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Brexit: a vote driven by deprivation?

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Why did the British electorate vote to leave the European Union? Using an extensive data set on deprivation at the local authority level, we explore the factors that shaped the leave decision. We find that the sharp rise in deprivation during 2010-15 was closely associated with an increased likelihood of the leave vote, lending support to the arguments that austerity from 2010 onwards played a key role in the Brexit decision. Our results also reveal that deterioration in employment, educational opportunities, health and rise in crime and barriers to housing had been particularly influential in the leave vote.

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1. Introduction

On the 23rd of June 2016, 51.9 per cent of the British electorate voted to leave the European Union (EU) - a decision commonly referred to as 'Brexit'. This outcome was largely unexpected and has been seen as a historic moment both for the UK and the EU. Given the outcome of the recent general elections in Britain, Brexit is set to be finalized soon, with enormous implications for both sides as well as for the third countries.

A key event shaping the pre-referendum landscape in the UK had been the global financial crisis of 2008/9. The stimulus package put in place as a policy response to the crisis led to serious fiscal sustainability issues, giving way to its swift reversal. The ensuing tightening entailed substantial fiscal cuts which were concentrated in already struggling areas. Such sharp falls in public spending and benefits fuelled a Eurosceptic outlook, particularly in view of significant immigration from the other EU countries. Although the potential role of austerity on the leave outcome has been widely debated in both the media and political circles, there is little formal work specifically on the link between fiscal austerity and Brexit.[1]

Given that Brexit was both a monumental decision and an unexpected outcome, there have been significant efforts towards understanding the factors that triggered it. Existing work explored both individual characteristics of voters - based on survey data - and features of voting constituencies as potential sources of voting behaviour in the referendum. It was shown that educational attainment, cultural attitudes, demographic and ethnic background were important factors driving the Brexit outcome (see, for example, Goodwin and Heath, 2016a,b; Clarke et.al. 2017 and Becker et.al. 2017). In addition, the leave vote was shown to be greater in areas with a greater share of agriculture; low skilled jobs; stagnated wage growth and greater unemployment (see, for example, Arnorsson and Zoega, 2016; Bell and Machin, 2016 and Becker at al. 2017).

This paper is distinct from previous research in directly linking the deterioration in the voting populations' well-being during 2010-2015 to the tendency to vote for Brexit. In so doing, we combine electoral data at the local authority level with an extensive data set on deprivation - Index of Multiple Deprivation (*IMD*). The *IMD* measures relative deprivation in each voting district over a range of indicators including employment, education and health and living environment.
We find that the sharp rise in deprivation during 2010-15 was closely associated with an increased likelihood of the leave vote, lending support to the arguments that austerity from 2010 played a key role in the outcome of the referendum. Our results also reveal that deterioration in employment, educational opportunities, health and rise in crime and barriers to housing had been particularly influential.

[1] Becker *et al* (2017) is a notable exception.

2. Empirical specification

Our empirical strategy is to estimate the role played by a set of characteristics on the *Leave* result. As a result, our empirical specification takes the form of

$$Y_i = \beta_0 + \beta_1 X_i + \varepsilon_i \quad \textbf{(1)}$$

where Y_i indicates the percentage of the *Leave* vote in district i, X_i is the set of voter characteristics that are expected to shape the outcome of the vote and ε_i denotes the corresponding residuals. As outlined in Table 1, set X_i is taken to include the percentage of the *Turnout*, the percentage of *Female* voters, the share of those aged *65 and over* in the constituency and the proportion of *Immigration* among the voters.

We estimate specification (1) by ordinary least squares (OLS) for the sample of 326 local authorities in England as a cross-sectional estimation for our benchmark results. We also present estimation results from a Logit model as part of our robustness checks.

3. Data

The most disaggregated form of the voting outcomes of the EU Referendum published by the Electoral Commission are at local authority level, of which there are 326 in England. As such, we utilize the percentage of *Leave* votes at 326 local authorities in England as our dependent variable (The Electoral Commission, 2016).[2]

Our key explanatory variable is the *Index of Multiple Deprivation* (*IMD*), the official measure of relative deprivation derived and published by the UK government.[3] *IMD* contains 37 separate indicators on 'a wide range of aspects of an individual's living conditions', and covers seven domains where figures for each domain are compiled from an array of different data sets. *Income deprivation* gauges the proportion of people experiencing deprivation associated with low earnings. *Employment deprivation* is the proportion of people of working age who are not in the labour force involuntarily. *Education, training and skills deprivation* is a measure of the level of education, qualifications and skills. *Health deprivation* and disability assesses the risk of premature death and quality of life relating to mental and physical health. *Crime* is an indication of the risk of victimisation in an area. *Barriers to housing and services* considers the geographical and economic accessibility to housing and services. *Living environment deprivation* is a measure of the quality of housing and external environmental factors such as air quality.

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[2] This is primarily due to data availability. Also, two of the three other constituent states (Scotland and Northern Ireland) voted to remain in the EU with 62 and 57 percent in favour, respectively.

[3] The IMD are compiled by the Ministry of Housing, Communities and Local Governments since 2000 and are available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/465791/English_Indices_of_Deprivation_2015_-_Statistical_Release.pdf

Based on the overall index aggregating these seven domains, the *IMD* ranks every local area from the most to the least deprived area.[4]

Hence, *IMD* represents 'an overall measure of multiple deprivation experienced by people living in one area relative to that of other areas'.(Department for Housing, Communities and Local Governments, The English Indices of Deprivation 2015, Statistical Release, p.2). Our data on population estimates, voter characteristics and the local area migration indicators come from the *Office for National Statistics*.

Table 1 lists descriptive statistics of our main variables of interest.

4. Main results

Table 2 reports the results from the OLS estimation of (1) under a number of specifications arising from alternative sets of control variables.

The estimation results from specification (1) reveal that a greater share of 65 and over and a greater percentage of those with white ethnic background in the voting population are both positively related to an increased share of the *Leave* vote. Conversely, a higher turnout, a greater female share of the electorate and a greater share of immigration in the voting district are all negatively linked to the tendency to vote leave in the referendum.

The finding that the proportion of people who are 65 or over increasing the probability of the *Leave* vote is widely observed (see, for Goodwin and Heath 2016b). The demographics reveal that older voters tended to vote *Leave* in much greater numbers relative to the young, revealing that the country was divided on Brexit not only geographically but also along generational lines.

Unsurprisingly, a rise in the female share of the voters is seen to reduce the likelihood of Brexit. Such an effect is commonly linked to the EU's strong gender equality agenda as enshrined in EU law (see, for example, the Independent, 2016, 23 June).

Estimated coefficients in Table 2 also suggest that, interestingly, areas with higher levels of immigration were less inclined to vote *Leave*, which is also consistent with the existing findings on the role of demographics in the referendum (Goodwin and Heath, 2016a,b; Colantone and Stanig, 2016). As such, the rhetoric on the threat of immigration against national identity appears to have been more powerful than the effect of actual immigration itself. [5]

The voting patterns in the 2016 EU Referendum exposed major social and economic divisions. Immigration and the EU have been seen as the source of economic

[4] The weights attached to each domain in compiling the overall index are the following; 22.5% for *Income deprivation*; 22.5 % for *Employment deprivation*; 13.5 % for *Education, training and skills deprivation*; 13.5 % for *Health deprivation and disability*; 9.3% for *Crime*; 9.5% for *Barriers to housing and services*; and 9.3% for *Living environment deprivation*.

[5] Immigration would have different consequences depending on its source. Becker *et al*. (2017) find that immigration growth from EU accession countries after the Eastern enlargement of the EU was the only immigration positively associated with voting leave.

inequality at a time with major public spending cuts as part of fiscal austerity that was put in place in 2010 (Dorling, 2016). As a result of substantial cuts in public spending in education, training, health and care provision and public sector wages, income inequality in the UK reached a level that was one of the highest in the EU (Darvas, 2016). Such inequality was seen as arising from immigration and hence the EU, inciting support for the *Leave* vote.

We now turn to our key variable of interest - the *IMD*. We start by examining the impact of a combined measure of deprivation - 2015 average score - on the outcome of the vote, as is presented by the first specification listed in the second column. As can be seen from Table 2, the higher the 2015 *IMD* score - the more deprived an area is relative to the rest of the country - the higher the percentage of *Leave* votes in that area. More specifically, an increase in the *IMD* average score of one unit raises the percentage of the *Leave* vote in that area by around 0.35 percentage points.

To examine the role of the deterioration in well-being (the rise in deprivation), we replace *IMD* 2015 average value with the change in *IMD* between 2010 and 2015, as is exhibited in Specification (2) in Table 2. The estimated coefficient is nearly three times as large as that of the IMD 2015 level, and is estimated with high statistical significance. An increase in the average score of deprivation relative to other areas by one unit over 2010-2015 increases the share of leave votes by 1.2 percentage points, pointing to the importance of the deterioration in deprivation since 2010 as a key driver of the Brexit vote.

In principle, it is possible that other indicators that may move with deprivation might be at the source of the *Leave* vote, and the *IMD* Index is a proxy for those. In order to explore this possibility of excluded variables relevant for the period of fiscal austerity, Specifications (3) and (4) explicitly account for the role of the change in *Employment growth* and *Wage growth* over the same period; 2010-2015. As can be seen from Columns (4) and (5), our estimates are robust to the inclusion of these two variables and the estimated coefficients of both the *Employment growth* and *Wage growth* are statistically insignificant.

In order to identify which areas of deprivation are driving the results in Specifications (1) and (2), the *IMD* average score is split into its 7 individual domains in Specification (5): income; employment; education, skills and training; health deprivation and disability; crime; barriers to housing and services; and living environment.

The estimated coefficients of the specific deprivation measures show that within the *IMD*, employment, education, skills and training and crime related deprivation measures are positively and statistically significantly related to the leave vote. The Wald test on the joint significance of the seven individual *IMD* variables can reject the null hypothesis of no joint significance at one per cent confidence level.[6]

[6] The two sub-indices – Living Environment deprivation and Income deprivation - are estimated with negative coefficients, which may appear counterintuitive. It must be noted, however, that the former domain (Living Environment deprivation) measures indoors and outdoors deprivation and hence encompasses indicators such as road accidents and air quality, which is likely to be skewed by that big inner cities tended to vote remain more heavily. It is likely that those areas have worse air quality and

As a robustness check of the estimation results displayed in Table 2, we consider an alternative empirical specification. Rather than examining the determinants of the share of the leave vote, we now estimate the probability of *Leave* by using a binominal Logit model where the dependent variable takes the value of 1 if the *Leave* share of the vote in district *i* is greater than 50 per cent and 0 otherwise. The estimation results of the Logit model are displayed in Table 3.

As can be seen from Table 3, the change in deprivation since 2010 remains a key determinant of the leave decision. Among the sources of deprivation, education, skills and training; crime; and housing continue to be associated positively with the leave decision. Health deprivation and barriers to housing which were not significant in the previous specifications are now also linked positively and significantly to the leave decision.

5. Conclusions

This paper showed that increases in relative deprivation since the global financial crisis - particularly regarding employment, educational opportunities, health and rise in crime and barriers to housing - significantly contributed to Brexit. The recent rise in nationalist sentiment across the globe clearly points to the importance of not just understanding the factors that shaped the Brexit outcome but also of acting on them.

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higher road accidents, hence leading to an increase in living environment deprivation measure decreasing the incidence of leave voting.

Regarding the second domain (Income deprivation), it is commonly argued that income is not a good indicator of the leave vote, while worsening financial conditions increased the probability of voting leave. As is widely documented, the 'middle class' were the predominant driving force behind Brexit, where a higher income band drove a high incidence of leave votes (see, for example, Antonucci, et al. 2017). In addition, the income domain is only significant at the 5% in our estimations, as opposed to the 1% significance of most other components, possibly indicating that the leave vote crossed income divides but was more strongly affected by other forms of deprivation such as those underlying education and crime.

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Appendix

Table 1- Descriptive statistics

Variable	*Mean*	*Std. Deviation*	*Minimum*	*Maximum*
Percentage Leave	54.50	10.02	21.38	75.56
IMD 2015 average	19.46	8.004	5.00	42.00
Percentage female	51.19	1.04	43.91	53.44
Percentage 65 and over	24.37	5.67	7.68	39.40
Percentage of white	89.32	12.87	29.00	98.90
Percentage of immigration	0.856	1.02	0.12	9.30

Table 2. Determinants of Brexit – OLS results

Variable	*Specification* (1)	*Specification* (2)	*Specification* (3)	*Specification* (4)	*Specification* (5)
Percentage Turnout	-0.436** (0.209)	-1.028*** (0.095)	-0.443** (0.219)	-1.033*** (0.098)	-0.254 (0.160)
Percentage Female	-1.970*** (0.487)	-1.669*** (0.468)	-2.088*** (0.518)	-1.761*** (0.504)	-1.271*** (0.406)
Percentage 65 and over	0.491*** (0.114)	0.527*** (0.109)	0.517*** (0.123)	0.552*** (0.12)	0.748*** (0.111)
Percentage White	0.122** (0.049)	0.099** (0.048)	0.079 (0.051)	0.077 (0.050)	-0.047 (0.048)
Percentage Immigration	-6.122*** (0.588)	-5.956*** (0.571)	-6.908*** (0.686)	-6.438*** (0.675)	-2.784*** (0.487)
IMD2015	0.349*** (0.107)		0.343*** (0.112)		
ΔIMD2010-2015		1.193*** (0.226)		1.035*** (0.241)	
Income Deprivation IMD 2015					-1.302*** (42.511)
Employment Deprivation IMD 2015					0.875* (51.159)
Education, Skills and Training IMD 2015					0.786*** (0.062)
Health Deprivation and Disability IMD 2015					-0.001 (1.198)
Crime IMD 2015					0.056*** (1.268)
Barriers to Housing and Services IMD 2015					0.084 (0.070)
Living Environment IMD 2015					-0.227*** (0.036)
ΔEmployment Rate 2010-2015			-4.099 (5.956)	-2.657 (5.862)	
ΔWage Growth 2010-2015			-1.884 (7.039)	-1.082 (6.929)	
N	326	326	326	326	326
Adjusted R-squared	0.57	0.59	0.58	0.58	0.78

Table 3. Determinants of Brexit - Logit estimation results

Variable	*Specification (1)*	*Specification (2)*
Percentage Turnout	-0.398***	-0.302**
Percentage Female	-0.556**	-0.413
Percentage 65 and over	0.154**	0.136
Percentage White	0.046*	-0.032
Percentage Immigration	-2.179***	-2.950***
ΔIMD2010-2015	0.648***	
Income Deprivation		-1.577***
Employment Deprivation		0.905
Education, Skills and Training		0.371***
Health Deprivation and Disability		0.028**
Crime		0.026**
Barriers to Housing and Services		0.291***
Living Environment		-0.079**
N	326	326
Pseudo R-squared	0.45	0.60