and Wang, 2020), foreign direct investment towards the UK (Simionescu, 2018), financial markets (Opatrny, 2021) and labour productivity (Farid, 2020). Only one study applied impact evaluation techniques focusing on employment at the national level and found that the effects in the labour market were negligible (Papyrakis *et al.*, 2022). In this study, we apply the Synthetic Control Method (SCM), a standard impact evaluation technique used to quantify the impacts of single events (potentially important interventions/shocks) in the context of the Brexit referendum and unemployment in the regions that make up the UK To our knowledge, this is the first empirical study that examines the effect of the Brexit referendum on unemployment at the subnational level. Other studies have looked at the effect Brexit had on the number of newly created jobs in Northern Ireland (Siedschlag and Koecklin, 2019), on a combination of macroeconomic indicators (GDP, migration flow and trade, Hantzsche *et al.*, 2019) and on the UK productivity (Farid, 2020). The rest of the paper is organised as follows; Section 2 explains how the SCM works while Section 3 will illustrate the set of data used. Section 4 discusses the main results, and it is followed by the concluding remarks.

2. The synthetic control method

One of the most influential recent methodological developments in quantitative comparative case studies is the Synthetic Control Model (Athey and Imbens, 2017). SCM has been originally developed by Abadie and Gardeazabal (2003) in their study on the effect on aggregate income of ETA terrorism in the Basque region.

SCM is a data-driven econometric technique that builds a synthetic unit which approximates a "counterfactual" (a control, in medical terms). The synthetic unit consists of weighted units (typically referred to as "donors") that were not exposed to the treatment and approximate what would have happened to the treated unit had the treatment not occurred. The method is a powerful straightforward generalization of the difference-in-differences strategy. The difference between the synthetic and the observed unit estimates the treatment effect.

This method has several advantages if compared to standard regression-based methods. SMC precludes extrapolation and instead uses interpolation (King and Zeng, 2006), as "the estimated causal effect is always based on a comparison between some outcome in a given year and a counterfactual in the same year" (Cunningham, 2021). A second advantage of the SCM has to do with the processing of the data because, unlike regression analysis, the construction of the counterfactual does not need post-treatment outcomes (Rubin, 2008). Another benefit is that the non-negative weights assigned to the donor units are made explicit so that the way each unit is contributing to the counterfactual is known, while regression analysis weights the data without making these weights explicit.

Comparative case studies need to consider the effects of observed -as well as unobserved- factors which may potentially affect the outcome of interest. SCM addresses this common problem identified in econometric analysis, i.e. it minimises the potential bias attributed to unobservable confounding factors. Abadie *et al.* (2010) note that if the number of pre-intervention periods in the data is large enough, then matching on pre-intervention outcomes can allow us to control for the heterogeneous responses to multiple unobserved factors. The

intuition here is that only observations that behave in the same way with respect to both unobservables and observables would follow a similar pre-treatment trend.

We use the SCM to estimate the effect that the Brexit referendum has had on the regional unemployment rate in UK in the two years following it. The treatment here is represented by the June 2016 referendum to withdraw from the European Union. The synthetic unit is constructed with an optimal combination of non-negative weights that minimise the distance (the root mean squared of the prediction error) for a specific outcome variable –-i.e. the unemployment rate at the regional level for each of the 12 UK regions -– between the treated unit (that experiences the intervention) and its corresponding synthetic unit, for the years preceding the intervention. This is formally presented in equation (1), which indicates that the SCM minimises the distance between the observed and synthetic regional unemployment in the pre-treatment period. In Equation (1), "*m*" indicates the number of donor units (ranging between 1 and 67 as explained later) and "*W*" is an (m × 1) vector of non-negative weights which sum to one.

$$min\left(Unemployment_{Region} - \sum_{m=1}^{67} Unemployment_m W\right)^2 \; subject\; to\; w_m \geq 0 \qquad (1)$$

For our analysis, SCM produces a synthetic regional UK unit that mimics the unemployment patterns of the UK region before the intervention (i.e. prior to the 2016 Brexit referendum). Any deviations (in unemployment) in the aftermath of the intervention can then be attributed to the treatment (the Brexit referendum). The statistical significance of the differences is typically derived through ex-post placebo tests; these replicate the SCM analysis for all donor countries and assess the probability that they experience an effect of similar or larger magnitude The estimated gaps between the observed UK region and its synthetic counterpart approximate the impact of the 2016 referendum on the rate of unemployment.

3. Data

We make use of the SCM to estimate the effect of the Brexit referendum on unemployment level for the population between 20 and 64 years old. Our potential donor pool consists of 129 regions located in 33 European countries that have consistently been EU member states throughout the period of our analysis; the analysis focuses only on the regions –67- which did not display missing values for the period of analysis.

The period of analysis considered extends from 2008 to 2018, with the years 2017 and 2018 being the post-treatment period; data for 2019 (and beyond) were not available for several regions and hence post-2018 years have been omitted from the analysis (also to avoid Covid-19 pandemic impacts conflating with the Brexit referendum effects). Data comes from the Quality of Government Institute, an independent research institute within the Department of Political Science at the University of Gothenburg. The Institute aggregates several datasets that "draw on a number of freely available data sources" (EU Regional Dataset, 2022) to create the "QOG EU Regional Dataset" with the aim of facilitating the comparison of 350 macroeconomic indicators across European regions.

The SCM analysis uses a list of predictors to construct the 12 synthetic UK regions (Table 1); the predictor variables have been identified based on their ability to forecast the time evolution of the unemployment outcome variables in the pre-Brexit referendum period. In line with earlier synthetic control analyses (e.g. Pellegirni *et al*., 2021; Villar and Papyrakis, 2017) we also include lagged (pre-intervention) values of the dependent variables in the list of their covariates, as this controls for unobservable characteristics and helps to produce a better-fitting pre-intervention model.

Table 1. List of variables used

Variables	Description
Unemployment for 20–64 years old (in %)	Persons who fulfil all the three following conditions: being without work during the reference week; being available to start work within the next two weeks; have been actively seeking work in the past four weeks or have already found a job to start within the next three months
Higher education sector intramural expenditure in R&D, euro per inhabitant	Intramural R&D expenditures comprehend all current expenditures plus gross fixed expenditure for R&D
Employment in services (as % of total employment)	Persons aged 15 years and over who during the reference week performed work, even for just one hour a week, for pay, profit or family gain
Educational attainment for ages 25 to 64, secondary education, total	Percentage of 25–64 years old population whose highest level of education successfully completed is upper secondary and post-secondary non-tertiary education
Income of households (balance), euro per inhabitant	It refers to the balance of primary income and the redistribution of income in cash

Note(s): The description of the variables comes from the QOG EU Regional Dataset codebook

4. Analysis

We analyse synthetic control graphs for unemployment (for those between 20 and 65 years of age) between 2008–2018 for all 12 UK regions (i.e. East Midlands, East of England, London, North East, North West, Northern Ireland, Scotland, South East, South West, Wales, West Midlands, and Yorkshire and the Humber). The list of donor regions and their respective weights is in Table A1 in Appendix.

When looking at the picture across all 12 UK regions, there is no evidence suggesting a substantial statistically significant impact of the Brexit referendum shock on local unemployment (see Table 2). Compared to their counterfactual synthetic units, unemployment was higher (lower) for 8 (4) and 5 (7) UK regions in 2017 and 2018 respectively; in addition, the gaps are relatively modest (ranging between −0.72% and 1.13%). In most of the regions, the gap is not statistically significant (except for East Midlands, and Yorkshire and the Humber for 2018). As an example, Figure 1 presents how the observed unemployment rate for East Midlands -continuous line-compares to its synthetic unit -dotted line. The vertical dotted line in 2016 represents the timing of the intervention, the Brexit referendum, which took place on 23 June 2016. Unemployment in East Midlands, in the aftermath of the Brexit referendum, appears to be higher compared to its synthetic control unit; the positive gap between the two (suggesting an unemployment-raising effect of Brexit for East Midlands) is relatively modest and equal to 0.47 and 1.13% points for the first and second year after the referendum (2017 and 2018). Moreover, the statistical inference suggests that the gap is only marginally statistically significant (at the 10% level) for 2018 (results available from the authors upon request).

Overall, there is also no evidence suggesting that UK regions that voted in favour of Brexit in 2016 experienced any substantial drop (or increase) in unemployment in comparison to those regions that voted against (Figure 2).

The absence of statistically significant differences in regional unemployment rates is corroborated by the results presented in Tables A2 and A3 in Appendix.

One potential effect of Brexit announcements could have been a reduction in trade between the UK and the rest of Europe (Buigut and Kapar, 2023; Douch and Edwards, 2022). Including regions from highly trade-dependent countries in the donor pool -which had potentially experienced a reduction in the trade after the Brexit announcement-may introduce bias into the estimation of the synthetic regional unemployment indicator. A detailed examination of Table A1 reveals that at least one region from France, Germany, or the Netherlands contributed

Table 2. Results for all UK regions (gap, statistical significance)

UK regions	2016 vote for leaving (%)	2017 unempl. (%, actual)	2017 unempl. (%, synthetic)	2017 gap (%)	St. significance	2018 unempl. (%, actual)	2018 unempl. (%, synthetic)	2018 gap (%)	St. significance
East Midlands	58.8	3.3	2.83	0.47	No	3.8	2.67	1.13	*
East of England	56.5	3.5	3.29	0.21	No	2.7	3.42	−0.72	No
London	40.1	4.9	4	0.9	No	4.3	4.12	0.18	No
North East	58	4.9	5.1	−0.2	No	4.2	4.8	−0.6	No
North West	53.7	3.5	3.69	−0.19	No	3.5	4.04	−0.54	No
Northern Ireland	44.2	4.5	4.29	0.21	No	3.6	3.56	0.04	No
Scotland	38	3.6	3.41	0.19	No	3.5	3.19	0.31	No
South East	51.8	2.7	2.32	0.38	No	2.9	3.26	−0.36	No
South West	52.6	3	3.31	−0.31	No	2.6	3.3	−0.7	No
Wales	52.5	4	4.1	−0.1	No	3.5	4.19	−0.69	No
West Midlands	59.3	4.7	4.22	0.48	No	4.4	4.32	0.08	No
Yorkshire and the Humber	57.7	4.2	4.17	0.03	No	4.2	4.25	−0.05	*

Note(s): Authors' calculation using QOG EU Regional Dataset data. '*' denotes a 10% level of statistical significance

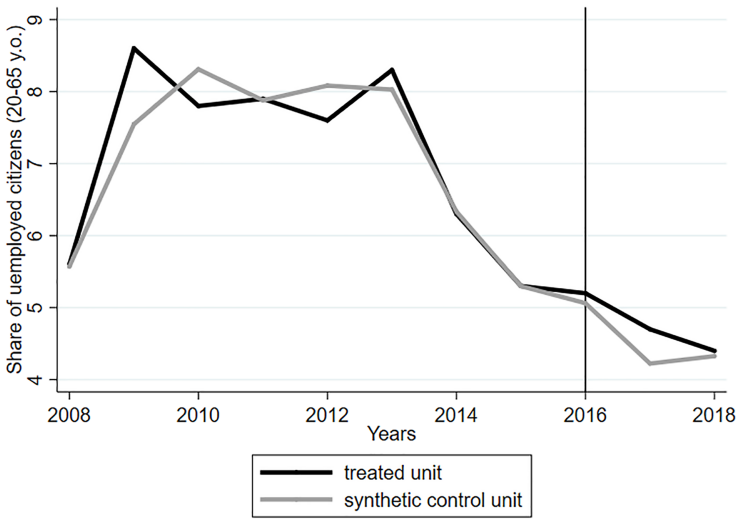

Figure 1. Unemployment rate (20–65 y.o.), 2008–2018, observed and synthetic East Midlands. Notes: Authors' calculation using QOG EU Regional Dataset data

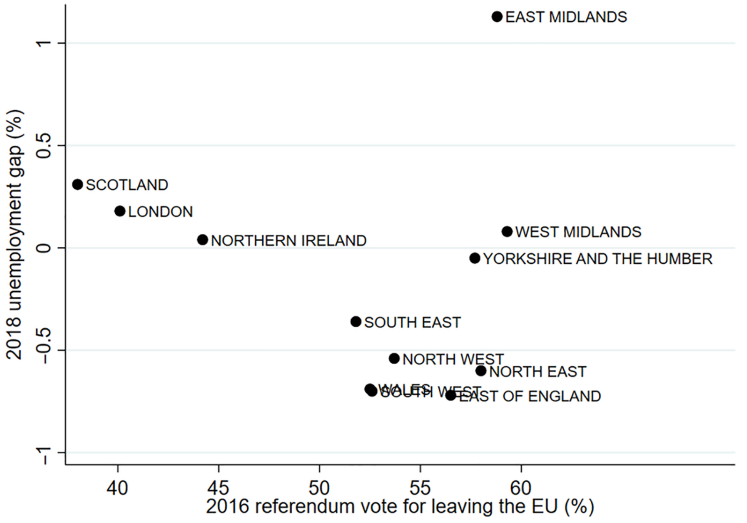

Figure 2. 2018 unemployment gap vs 2016 Brexit referendum result. Notes: Authors' calculation using QOG EU Regional Dataset data (17)

to the construction of the synthetic unemployment indicator for each UK macro-region. To address this concern, Table A2 presents the results of a synthetic control method analysis that excludes regions located in France, Germany, and the Netherlands—three of the UK's largest trading partners—from the donor pool. This robustness check shows no significant deviations from the results in Table 2. The differences between the observed and synthetic unemployment indicators remain statistically insignificant and below one percentage point, and the synthetic unemployment indicators in Table 2 and Table A2 are closely aligned in terms of values.

As an additional robustness check, we adjust the timing of the Brexit announcement by postponing it by one year, from 2016 to 2017. This approach allows us to assess whether the observed divergence in unemployment rates between UK regions and their synthetic counterparts, beginning in 2016, persists when the treatment period is delayed. If the results remain consistent with the delayed treatment, it provides further evidence that the Brexit announcement is the primary driver of the observed differences in the unemployment indicator, rather than other unrelated events occurring in 2016.

The results of this robustness check are presented in Table A3. The findings remain consistent; the difference in the regional unemployment share between the observed and synthetic UK regions is minimal and statistically insignificant, with the exception in the region Yorkshire and the Humber. These results reinforce the robustness of the synthetic control method and the validity of the conclusions drawn from the analysis.

The limited statistical effect of Brexit on regional employment is an important finding. This is because the limited statistical impact challenges some of the strongly asserted claims that were put forward by both the Brexiter and Remainer campaigns at the time of the referendum. Politicians and newspapers in favour of Brexit (i.e. the Vote Leave front) passionately argued that Brexit would boost local employment by freeing businesses from EU red tape, repurposing public funds that were originally aimed for the EU budget and allowing the UK to strike its own ambitious trade deals (see for example, Simpson and Startin, 2023). On the other hand, politicians and media opposed to Brexit (i.e. the Vote Remain front) predicted that Brexit would harm employment by generating macroeconomic uncertainty, causing supply chain disruption, reducing foreign direct investment and disrupting access to the EU single Market – in addition, any negative Brexit employment effects could be region-specific, reflecting regional differences in access to EU funding or dependence on EU trade (see for example, Dhingra *et al*., 2017). Our analysis contributes to these debates by demonstrating that at large, the empirical outcomes of Brexit lie somewhere in the middle of these polarised narratives.

5. Concluding remarks

This study examines the impact of the Brexit referendum on unemployment levels in all UK regions. The results indicate that the impact of the referendum on regional unemployment has been minimal. Only in the case of East Midlands, and Yorkshire and the Humber there is a statistically significant (positive and negative) deviation from what one would expect in the absence of the Brexit referendum (i.e. in comparison to their synthetic units). Even in these cases, the statistical significance is marginal (10%) and the magnitude of the estimated impact is modest in size (1.13% and −0.05%, respectively).

The uncertainty following the 2016 Brexit referendum could have influenced the UK regional labour markets in different directions. It could have discouraged inward migration from other EU members in favour of UK workers and, hence, reduced the local unemployment rates. Alternatively, the business uncertainty and an adverse climate for foreign investment could have hampered employment opportunities (and perhaps more so for regions that displayed a stronger anti-EU sentiment through the 2016 Brexit referendum vote). We find little support for either of these two hypotheses for the two immediate years following the Brexit referendum (and preceding the Covid-19 pandemic). Our analysis covers only two years of employment dynamics after the referendum and the modest impacts could be also led by a short-term reaction to uncertainty that depresses investment in labour saving technology (Farid, 2020). Our results need to be read with caution since the labour market can react in different direction over different time spans and the impacts of Brexit have been entangled with the disruption of the Covid-19 pandemic. The long-term effects of Brexit on local UK unemployment remain to be seen, especially in a post-Covid-19 future when the pandemic impacts will not conflate with the Brexit effects.

5.1 Implications for research, practice and society

There are important implications for research, policy-making and society. Our study highlights the need to investigate the (potentially differentiated) economic impacts of Brexit at the regional level and examine their temporal dynamics and trends over time. Similarly, policymakers need to bear in mind these unique economic conditions and craft policies that address potential regional disparities (as in the case of the increase in unemployment in Yorkshire and the Humber in the aftermath of the referendum). Transparency on regional outcomes can potentially inspire collaboration across regions (with even differing Brexit preferences as expressed during the referendum) to address shared challenges in the labour markets. In addition, regional authorities could use such findings to engage with their constituencies about the realistic economic outcomes of major policy shifts (as in the case of Brexit). This will also foster a more informed discussion on Brexit's economic consequences and hence mitigate polarised attitudes and discourses from both the pro- and anti-Brexit fronts.

Notes

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3. For reviews on the anticipated Brexit effects, we refer interested readers to Mathieu (2020) and Latorre *et al*. (2022).

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Table A1. List of (4 most important) donors and associated weights for each of the 12 UK region

UK regions	Donor (1)	Weight	Donor (2)	Weight	Donor (3)	Weight	Donor (4)	Weight
East Midlands	Közép (HU)	47.3	Bayern (DE)	36.5	Schleswig–Holstein (DE)	13.2	R. A. Acores (PT)	3.0
East of England	Denmark (DK)	68.0	Westösterreich (AU)	28.0	Bayern (DE)	4.0		
London	Centro (ES)	64.9	Berlin (DE)	13.4	Közép (HU)	12.1	Ireland (IR)	9.6
North East	Közép (HU)	24.6	Bretagne (FR)	18.0	Luxembourg (LU)	16.7	Ireland (IR)	13.6
North West	Centre (Val de Loire) (FR)	82.9	Bremen (DE)	6.0	Ireland (IR)	4.1	Mecklenburg (DE)	3.8
Northern Ireland	Vlaams Gewest (BL)	43.8	Közép (HU)	29.6	Westösterreich (AU)	13.7	R. A. Madeira (PT)	8.7
Scotland	Latvija (LT)	37.9	Bayern (DE)	30.0	Denmark (DK)	29.7	Eesti (ET)	2.3
South East	Bretagne (FR)	47.4	Westösterreich (AU)	34.7	Bayern (DE)	12.3	Denmark (DK)	5.6
South West	Centro (ES)	56.3	120	40.8	Bayern (DE)	1.8	Közép (HU)	1.1
Wales	Berlin (DE)	57.9	Denmark (DK)	18.6	Hamburg (DE)	11.6	Ireland (IR)	9.9
West Midlands	Denmark (DK)	76.6	Continente (PT)	9.9	Eesti (ET)	8.3	Berlin (DE)	4.6
Yorkshire and the Humber	Centre (Val de Loire) (FR)	56.0	Ireland (IR)	19.4	Hamburg (DE)	10.6	Berlin (DE)	10.6

Note(s): Authors' calculation using QOG EU Regional Dataset data. The total of the weights for each of the UK regions should sum up to 100; when it does not, that means there are more donors which have been omitted

Table A2. Results for all UK regions (gap, statistical significance) excluding regions located in France, Germany and the Netherlands

UK regions	2016 vote for leaving (%)	2017 unempl. (%, actual)	2017 unempl. (%, synthetic)	2017 gap (%)	St. significance	2018 unempl. (%, actual)	2018 unempl. (%, synthetic)	2018 gap (%)	St. significance
East Midlands	58.8	3.3	3.3	0	No	3.8	2.8	1.0	No
East of England	56.5	3.5	3.2	0.3	No	2.7	2.7	0	No
London	40.1	4.9	4.1	0.8	No	4.3	3.8	0.5	No
North East	58	4.9	5.2	−0.3	No	4.2	4.9	−0.7	No
North West	53.7	3.5	3.8	−0.3	No	3.5	3.1	0.4	No
Northern Ireland	44.2	4.5	4.3	0.2	No	3.6	3.6	0	No
Scotland	38	3.6	3.5	0.1	No	3.5	3.1	0.4	No
South East	51.8	2.7	3.3	−0.6	No	2.9	2.7	0.2	No
South West	52.6	3	3.3	−0.3	No	2.6	2.7	−0.1	No
Wales	52.5	4	3.9	0.1	No	3.5	3.2	0.3	No
West Midlands	59.3	4.7	3.9	0.8	No	4.4	3.1	0.7	No
Yorkshire and the Humber	57.7	4.2	4.1	0.1	No	4.2	3.4	0.5	No

Note(s): Authors' calculation using QOG EU Regional Dataset data

Table A3. Results for all UK regions (gap, statistical significance) with the Brexit announcement delayed to 2017

UK regions	2016 vote for leaving (%)	2018 unempl. (%, actual)	2018 unempl. (%, synthetic)	2018 gap (%)	St. significance
East Midlands	58.8	3.8	2.7	0.9	No
East of England	56.5	2.7	3.3	−0.6	No
London	40.1	4.3	4.3	0	No
North East	58	4.2	4.9	−0.7	No
North West	53.7	3.5	4.0	−0.5	No
Northern Ireland	44.2	3.6	3.6	0	No
Scotland	38	3.5	3.5	0	No
South East	51.8	2.9	2.5	0.4	No
South West	52.6	2.6	3.0	−0.4	No
Wales	52.5	3.5	4.1	−0.6	No
West Midlands	59.3	4.4	4.5	0.1	No
Yorkshire and the Humber	57.7	4.2	4.3	−0.1	**

Note(s): Authors' calculation using QOG EU Regional Dataset data. '**' denotes a 5% level of statistical significance

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