

The UK's Brexit election 2019: space and time

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PART 1

- 1.1 The faces of victory and defeat
- 1.2 Election results: key points
- 1.3 Before the election: key points
- 1.4 "How the Labour party's 'red wall' turned blue."
- 1.5 The Brexit effect

PART 2

- 2.1 The result
- 2.2 How good were the predictions?
- 2.3 Labour: Brexit, leadership and economic policies
- 2.4 Explanatory variables
 - . 2.4.1 Previous voting
 - . 2.4.2 How did social groups vote?
- 2.5 The election: politics in space and time

PART 3 Political geography

- 3.1 The electoral map of the UK, 2017 and 2019: the cluster structure
- 3.2 Regions: centre-periphery gradient ... the size of vote and change of size
- 3.3 Regions and nations:
 - proportional change, residual R and centre-periphery gradient
- 3.4 North East England: percentage vote contour map and proportional change
- 3.5 A model of how voting depends on previous voting

PART 1

1.1 The faces of victory and defeat

There is a big difference between victory and defeat – and a huge difference between triumph and disaster. On election night on the BBC after the exit poll, the beaming smile of Priti Patel and the grim face of John McDonnell. A few days later, walking in to the opening of parliament, the set face of Jeremy Corbyn alongside the smiling Boris Johnson. In the debate a Conservative MP called out for Corbyn to give a smile. In truth there was not much for him to smile about.

1.2 Election results: key points

Competing democratic criteria

One-Party Government winner: Conservatives 100%.

Constituency Majority winner: Conservatives 56.2%; others 43.8%.

Individual Proportional Representation: Conservatives 43.6%; others 56.4%.
 Median Voter (Left-Right dimension): Liberal Democrat.
 Median Voter (Brexit dimension): Labour.

Group A and Group B

Group A: Conservative, Brexit Party, UKIP
 Group B: Labour, Lib Dem, SNP, Green, PC

Group results

Group A: 45.7%
 Group B: 50.4%

Group results, 2015-2019

Table 1 Group results, 2015-2019

	2015	2017	2019	2015-7	2017-9
Group A:	49.4	44.1	45.7	-5.3	+1.4
Group B:	46.8	52.0	50.4	+5.2	-1.6
Group A, Cons:	36.8	42.3	43.6	+5.6	+1.2
Group B, Labour:	30.4	40.0	32.2	+9.6	-7.8
Group A, non-Cons:	12.6	1.8	2.1	-10.8	+0.3
Group B, non-Labour:	16.4	12.0	18.2	-4.4	+6.2

Remain scores for the parties

Group A: Brexit Party 0.00, Conservative 0.20.
 Group B: Green 0.67; SNP 0.75; Labour 0.78; Lib Dem 0.88.

Group loyalty was very strong.

Group A voters in 2017, voting in 2019: 87% for Group A, (Cons; UKIP/Brexit Party).
 Group B voters in 2017, voting in 2019: 86% for Group B, (Lab, LD, G, SNP, PC).

Brexit was a dominant factor.

Leave voters in 2016, voting in 2019:
 78% for Group A parties; 21% for Group B parties.
 Remain voters in 2016, voting in 2019:
 19% for Group A parties; 81% for Group B parties.

The four nations

Group A won seats in Leave nations and lost seats in Remain nations.

Daily Telegraph and Morning Star agree ...

“Remain is over.”

Political and economic geography and history

The UK map contains 60 one-party clusters. The largest cluster spreads throughout England and into Wales and Scotland with 345 Conservative seats.

The rise and fall of the coal, steel, mill, rail and shipbuilding industries of the industrial revolution.

Age and education were a factor but less important than Brexit ...

Group A supported by:

66% of retired / 65+ years old;

61% with \leq GCSE education.

... other social categories were not strong factors.

Group A supported by less than 54% in gender, class, employment and income categories.

Predictions

Good, says John Curtice. Exit poll accurate. Earlier polls good. The second sophisticated YouGov predicted a closer result than actually happened.

1.3 Before the election: key points

Last week, the day before the election, I wrote

Love

<https://sites.google.com/site/gordonburtmathsocsci/love>

Brexit election 2019 ... Middle Voter Democracy

The distribution of voters in political space is known. So the middle voter can be identified. Under certain circumstances and according to certain definitions of value, the option preferred by the middle voter is optimal. In this sense ...

... a general election is suboptimal unless it results in the middle voter option;

... a referendum is suboptimal unless it results in the middle voter option.

However winners of suboptimal procedures can choose to implement the optimal option; and this would be consistent with notions of 'being the honest broker', 'bringing the country together' and 'bridging the divide'.

Voter distribution in political space:

Tunisia, Austria, Israel, Portugal, Poland, UK

<https://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbnxnb3Jkb25idXJ0bWF0aHNvY3NjaXxneDo1ZWVmM2M5MGFjN2Q0NWZi>

The majority problem and central optimality

<https://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbnxnb3Jkb25idXJ0bWF0aHNvY3NjaXxneDo0ZWVmZmViNTBlYmJiNGI4>

UK election, 2019

<https://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbnxnb3Jkb25idXJ0bWF0aHNvY3NjaXxneDo2ODlmNDRhY2UzZjgwMjI4>

Brexit

The Brexit year, 2019

Brexit and specific-option decisiveness: the majority problem and alternative social choice criteria

Extremes and factions ... Middle Voter Democracy

Brexit: the impact on UK politics
Brexit: the VFSD model (Value Function Spatial Distribution)
Brexit and the majority problem: competing democratic criteria
Brexit background 2007-2017 ... UK politics; Ireland politics
Optimal social design
<https://sites.google.com/site/gordonburmathsocsci/central>

UK politics; Ireland politics

<https://sites.google.com/site/gordonburmathsocsci/World-Society-Programme/uk-politics-ireland-politics>

UK election 2019, details:

Here in the UK, 2019 has been Brexit election year.

A year ago, on 9th December 2018, the Conservative party enjoyed 38% support and Mrs May's Brexit deal was in the offing.

Today, on 9th December 2019, the Conservative party enjoys 42% support and Mr Johnson's Brexit deal is in the offing.

In the UK, half (47%) the people want independence from the EU.

In Scotland, half (46%) the people want independence from the UK.

In Northern Ireland, half (50%) the people want independence from the UK.

In Wales, a third (36%) of the people want independence from the UK.

For 'those left behind', independence is the answer.

Half want independence;

... half do not want independence.

All the above uses a binary perspective.

A more complex perspective looks at voter distribution in political space:

... half want something in the middle ...

... indeed you can find a half 'anywhere' in space.

Majority Democracy sometimes gives one or other extreme.

Middle Voter Democracy gives something in the middle.

Under certain circumstances and according to certain definitions of value, the option preferred by the middle voter is optimal (as mentioned earlier).

Final 2019 general election MRP model: small Conservative majority likely

<https://yougov.co.uk/topics/politics/articles-reports/2019/12/10/final-2019-general-election-mrp-model-small->

The 2017 election polls

https://en.wikipedia.org/wiki/Opinion_polling_for_the_2017_United_Kingdom_general_election#/media/File:Opinion_polling_UK_2017_election_short_axis.png

1.4 “How the Labour party's ‘red wall’ turned blue.”

Earlier this week, Daniel Finkelstein offered his analysis

“Tory party's strength is never standing still. An appetite for power and a coalition that is constantly evolving is a template for success that Labour can copy.”

Finkelstein, Daniel. *The Times*, December 17 2019, 31.

<https://www.thetimes.co.uk/article/tory-partys-strength-is-never-standing-still-82gldc6bt>

Fifty years ago, three of us were hiking in the Alps. We wondered, what was the point of having arguments? The point was to win, said Alan. The point was to enjoy them, said Dave. The point was to establish the truth, said Gordon ...

A similar distinction arises in Daniel Finkelstein's article yesterday. He notes the title of John Ramsden's history of the Conservative Party: *An Appetite for Power*. The success of the Conservative party at winning elections has been its focus on winning power. In contrast other parties have placed value on loyalty to their base and on intellectual rigour, hindering their pursuit of power.

The Conservative approach has been to be flexible and adaptable. This has involved "constantly changing and counterintuitive political alliances ... shifting demographic coalitions" ... "always linking aspirers with possessors rather than pitching them against one another". Finkelstein cites Disraeli, Salisbury, Joe Chamberlain, Bonar Law, Baldwin, Macmillan, Thatcher, Cameron ... and now Boris Johnson. A successful approach is characterised by vagueness and inconsistencies rather than "an intellectual clarity [which] invariably repels some potential supporters as much as it attracts other."

Applying this approach won Liberal Democrat seats in 2015; seats in Scotland in 2017; and the collapse of the red wall in 2019. New seats share certain demographics with existing seats, but have some resistance which needs to be overcome. A paper on this has been by Hanbury Strategy, published by Onward, the think tank chaired by Finkelstein.

<https://www.ukonward.com/about/>;

<https://www.jrf.org.uk/report/every-voter-counts-winning-over-low-income-voters>;

<https://hanburystrategycloud.filecloudonline.com/ui/core/index.html?mode=single&path=/SHARED/data/Nm8MVCi8HfjQb4mb>;

Kanagasooriam's writings are very informative.

Kanagasooriam, James. "How the Labour party's 'red wall' turned blue." *Financial Times*, December 14 2019.

<https://www.ft.com/content/3b80b2de-1dc2-11ea-81f0-0c253907d3e0>

<https://blogs.spectator.co.uk/2019/12/the-margin-between-a-tory-landslide-and-defeat-is-tiny/>

Note. 'The red wall'. This phrase has been used repeatedly throughout the election. Just the other night I heard reference to the 'the blue wall' in the USA. They also have a 'red wall' or 'red sea'.

[https://en.wikipedia.org/wiki/Blue_wall_\(politics\)](https://en.wikipedia.org/wiki/Blue_wall_(politics))

1.5 The Brexit effect

The Conservatives increased their vote share in many areas that voted Leave in the 2016 EU referendum.

By contrast they lost votes in strong Remain constituencies such as those in Scotland and London. But Labour lost votes in both strong Remain and strong Leave areas. Strong Leave and strong Remain constituencies are those where an estimated 60% or more of the electorate voted for that option at the EU referendum.

These estimates of constituency Brexit votes were modelled by Professor Chris Hanretty, as the 2016 referendum result was only recorded by local authority and not by Westminster constituency.

The Conservatives were clear winners in constituencies estimated to have voted majority Leave in 2016. They won almost three quarters of all these seats. By contrast, there was no clear winner among Remain backing constituencies, with a crowded field of parties all winning substantial numbers of seats.
<https://www.bbc.co.uk/news/election-2019-50770798>

PART 2

2.1 The result

Table 2 gives the results.

Table 2 The results

	% vote	change	seats	change	% seats	
Conservative	43.6	+1.2	365	+47	56.2	over-represented
Labour	32.2	-7.9	203	-59	31.1	
Lib Dem	11.6	+4.2	11	-1	1.7	under-represented
SNP	3.9	+0.8	48	+13	7.4	over-represented
Green	2.7	+1.1	1	0	0.2	under-represented
Brexit	2.0	+2.0	0	0	0	under-represented
DUP	0.8	-0.1	8	-2	1.2	
Sinn Fein	0.6	-0.2	7	0	0.2	
Plaid Cymru	0.5	+0.5	4	0	0.6	
SDLP	0.4	+0.1	2	+2	0.3	
Alliance	0.4	+0.2	1	+1	0.2	
UKIP	0.1	-1.8	0	0	0	
Speaker			1			
.						
Turnout	67.7		650			

https://en.wikipedia.org/wiki/Results_breakdown_of_the_2019_United_Kingdom_general_election

2.2 How good were the predictions?

There were attempts to predict various aspects of the results: the overall percentage votes; the overall number of seats, individual seats etc. There is usually great interest in whether the opinion polls in the lead up to the election match up to the actual results. The size of the difference is of interest but also whether or not the polls correctly predict the winner. The polls are usually ‘pretty close’ but sometimes the error is more than it should be. In recent years the exit poll has been quite accurate – not surprisingly.

A quite different approach is to consider how party support changes over the long term. Burt considers the voting trajectory for UK general elections over the period 1945-2015. He estimates equations which express the vote in the current election in terms the vote in the previous election and (effectively) an equilibrium value. We can apply these equations to obtain predictions of the actual results.

Table 3 Predictions

	equilibrium 1945-2015	2017 result	model-based prediction 2019	opinion polls 9 Dec 2019	result 12 Dec 2019
two main parties	72.5*	82.4	81.1*	77	75.8
Conservative	40.5	42.4	41.7	43.5	43.6
Labour	35.6	40	38.9	33.5	32.2
Liberal Democrat	13.8	7.4	9.8	12.5	11.6

*predicted separately

2.3 Labour: Brexit, leadership and economic policies

In Leave constituencies Labour lost 53 seats to Conservatives. In Remain constituencies Labour lost only 7 seats, either to SNP or to Lib Dems. This might suggest that Labour might have done better with a stronger Leave stance. However we know that most of the Labour voters had voted Remain in 2016.

Table 4 Change of seats by Brexit vote in 2016

	Strong leave % Remain <40%	weak leave 40-50%	weak remain 50-60%	strong remain >60%
Cons	28	28	0	-7
Labour	-28	-25	-3	-4
Lib Dem	0	-4	0	2
SNP	0	0	4	9

Daily Telegraph. "Five charts that tell the story." *Daily Telegraph*, December 14, 2019: 5.

What were the main reasons voters did not vote Labour? Almost half of those not voting for Labour gave as their main reason the Labour leadership – only a sixth gave Labour's stance on Brexit as the main reason. However, amongst Labour defectors to Conservative, Brexit was the main reason for a third of them. Labour's economic policies were the main reason for 12% of all non-Labour voters.

Table 5 Main reasons voters did not vote Labour

	the leadership	stance on Brexit	economic policies
Labour defectors to LD	29	15	5
Labour defectors total	37	21	6
All non-Labour	43	17	12
Labour defectors to Cons	45	31	6

Daily Telegraph. "Five charts that tell the story." *Daily Telegraph*, December 14, 2019: 5.

These figures leave some questioned unanswered.

For those who did not like Labour’s stance on Brexit, presumably the defectors to Lib Dem wanted a stronger Remain stance and defectors to Conservatives wanted a stronger Brexit stance. This suggests that a different Brexit stance would have resulted in more defectors to one of these two other parties and fewer defectors to the other party – was there a different stance that would have reduced the total number of defectors? ... was there a stance that would have minimised the total number of defectors? ... might it be that the actual stance adopted was the one that minimised the total number of defectors?

For those whose main reason was the leadership, was it perhaps the leadership’s stance on Brexit that they did not like?

2.4 Explanatory variables

2.4.1 Previous voting

Voting is explained by previous voting!

Quite often the best prediction is that people will stay the same. The past explains the present. This was the case here. The best prediction of voting Conservative in 2019 was that the person had voted Conservative in 2017. The second best prediction was also to do with voting. This was the Brexit election and the Conservatives argued that they would get Brexit done. So it is not surprising that the next best prediction of voting Conservative in 2019 was that the person had voted Leave in 2016. The third best prediction of voting Conservative in 2019 was that the person had voted for the pro-Leave party UKIP in 2017. So the top three predictions all relate to past voting behaviour and are all indicators of pro-Leave opinions.

	vote Conservative in 2019
Conservatives in 2017	85%
Leave in 2016	74%
UKIP in 2017	67%

These results are based on univariate data, taking each explanatory variable, one at a time. Table 5 presents bivariate data showing how the top two explanatory variables combine to give a combined effect. For example if we look at the group who both voted Leave in 2016 and also voted Conservative in 2017 then we find that 92% of this group voted Conservative in 2019.

Table 6 Voting for Cons, Brexit and Group A by previous party voting and previous Brexit voting

. 2017 general/ . 2016 referendum	voting in 2019		
	Cons	Brexit	Group A
Con remain	65	0	65
LD remain	6	0	6
L remain	3	0	3

Con leave	92	2	94
LD leave	46	4	50
Lab leave	33	6	39

Because previous party voting and Brexit voting are the two strongest explanatory variables, these are the ones which we analyse in greater depth later in the paper.

2.4.2 How did social groups vote?

In this section we take a univariate approach. In other words we take one variable at a time and consider how it relates to voting Conservative. A more sophisticated approach is a multivariate approach. This was adopted in some of the YouGov analyses before the election ...

The Conservatives had 43.6% of the vote. Certain social groups were more likely to vote Conservative than other groups. Only a few groups were *very* likely to vote Conservative.

We have already looked at the top three predictions provided by previous voting, giving 85%, 74% and 67% predictions. The next two best predictions relate to old age – in terms of actual age and in terms of working status. These five social categories – previous voting and age - were the only ones in which the Conservatives enjoyed 54% support or more:

	vote Conservative in 2019
aged 65+ years	64%
retired	63%

Group A parties, namely Conservatives and UKIP/Brexit Party combined, enjoyed 50% support or more in the categories listed above and also in the following categories:

	vote Group A in 2019
≤GCSE	61%
East	58
East Midland	56
South East	55
West Midlands	55
aged 50-64 years	53
South West	53
social grades C2, DE and C2DE	52, 50 and 51, respectively;
medium education	50

Table 4 gives the full results.

Table 7 Voting for Cons, Brexit and Group A by different social groups

	Cons	Brexit	Group A
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<i>Gender</i>			
Male	46	2	48
Female	44	2	46
<i>Age</i>			
15-24	21	1	22
25-49	34	2	36
50-64	50	3	53
65+	64	2	66
<i>Social grade</i>			
AB	42	1	43
C1	43	2	45
ABC1	43	1	44
C2	49	3	52
DE	47	3	50
C2DE	48	3	51
<i>Education</i>			
≤GCSE	58	3	61
Medium	48	2	50
Degree+	29	1	30
<i>Employment status</i>			
Full time	39	2	41
Part time, 4+	41	2	43
Part time, under 8 hours	40	1	41
FT student	17	1	18
Retired	63	2	65
Unemployed	32	4	36
Not working	40	3	43
Other	37	3	40
<i>Household income</i>			
Under £20000	45	3	48
20-40	47	2	49
40-70	43	1	44
70+	40	1	41
<i>Region (England)</i>			
East			58
East Midland			56
South East			55
West Midlands			55
South West			53
York & Humber			49
North East			46
North West			41
London			33
<i>2017 election</i>			
Con	85	2	87
Lab	11	2	13
LD	14	1	15
UKIP	67	19	86
Green	10	1	11
Other	14	1	15
<i>2016 referendum</i>			
Remain	19	0	19
Leave	74	4	78

.	Cons	Brexit	Group A
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Chorley, Matt. "Working class switched to Tories." *The Times*, December 17, 2019: 31.
<https://yougov.co.uk/topics/politics/articles-reports/2019/12/17/how-britain-voted-2019-general-election>

We have been interested in what gives a strong prediction. Also of interest is what does not give a strong prediction. In particular social class does not give a strong prediction. The Labour Party was formed precisely to represent the interests of the working class and in the past social class was a very strong predictor of party voting (although there always have been 'working-class Tories'). However this class effect has continuously weakened in recent times and the above table indicates that it has reversed, albeit very marginally. A key question is whether this is because of Brexit and whether the working class shall return to Labour.

This leads to the question of where are the working class? This leads us into the next part of the paper which focusses on political geography.

2.5 The election: politics in space and time

Politics takes place in space and time. The next part of the paper looks at how the results vary across geographical space. The previous two sections have also been about space, not geographical space but what might be thought of in an abstract way as political space and social space. As well as studying space we also study time. We also consider space and time. We study spatial variation at a fixed point of time, namely the voting on 12 December 2019. We also study space and time together – how spatial patterns vary over time. The table below indicates which sections address which aspects of space and time.

Table A The aspects of space and time studied in the different sections.

	Sections
political space	2.4.1
social space	2.4.2
geographical space	3.1, 3.2, 3.4
time	3.2, 3.4, 3.5
geographical space and time	3.2, 3.3, 3.4

PART 3 Political geography

3.1 The electoral map of the UK, 2017 and 2019: the cluster structure

The pervasiveness of the Conservatives in England - and into Wales and into Scotland (and arguably into Northern Ireland via the DUP). The fragmentation of Labour in England ...

The electoral map of the UK is dominated by a vast sea of Conservative blue throughout England and crossing the border into Scotland and the border into Wales (one constituency deep for the most part). In the middle of the blue Conservative sea are many islands, large and small, mostly Labour red. Scotland for the most part is a

yellow sea for the Scottish Nationalist Party (SNP). Around the yellow SNP sea are a number of islands. Wales is Labour red in the south, Conservative blue in the borders and Plaid Cymru (PC) green in the west. Northern Ireland has quite different parties: a unionist band looking across the sea to Scotland and a nationalist band looking across the border to Ireland.

Sources:

electoral maps in The Times and Daily Telegraph.

Daily Telegraph. "Five charts that tell the story." *Daily Telegraph*, December 14, 2019: 4.

https://en.wikipedia.org/wiki/2019_United_Kingdom_general_election;

https://en.wikipedia.org/wiki/2019_United_Kingdom_general_election_in_Northern_Ireland;

https://en.wikipedia.org/wiki/2019_United_Kingdom_general_election_in_Wales;

https://en.wikipedia.org/wiki/2019_United_Kingdom_general_election_in_Scotland;

https://en.wikipedia.org/wiki/2019_United_Kingdom_general_election_in_England.

Likewise for 2017.

Map opposite <https://geographical.co.uk/geopolitics/geopolitics/item/3557-ukge2019>

The previous paragraph describes what the map looks like after the most recent election in 2019. Indeed *in qualitative terms* it is what the map looked like after the previous election in 2017. The SNP dominance in Scotland is quite recent but elsewhere, and going further back in time, aspects of the 2019 map, particularly the Conservative sea of blue in England, can be detected as far back as 1945 ... 1918 ... 1895 (thus pre-dating Labour MPs, with Liberal MPs instead). Looking quite different is the map for 1868, the first general election after the passing of the Reform Act of 1867.

https://en.wikipedia.org/wiki/1945_United_Kingdom_general_election

https://en.wikipedia.org/wiki/1918_United_Kingdom_general_election

https://en.wikipedia.org/wiki/1895_United_Kingdom_general_election

https://en.wikipedia.org/wiki/1868_United_Kingdom_general_election

The change from one election to the next may be thought of as the level of the Conservative blue sea rising or falling, covering or exposing the islands, and covering or exposing the fringes of the islands.

The key concept here is a one-party cluster of seats or constituencies. A cluster is a set of constituencies which are connected directly or indirectly to one another. The immediate neighbourhood of a cluster is the set of constituencies which are not in the cluster but which are connected to the cluster. A one-party cluster is a cluster all of whose seats belong to party A but whose immediate neighbourhood does not have any party A seats. For example a Labour cluster is surrounded by a non-Labour immediate neighbourhood. A cluster can contain just one constituency.

There were 60 such clusters of seats in the UK after the election in 2019. Labour had 35 clusters, Lib Dem had 9 clusters, Conservatives had 6 clusters, Greens had 1 cluster, SNP had 2 clusters and Plaid Cymru had 1 cluster. In Northern Ireland, Sinn Fein and SDLP each had 2 clusters while DUP and Alliance each had 1 cluster.

Mapping the 2019 General Election

A cartographic look at the winning party in each parliamentary seat

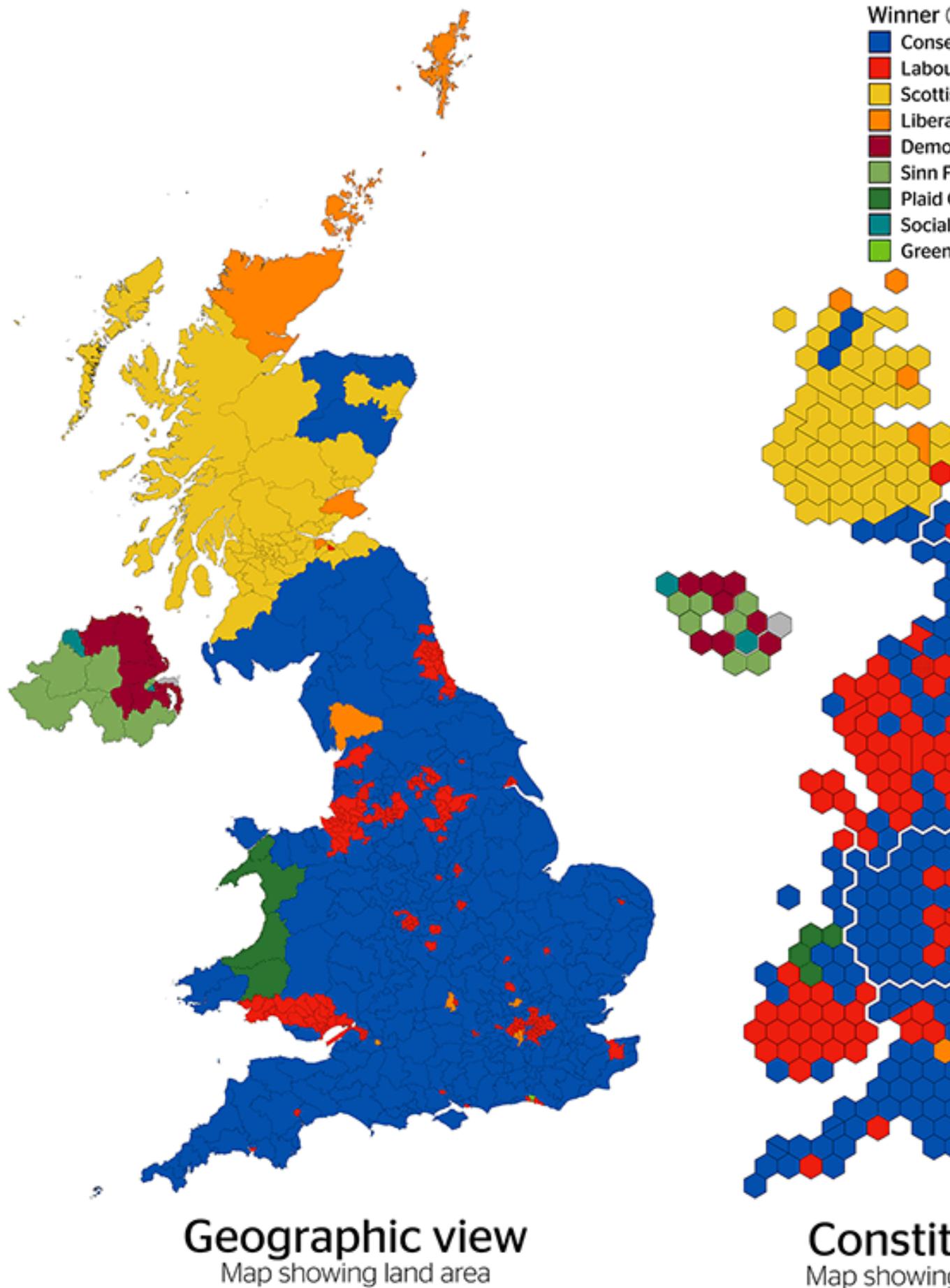


Table 8 Clusters of seats in the UK and in the four nations, 2019

	UK	Eng.	Wales	Scotland	N Ireland
Labour	35	32	2	1	
Lib Dem	9	5		4	
Conservative	6	2	4-1=3	2-1=1	
Green	1	1			
PC	1		1		
SNP	2			2	
SF	2				2
SDLP	2				2
DUP	1				1
Alliance	1				1
total	60	40	6	8	6

The above-mentioned ‘vast sea of Conservative blue throughout England and crossing the border into Scotland and the border into Wales’ has 345 seats. In Scotland ‘the yellow sea’ for the Scottish Nationalist Party (SNP) has 45 seats. In Northern Ireland the DUP cluster has 8 seats. In Wales the PC cluster has 4 seats. Table 6 shows the sizes of the clusters for the different parties in each of the four nations.

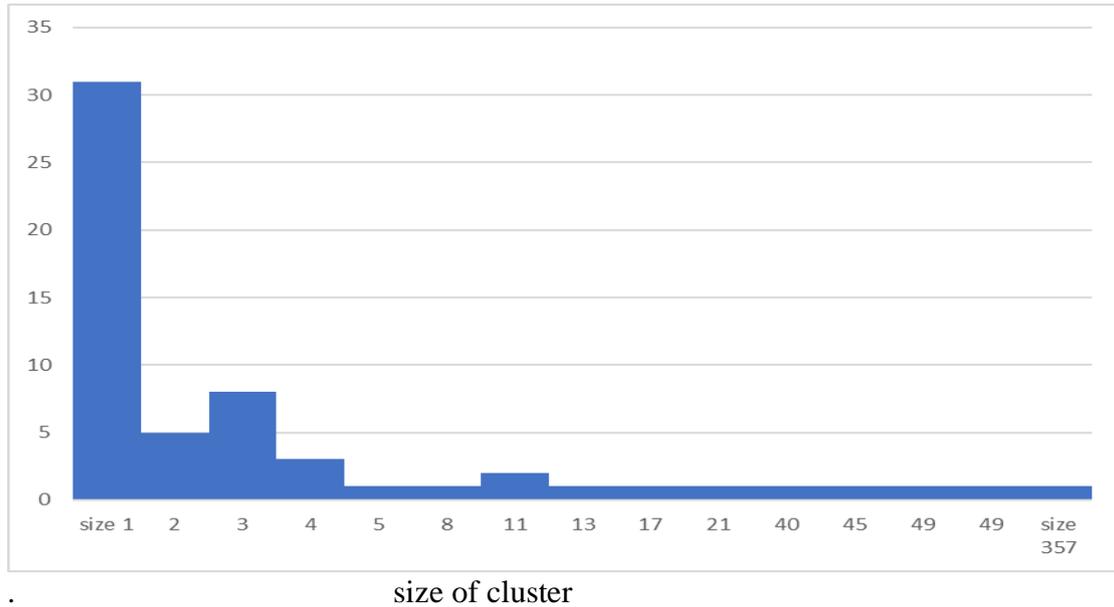
Table 9 The sizes of the clusters of seats in the UK and in the four nations, 2019

	Eng.	Wales	Scotland	N Ireland
Labour	*	1 21	1	
Lib Dem	1x4 3		4	
Conservative	3 (345)	1 2 2 (9)	3 (3)	
Green	1			
PC	4			
SNP			3 45	
SF				5 2
SDLP				1 1
DUP				8
Alliance				1
Sizes of Labour clusters in England’s regions				
.	2x1 2x3	3x1 2	49	1 17
				2x1 40
				8x1
				1 1 4
				1 3 11
				1 3 11 13

The distribution of sizes of clusters follows a common pattern for the distribution of size - with many small clusters and a few large clusters. See Figure 1.

Figure 1 The distribution of sizes of clusters

number of clusters



We now consider the four nations in order from the smallest to the largest.

Northern Ireland

Northern Ireland has 18 seats. In 2017 there were three parties with seats: DUP had 10 seats; Sinn Fein had 7 seats; and Independent had 1 seat. There were four clusters: DUP had one 10-seat cluster; Sinn Fein had two clusters, a 5-seat cluster and a 2-seat cluster; and Independent had a 1-seat cluster.

In 2019 there were four parties with seats: DUP had 8 seats; Sinn Fein had 7 seats; SDLP had 2 seats; and Alliance had 1 seat. There were six clusters of one-party seats: DUP had one 8-seat cluster; Sinn Fein had two clusters, a 5-seat cluster and a 2-seat cluster; SDLP had two 1-seat clusters; and Alliance had a 1-seat cluster.

Between 2017 and 2019 the change in the number of parties with seats was from three parties to four parties. The change in seats was: DUP lost 2 seats; Sinn Fein gained 1 seat and lost 1 seat; SDLP gained 2 seats; Independent lost 1 seat; and Alliance gained 1 seat. The change in clusters was: from four clusters to six clusters: DUP and Sinn Fein no change; SDLP gained 2 clusters; Independent lost 1 cluster; and Alliance gained 1 cluster.

Table 10 Parties, seats and clusters, Northern Ireland 2017-2019

party	change	seats			temp	clusters m to n	cluster sizes	
		m to n	gain	loss			2017	2019
Independent (NI)	-1	1 to 0	0	1	1 to 0	1	-	
Alliance	+1	0 to 1	1	0	0 to 1	-	1	
SDLP	+2	0 to 2	2	0	0 to 2	-	1; 1	
DUP	-2	10 to 8	0	2	1	10	8	
Sinn Fein	0	7	1	1	2	5; 2	5; 2	
Total	0	18	4	4	4 to 6			

SF to SDLP, Foyle (Derry/Londonderry); DUP to SDLP (Belfast South); DUP to SF (Belfast North); Indep to Alliance (North Down).
https://en.wikipedia.org/wiki/2019_United_Kingdom_general_election_in_Northern_Ireland;
https://en.wikipedia.org/wiki/Results_breakdown_of_the_2019_United_Kingdom_general_election.

Wales

Wales has 40 seats. In 2017 there were three parties with seats: Labour had 28 seats; Conservatives had 8 seats; and Plaid Cymru had 4 seats. There were eight clusters. Labour had three clusters: a 1-seat cluster, a 5-seat cluster and a 22-seat cluster. Conservatives had four clusters: a 1-seat cluster, two 2-seat clusters and a 3-seat cluster. PC had one 4-seat cluster.

In 2019 there were three parties with seats: Labour had 22 seats; Conservatives had 14 seats; and Plaid Cymru had 4 seats. There were seven clusters of one-party seats. Labour had two clusters: a 1-seat cluster and a 20-seat cluster. Conservatives had four clusters: one 1-seat clusters, two 2-seat clusters and a 9-seat cluster. PC had one 4-seat cluster.

Between 2017 and 2019 there was no change in the number of parties with seats. The change in seats was: Labour lost 6 seats; and Conservatives won 6 seats. The change in clusters between 2017 and 2019 was: from eight clusters to seven clusters: Labour lost a one-seat cluster; Conservatives gained a one-seat cluster; PC no change; and Labour's 5-seat cluster was reduced to a 1-seat cluster and its 22-seat cluster was reduced to a 21-seat cluster. Conservatives 1-seat cluster expanded into a 2-seat cluster; and clusters and gains combined into a 9-seat cluster.

Table 11 Parties, seats and clusters, Wales 2017 to 2019

party	change	seats m to n	gain	loss	temp	clusters m to n	cluster sizes	
							2017	2019
PC	0	4	0	0		1	4	4
Labour	+6	28 to 22	0	6		3 to 2	1 5 22	1 21
Conservative	-6	8 to 14	6	0		4	1 2 2 3	1 2 2 9
Lib Dem					1			
Total	0	40	6	6		8 to 7		

Lib Dem temporarily won Radnor+ in a by-election in 2019 but this seat returned to Conservatives in the general election.

https://en.wikipedia.org/wiki/Results_breakdown_of_the_2019_United_Kingdom_general_election

https://en.wikipedia.org/wiki/2019_United_Kingdom_general_election_in_Wales;

2019: A 36.1 5.4 0 = 41.6; B 40.9 9.9 6.0 1.0 = 57.8; change A 2.5 5.4 - 2.0 = 5.9;

change B -8.0 -0.5 +1.5 +0.7 = -6.3

2017: A 33.6 2.0 = 35.6, B 48.9 10.4 4.5 0.3 = 64.1

https://en.wikipedia.org/wiki/2017_United_Kingdom_general_election_in_Wales

Scotland

Scotland has 59 seats. In 2017 there were four parties with seats: Labour had 7 seats; Conservatives had 13 seats; Liberal Democrats had 4 seats; and SNP had 35 seats.

There were thirteen clusters. Labour had three clusters with 1, 3 and 3 seats respectively. Lib Dem had four 1-seat clusters. Conservatives had four clusters with 1,

2, 4 and 6 seats respectively. SNP had two clusters: a 1-seat cluster and a 34-seat cluster.

In 2019 there were four parties with seats: Labour had 1 seat; Liberal Democrats had 4 seats; Conservatives had 6 seats; and SNP had 48 seats. There were nine clusters. Labour had one 1-seat cluster. Lib Dem had four 1-seat clusters. Conservatives had two 3-seat clusters. SNP had two clusters: a 3-seat cluster and a 45-seat cluster.

Between 2017 and 2019 there was no change in the number of parties with seats. The change in seats was: SNP gained 13 seats, Labour lost 6 seats; Conservatives lost 7 seats; there was no change for Lib Dems. The change in clusters between 2017 and 2019 was: from thirteen clusters to nine clusters. Lib Dems gained a 1-seat cluster and lost a 1-seat cluster. Conservatives lost a 1-seat cluster and a 2-seat cluster; and its two clusters of 4 and 6 seats were reduced to 3 and 3 seats respectively. SNP's two clusters both expanded, from 1 to 3 seats and from 34 to 45 seats. Labour lost a 1-seat cluster and a 3-seat cluster and its other 3-seat cluster was reduced to one seat.

Table 12 Parties, seats and clusters, Scotland 2017 to 2019

party	change	seats m to n	gain	loss	temp	clusters m to n	cluster sizes	
							2017	2019
Lib Dem	0	4	1	1		4	1	1
Labour	-6	7 to 1	0	6		3 to 1	1, 3, 3	1
Conservative	-7	13 to 6	0	6		4 to 2	1, 2, 4, 6	3, 3
SNP	+13	35 to 48	13	1		2	1, 34	3, 45
Total	0	59	14	14		13 to 9		

https://en.wikipedia.org/wiki/Results_breakdown_of_the_2019_United_Kingdom_general_election

https://en.wikipedia.org/wiki/2019_United_Kingdom_general_election_in_Scotland;

https://en.wikipedia.org/wiki/2019_United_Kingdom_general_election_in_England.

2017 A 28.6 .2 = 28.8; B 36.9 27.1 6.8 .2 = 71

2019: A 25.1 .5 .1 = 25.7; B 45 18.6 9.5 1.0 = 74.1

Change: A -3.5 0.5 -0.1 = -3.1; B 8.1 -8.5 2.8 .8 = 3.2

England

England has 533 seats. In 2017 there were four parties with seats: Labour had 227 seats; Conservatives had 296 seats (including speaker?); Liberal Democrats had 8 seats; and Greens had 1 seat.

In 2019 there were four parties with seats: Labour had 180 seats (including speaker?); Conservatives had 345 seats; Liberal Democrats had 7 seats; and Greens had 1 seat. There were forty clusters. Conservatives had a 3-seat cluster and a 342-seat cluster; Labour had; Labour had 32 clusters. Liberal Democrats five clusters four 1-seat clusters and a 1-seat cluster, Greens a 1-seat cluster.

Table 13 Parties, seats and clusters, England 2017 to 2019

party	change	seats m to n	gain	loss	temp	clusters m to n	cluster sizes	
							2017	2019
.								

NEEDS CHECKING

Conservative	+49	296 to 345	49	2		2 to 2				1 2 3 4 2
Labour	-48	227 to 179	1	48		to 32				
Lib Dem	-1	8 to 7	0	1	5	7 to 5			6x1 2	4x1 3
Green	0	1	0	0		1			1	1
Speaker	0	1								
Total	0	533								

https://en.wikipedia.org/wiki/Results_breakdown_of_the_2019_United_Kingdom_general_election

https://en.wikipedia.org/wiki/2019_United_Kingdom_general_election_in_England.

https://en.wikipedia.org/wiki/2019_United_Kingdom_general_election

21+0=21

49+0=49

Table 14 Parties and seats, England regions 2017 to 2019

party	EM	E	L	NE	NW	SE	SW	WM	YH	total
Conservative	31+7=38	50+2=52	21+0=21	3+7=10	20+12=32	72+2=74	47+1=48	35+9=44	17+9=26	
Labour	15-7=8	7-2=5	49+0=49	26-7=19	54-12=42	8?	7-1=6	24-9=15	37-9=28	
Lib Dem	-	1	3+0=3	-	1	2-1=1	1	-	-	
Green	-	-	-	-	-	1	-	-	-	
Speaker						1-1=0				
Total	46	58	73	29	75	84	55	59	54	
2019:										
Labour clusters (2017)	4	4 (7)	1	2	3	8 (10)	3 (4)	3	4	32
Lib Dem clusters		1	1		1	1	1			5
Conservative			1							+1=2
Sizes of Labour clusters										
.	2x1 2x3	3x1 2	49	1 17	2x1 40	8x1	1 1 4	1 3 11	1 3 11 13	

https://en.wikipedia.org/wiki/Results_breakdown_of_the_2019_United_Kingdom_general_election.

https://en.wikipedia.org/wiki/2019_United_Kingdom_general_election_in_England.

https://en.wikipedia.org/wiki/2017_United_Kingdom_general_election_in_England.

Further details

Liberal Democrats had 12 seats – they now have 11 seats. They had three gains and four losses. There were eleven clusters: ten one-seat clusters and one two-seat clusters. There are now nine clusters: one three-cluster and eight one-clusters: Kingston & S, Richmond P (new) and Twickenham in London; Bath, Oxford West, St Albans (new), Westmorland in the rest of England; Edinburgh W, Fife NE (new), Caithness etc. and Orkney & Shetland in Scotland. They lost Eastbourne, North Norfolk, Carshalton+ and Dunbartonshire E. All four were one-seat clusters in 2017.

Note that the two-cluster expanded to become a three-cluster on the edge of Greater London, surrounded by Labour on the inside and Conservative on the outside.

They lost five short-lived seats: Brecon+, Eddisbury, Penistone, Liverpool Wavertree and Totnes: a by-election win in 2019, a Conservative-to-LibDem defector in 2019, a Labour-to-LibDem defector in 2019, a Labour-to-LibDem defector in 2019, a Conservative-to-LibDem defector in 2019. All were one-seat clusters.

Table 15 Labour clusters

	seats held ... [seats lost]	seats %	seats, n	clusters, n
South West good	Plymouth 1; Exeter 1; <u>Bristol 4</u> ... [Stroud 1]	86	7 to 6	4 to 3
South East	Southampton, Portsmouth, Hove, Brighton K, Canterbury, 100 Reading W, Slough, Oxford E, (all 1)		8 to 8	9 to 8
London 49	London + Putney -1	100	49 to 49	1 to 1
East	Norwich S, Cambridge, Bedford, (all 1); <u>Luton 2</u> [Ipswich 1, Peterborough 1]	71	7 to 5	6 to 4
E Midlands 15 7	Derby S 1, Chesterfield 1, <u>Leicester 3</u> , <u>Nottingham 3</u> ... [Red Wall: High Peak, Bolsover, Bassetlaw, Ashfield,] ... [Derby N (S), Gedling (Nott), Lincoln 1, Scunthorpe 1, Grimsby 1]	47	15 to 7	7 to 4
W Midlands	Warwick 1, <u>Coventry 3</u> , Birmingham 11 ... [B5, Crewe, Newcastle uL, Stoke N, Stoke C 4]	63	24 to 15	4 to 3
Yorks & Humber .37 28	York C 1, <u>Hull 3</u> , <u>W Yorkshire 11</u> , <u>South Yorkshire 13</u> ... [WY4 SY3]	76	37 to 28	4 to 4
North West 54 42	Lancaster 1, Preston 1, <u>Liverpool & Manchester 40</u> ... [GM5, Burnley, Hyndburn, Warrington S, Blackpool S 1, Barrow 1, Workington 1]	78	54 to 42	6 to 3
North East 26 19	Wansbeck 1; Tyne and Wear & 17 ... Durham NW, [Bishop Auckland, Sedgfield, Darlington, Stockton S, Redcar]	73	26 to 19	1 to 2
.		79	227-179	42 to 32
Scotland	Edinburgh South ... [Glasgow 1 2, Lothian 2, Fife 1]	14	7 to 1	4 to 1
Wales	South Wales 21, Alyn & Deeside 1 ... [Anglesey 1, North Wales 4],	79	28 to 22	3 to 2
.		77	262-202	49 to 35

https://en.wikipedia.org/wiki/2019_United_Kingdom_general_election_in_England

From the above table the percentage survival of Labour seats was just below 80%. Some nations/regions were around this level: but West and East Midlands were lower. Finally in Scotland only one seat survived, just 14% of the 2017 figure. Looking at types of cluster, particularly low was the survival of one-seat clusters: 64%.

3.2 Regions: centre-periphery gradient ... size of vote and change of size

In this section we continue our study of political geography. Now however we look at groups of parties rather than at individual parties. We look at the aggregate votes for Group A (Conservative, Brexit Party and UKIP) and Group B (Labour, Lib Dem, Greens, SNP and PC). And rather than looking at clusters we focus on the distance of regions from the centre. We consider the nine regions of England. In England the political centre is London and the South East. Moving north and west goes into the periphery.

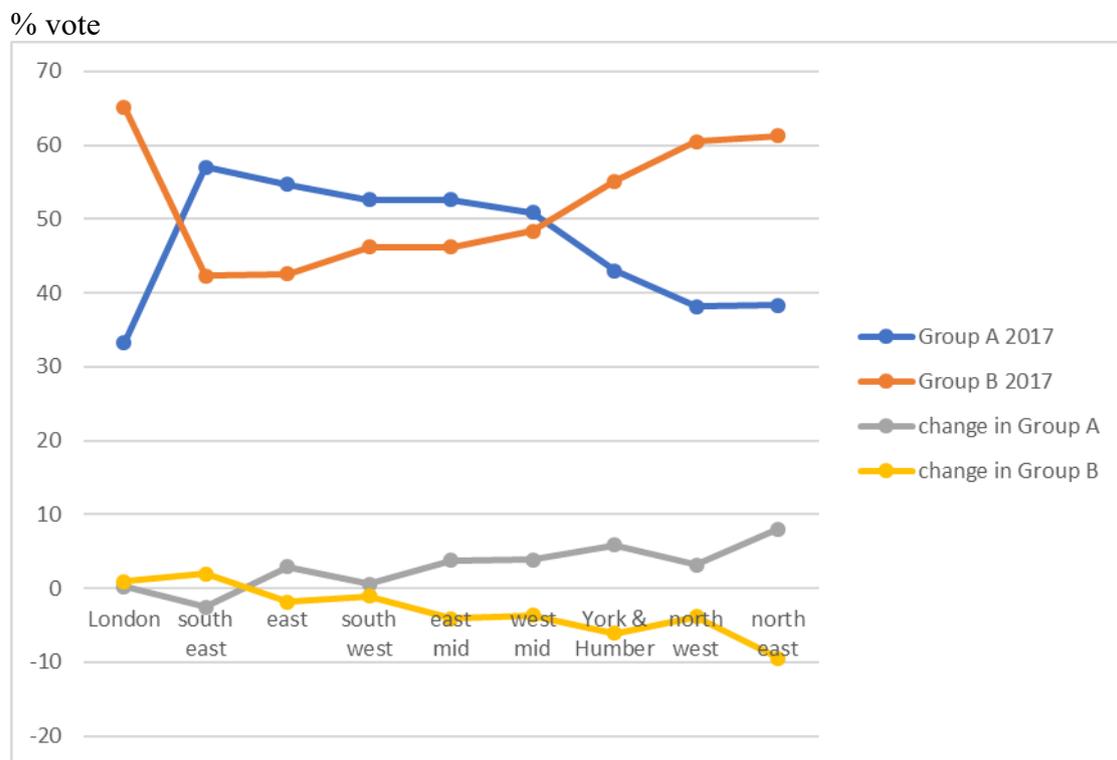
As well as being interested in how the vote changes over space we are also interested in how the vote changes over time – in ‘how the vote depends on the previous vote’. So we are interested not only in the vote in the election of 2019 but also in the vote in the previous election of 2017. We are interested in the change from 2017 to 2019. Often we shall look at 2017 and the change from 2017 to 2019 - and not explicitly at 2019.

In this section we note that the regional vote depends on the distance from the centre. Boulding's concept of loss-of-power gradient is well-known. Note however that if we regard power as a zero-sum entity then for every loss-of-power gradient there is a gain-of-power gradient. Here we apply this thought to centre and periphery. There is a centre-periphery gradient.

Size of vote. Figure 2 shows that the regional votes in 2017 for Groups A and B depend on distance from the centre. The size of the Group A vote decreases with distance from the centre; and the size of the Group B vote increases with distance from the centre. There is of course a dramatic exception to this rule, namely the centre, London, itself!

Change in the size of the vote. Figure 2 also shows the changes in the votes between 2017 and 2019. There is a clear distance effect – but change is opposite to size: for example the greater Group B's size, the greater is its loss.

Figure 2. The percentage vote for Groups A and B in 2017 in England's regions ordered by the distance from centre. England only; and the changes in the percentage vote between 2017 and 2019.



[https://en.wikipedia.org/wiki/2019_United_Kingdom_general_election_in_England.](https://en.wikipedia.org/wiki/2019_United_Kingdom_general_election_in_England)

3.3 Regions and nations: percentage vote, proportional change and R-residual

In this section we continue to look at the aggregate votes for Group A (Conservative, Brexit Party and UKIP) and Group B (Labour, Lib Dem, SNP and PC). We consider the nine regions of England and also England, Scotland and Wales, and the UK as whole – thirteen areas in all.

We are interested in explaining the change in the percentage votes from 2017 to 2019. We consider two explanatory variables, firstly the initial percentage vote in 2017 and secondly the Remain percentage in the 2016 referendum.

The initial percentage vote and the change in percentage vote

Figure .2 above prompts us to investigate directly the relationship between the size of the vote and the change in the size of the vote (in terms of percentages). In a later section we develop a mathematical model but in this section we simply look at the empirical relationships. We suggest that the following two equations provide a good way of thinking about the data and the underlying relationships (in a way that is consistent with the mathematical model).

$$\text{change in Group A \% vote 2017-2019} = -0.32 P + 15.6 + R1 \quad [1]$$

$$\text{change in Group B \% vote 2017-2019} = -0.43 Q + 20.4 + R2 \quad [2]$$

... where P and Q are the percentage votes for A and B in 2017, respectively; and R1 and R2 are the residuals or error terms.

Figure 3 shows the results for Group A, comparing the data for the thirteen areas with the straight line model given in equation [1a].

$$\text{change in Group A \% vote 2017-2019} = -0.32 P + 15.6 \quad [1a]$$

The straight line is the UK-SE benchmark line for Group A, defined as the line which passes through two points, the point for the UK and the point for the South-East.

Some of the points are on or near the line, residual $R1=0$. Others are above it, $R1>0$, or below it, $R1<0$.

Figure 3 UK, Group A: the change in vote depends on the vote in 2017 (percentages); the UK-SE benchmark line for Group A

change in Group A \% vote 2017-2019

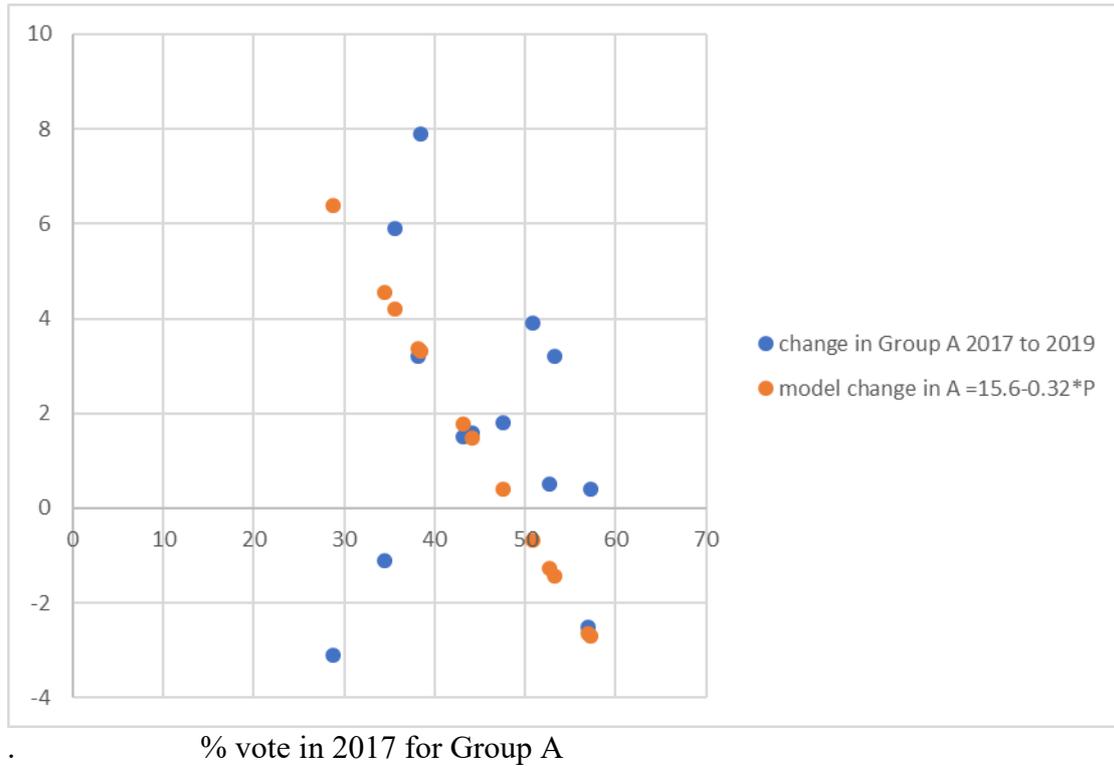


Figure 4 shows the results for Group B, comparing the data for the thirteen areas with the straight line model given in equation [2a].

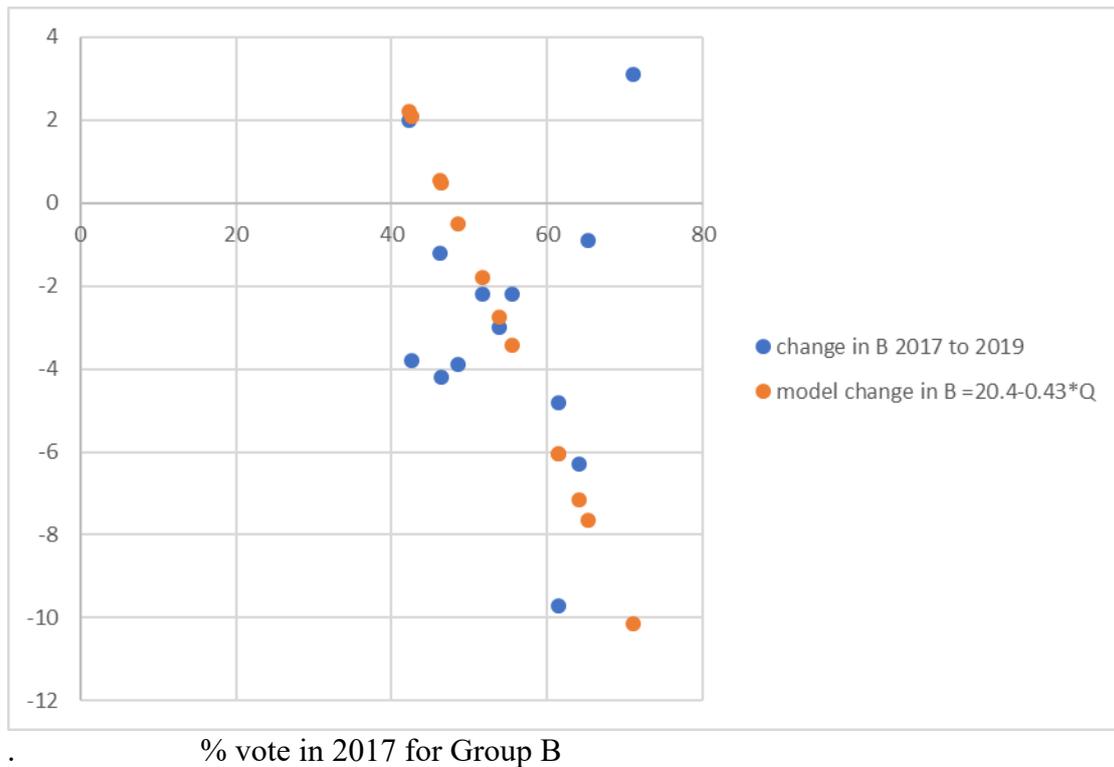
$$U = \text{change in Group B \% vote 2017-2019} = -0.43 Q + 20.4 \quad [2a]$$

The straight line is the UK-SE benchmark line for Group B, defined as the line which passes through two points, the point for the UK and the point for the South-East.

Some of the points are on or near the line, residual $R^2=0$. Others are above it, $R^2>0$, or below it, $R^2<0$.

Figure 4 UK, Group B: the change in vote depends on the vote in 2017 (percentages); the UK-SE benchmark line for Group B

change in Group B % vote 2017-2019



Comparing the above two figures, we note that they are approximately mirror images of one another about the benchmark line. This happens because $P+Q$ is approximately 1 because Groups A and B include almost every voter with just a small ‘other’ category.

In particular two points are below the line for Group A and above the line for Group B. In both cases the two points represent London and Scotland ...

The residual R and the percentage Remain vote in 2016

... and London and Scotland are the two areas which had a high Remain vote in 2016. This suggests that the Remain vote can explain points which deviate from the benchmark line – in other words the Remain vote relates to the residuals.

Below the benchmark line for Group A are areas which had a high Remain vote in 2016; and above the line are areas which had a low Remain vote in 2016.

Above the benchmark line for Group B are areas which had a high Remain vote in 2016; and below the line are areas which had a low Remain vote in 2016.

On or near the line for Group A are six points corresponding to areas that had much the same level, between 46% and 48% voting Remain in 2016:
UK 48, England 47, Wales 47, South East 48, South West 47, North West 46

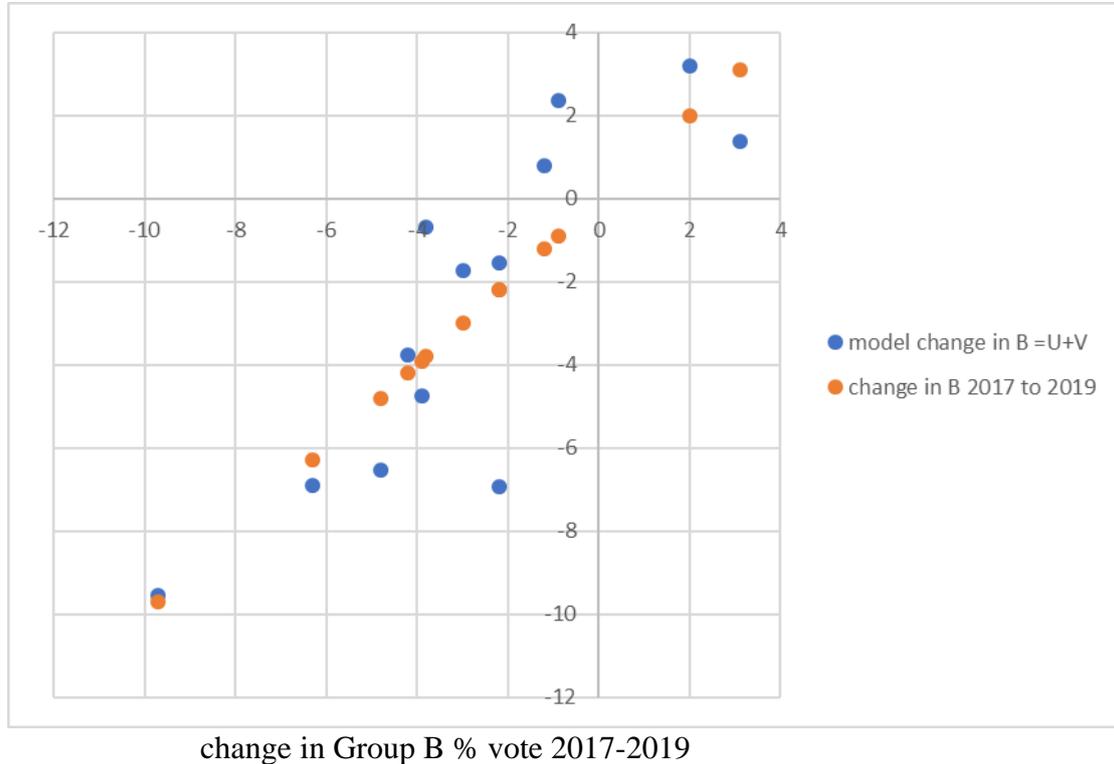
Below the line for Group A are two points corresponding to areas that had much the same level, between 60% and 62% voting Remain in 2016:
London 60 and Scotland 62

$$V = 3 \text{ Remain } \% / 4 - 35$$

Note: far from the line is Yorks & Humber (-2.2,-6.9).

Figure 6 Change in vote and model change of vote, U+V
 Note: far from the line is Yorks & Humber (-2.2,-6.9)

U+V



In other words the change in the vote depends on the previous votes ... for the parties and for Brexit.

3.4 North East England: the percentage vote map and proportional loss

In the previous section we looked at differences between regions and nations. In this section we carry out a similar analysis but this time looking at differences between constituencies within a single region, namely the North East of England.

The North East of England is the farthest part of England from London. It is part of ‘the red wall’ – the Labour territory in the north which the Conservatives hoped to win seats in. It was at the centre of the drama of election night. The exit poll had foretold dramatic swings to the Conservatives in the North East and elsewhere and the first seat to confirm this prediction was Blyth Valley. The North East is the region with the highest Group B vote in 2017, and with the highest loss of Group B vote from 2017 to 2019.

The percentage vote map

In a previous section we looked at the seat map and noted clusters of one-party seats based on which party had won each seat. Here we adopt a different approach – we consider the percentage vote map. For each level of percentage vote p , we ask which seats gained p or more for Group B. This gives the ‘high ground for Group B’ associated with p and gives the p -contour – just like the altitude contours on an ordinary map.

We look at the level of the vote for Group B in 2017. We introduce the seats in order of the level of the vote, starting with the highest level.

Consider a percentage vote of 66%. There are three clusters of seats which have their vote at or above this level:

.(1) The Newcastle cluster

Newcastle East 76, Newcastle Central 71, Gateshead 71, Jarrow 71, Tyne N 69, South Shields 67 ... Blaydon 66 ... see (5) below.

.(2) The Durham cluster

Durham City 67, Easington 66 ... see (5)

.(3) The Middlesborough cluster

Middlesborough 67

Before continuing the analysis, a comment which looks ahead to a later section. We shall have a special interest in a set of six seats. These were seats with more than 60% Group B vote in 2017 and with low swings away from Group B – and so are ‘above the line’ in a later analysis. There were five connected seats from the Newcastle cluster, and also Durham City (namely Gateshead* -6.3, Newcastle Central* -3, Newcastle East* +0.1, Newcastle North* below -4, Tynemouth* below -4, and Durham City* -5.4, the percentage swing indicated).

Consider next a percentage vote of 64%. At this level there is another cluster and also two of the previous clusters coalesce into one cluster due to two seats linking them together. (These two seats together form a saddle point.) We now have clusters (3), (4) and (5).

(4) the Wansbeck cluster

Wansbeck 64

(5) The Newcastle-Durham cluster

Durham North 64 and Washington 64, linking (1) and (2)

Here, at the level of 64% for Group B, we pause. At this level the percentage vote map for 2017 looks quite like the seat map for 2019. All the seats at 64% or above for Group B in 2017 remained in Group B in 2019. The seats at 63% or below for Group B in 2017 either shifted from Group B to Group A in 2019 or were already in Group A in 2017 – with just three exceptions which remained in Group B despite relatively low Group B vote in 2017.

What the contour map looks like at this level is a large Newcastle-Durham cluster, a one-seat cluster to the north at Wansbeck and a one-seat cluster to the south at Middlesborough. Surrounding these clusters is just one large cluster of all the seats with a Group B vote of 63% or less.

```
.   XXXXX
.   XXX W
.   XXXXX
.   X NNN
.   XXXXX
.   XX M X
.   XXXXX
```

Consider next a percentage vote of 63%. We now have clusters (3) and (6). As we move to lower levels, these clusters continue to expand. The * indicates the seven seats which switched from Group B in 2017 to Group A in 2019. All but one were on the outer rim of the region.

(3) The Middlesborough cluster
Continuing to expand: Redcar* 62, Stockton 59

(6) The Newcastle-Durham-Wansbeck cluster
Houghton & Sunderland S 63, joining (5). Also, Blyth* 63, linking (5) and (4).
Continuing to expand: Newcastle North 62, Durham NW* 61, Tynmouth 61, Sunderland C 61 ...
... Sedgefield* 57

Consider next a percentage vote of 54%.

(7) The Newcastle-Durham-Wansbeck-Middlesborough cluster
Darlington* 54, joining (6). Also, Hartlepool 54, linking (6) and (3).
Continuing to expand: Middlesborough S & Cleveland 52 (Cons both 2017 and 2019), Bishop Auckland* 51, Stockton S* 51

Consider finally a percentage vote of less than 50%. Two mainly rural seats in the north and east which were Conservative in both 2017 and 2019.

(8) Rural
Berwick 48, Hexham 44

The initial percentage vote and the change in percentage vote

The Group B vote in 2017 and the change in that vote from 2017 to 2019 for the seats in the NorthEast are given in Figure x. Also given is the Group B benchmark line introduced earlier (defined by two points, for the UK and for the South East). All the points are fairly near the line. Most of the points are below the line and appear to be roughly on a line parallel to the benchmark line. There are some points above the line. The general configuration of points is similar to the Group B configuration for UK as a whole, discussed earlier. Just as London was above the line so a set of six seats, the 'Newcastle Five' and Durham City, are above the line here.

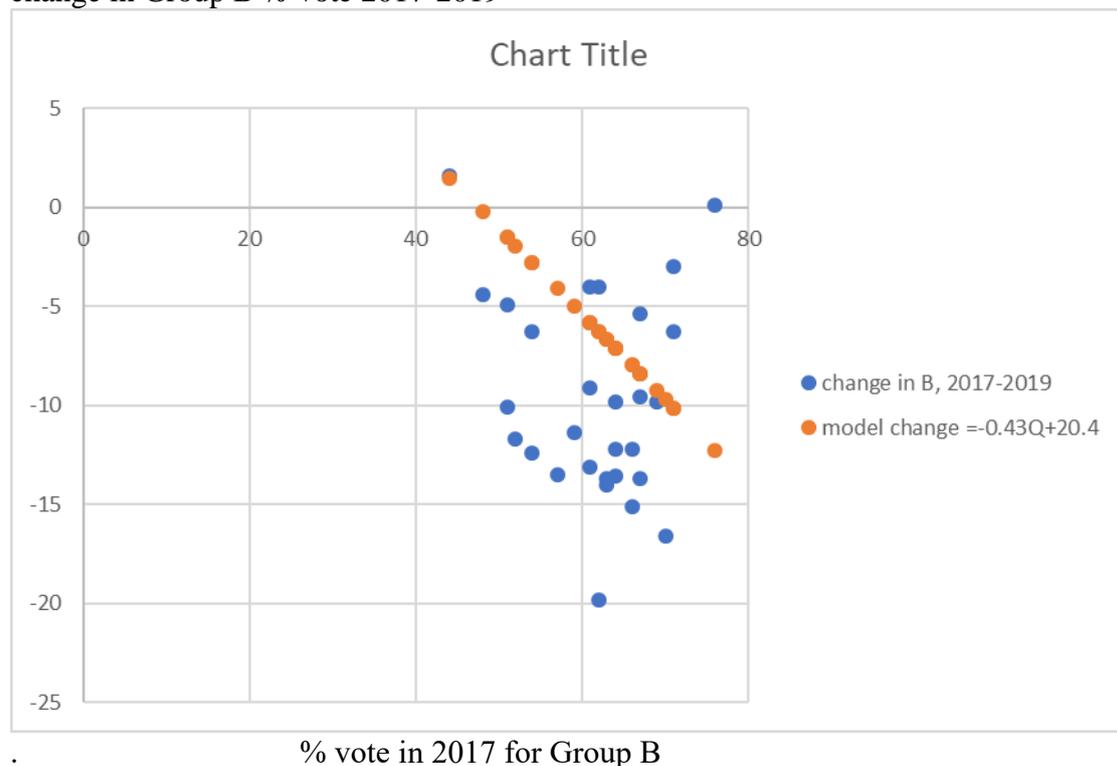
The six seats are: Gateshead -6.3, Newcastle Central -3, Newcastle East +0.1, Newcastle North -4, Tynemouth -4, and Durham City -5.4, the swings being indicated. Farthest from the line is Newcastle East.

Seats which were already Conservative are: Berwick -4.4, Hexham +1.6, Redcar -19.8, the latter two having the highest, +1.6, and lowest, -19.8, changes.

The centre of terh cluster of points in Figure 7 below is approximately the point (60,-10) and this is close to the opint for the North east in Figure 4 above – as one would expect.

Figure 7 North East England, Group B: the change in the vote depends on the size of vote in 2017

change in Group B % vote 2017-2019



UKIP to Brexit Party proportional gain, 2017 to 2019, North East

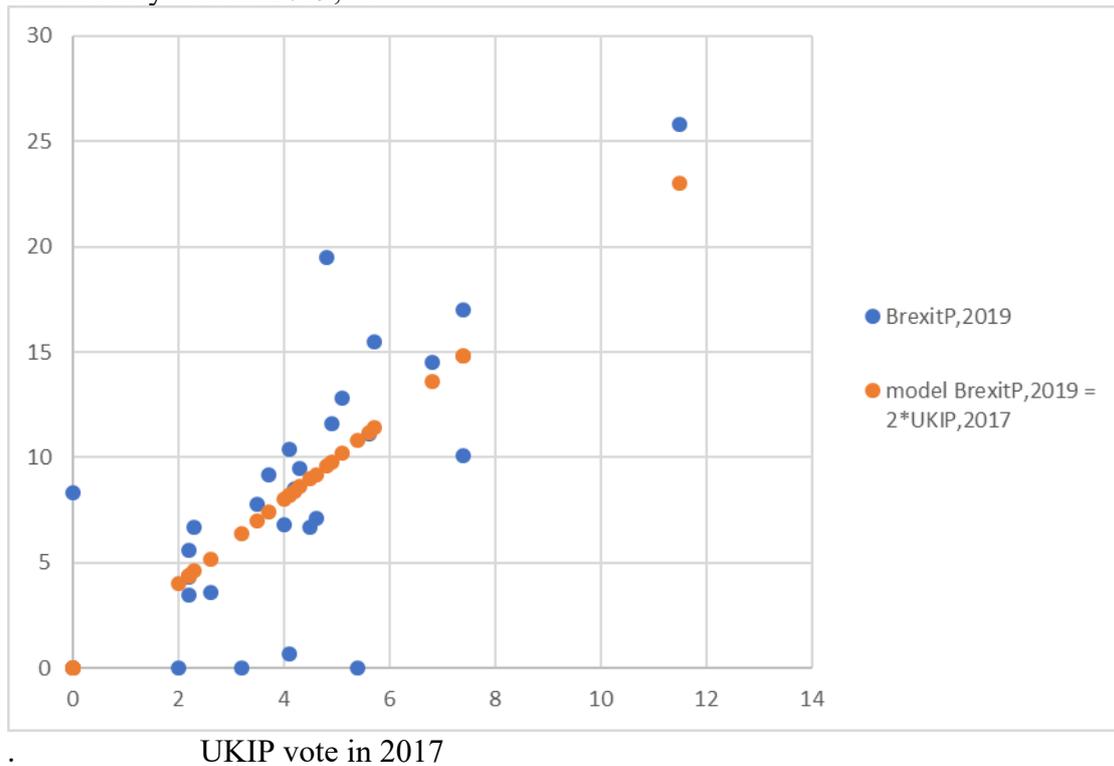
In the 2017 election Nigel Farage was leader of UKIP. Then in early 2019, Nigel Farage, no longer in UKIP, formed the Brexit Party. The aim of both parties was Brexit. Figure x shows that the votes for the two parties in the seats in the North East of England. From 2017 to 2019, the vote doubled. A seat’s vote for the Brexit Party in 2019 was twice what the vote had been for UKIP in 2017.

Note: There were a few seats which UKIP did not contend in 2017. In 2019 the Brexdit Party did not contend seats already held by the Conservatives.

Figure 8 UKIP vote in 2017 and Brexit Party vote in 2019; seats in North East England

Two outliers: Easington, 4.8, 19.5; Jarrow, 10.1, 7.4

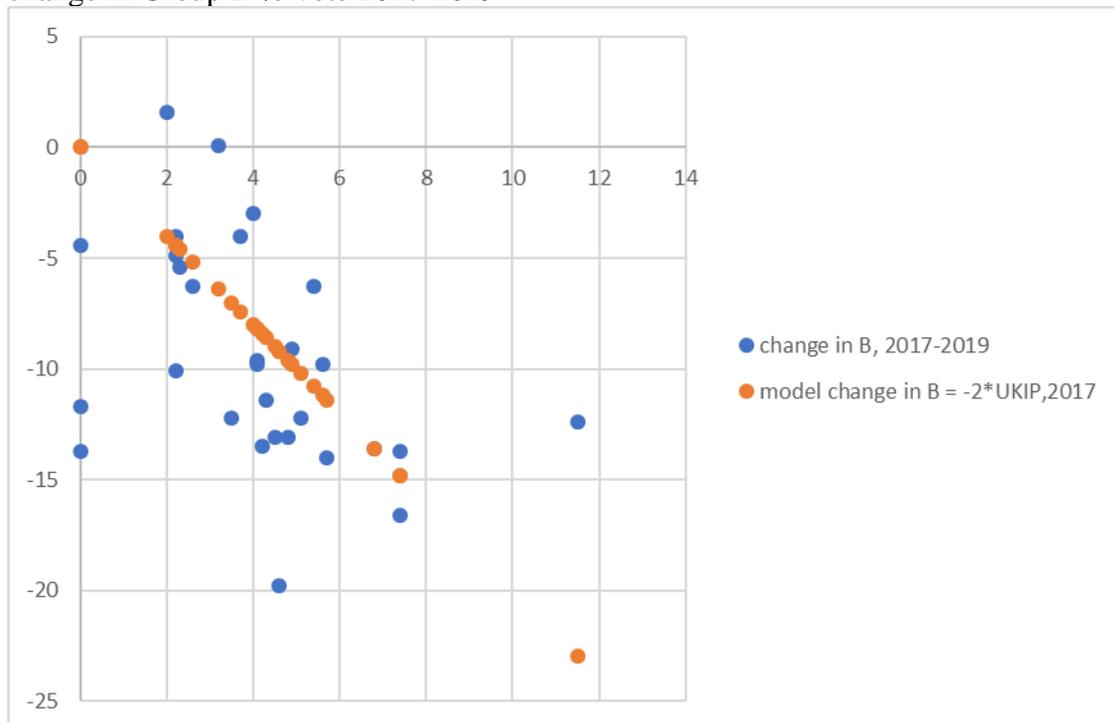
Brexit Party vote in 2019, %



In the North East the Group B vote in 2019 is strongly negatively related to the UKIP vote in 2017.

Figure 9 UKIP vote in 2017 and change in Group B vote 2017-2019; seats in North East England

change in Group B % vote 2017-2019



Comparing Figures 7 and 9, in both figures the points with a large loss of Group B vote are below the straight line. There is something here but I am still wrestling with what it is!

3.5 A model of how voting depends on previous voting

In earlier sections we have looked first at the raw percentages and then at the empirical equations showing how voting depends on previous voting. We now develop a simple mathematical model of this phenomenon.

Consider a situation where voters vote for one or other of two Groups A and B. We are interested in the proportions voting for A and B; and in how those proportions change from one election to the next. In the model here it will be shown how the change in the proportion depends on the initial proportion.

Suppose the voting proportions for A and B in an election are P and Q , respectively, where $P+Q=1$. Let the voting proportions for A and B in the next election be P_{next} and Q_{next} , respectively, where $P_{next}+Q_{next}=1$. Then the changes dP and dQ are:

$$\begin{aligned} dP &= P_{next} - P \\ dQ &= Q_{next} - Q \end{aligned}$$

[Note that it is common in mathematics to use the symbol 'd' to indicate change in a variable.]

Consider the survival proportion from one election to the next. Let the survival proportions be a and b , for Groups A and B respectively. Note: $0 \leq a \leq 1$ and $0 \leq b \leq 1$.

Theorem

The next values of P and Q are:

$$\begin{aligned} P_{next} &= k P + (1-b) \\ Q_{next} &= k Q + (1-a) \\ \text{where } k &= a+b-1 \end{aligned}$$

The changes dP and dQ are:

$$\begin{aligned} dP &= m P + (1-b) \\ dQ &= m Q + (1-a) \\ \text{where } m &= k-1 = a+b-2 < 0 \end{aligned}$$

An equilibrium (no change) occurs when

$$\begin{aligned} dP=0 & & \text{and} & & dQ=0 \\ P^* &= (1-b)/(2-a-b) & & & Q^* &= (1-a)/(2-a-b) \end{aligned}$$

Suppose the survival proportions a and b are variable. Then k and m are variable as are P^* and Q^* .

Proof

aP and bQ survive in their respective groups; and $(1-a)P$ and $(1-b)Q$ move to the other group.

So the voting proportions at the next stage are:

$$\begin{array}{ll} P_{\text{next}} & \text{and} \quad Q_{\text{next}} \\ = aP+(1-b)Q & = bQ+(1-a)P \\ = (a+b-1)P+(1-b)Q & = (b+a-1)Q+(1-a)P \\ = k P + (1-b)Q & = k Q + (1-a)P \\ \text{where } k=a+b-1 & \end{array}$$

This gives changes of:

$$\begin{array}{ll} dP & dQ \\ = (a+b-2)P+(1-b)Q & \text{and} \quad = (b+a-2)Q+(1-a)P \\ = m P + (1-b)Q & = m Q + (1-a)P \\ \text{where } m=a+b-2 < 0 & \end{array}$$

An equilibrium (no change) occurs when

$$\begin{array}{ll} dP=0 & \text{and} \quad dQ=0 \\ P^*=(1-b)/m & Q^*=(1-a)/m \\ P^*=(1-b)/(2-a-b) & Q^*=(1-a)/(2-a-b) \end{array}$$

Special cases

Case I

$P^*=Q^*$ if and only if $a=b$.

Case II

If $a=b$ then $m=-2(1-a)$ and so $(1-a)=-m/2$

The changes dP and dQ are:

$$\begin{array}{ll} dP & = m P - m/2 \\ dQ & = m Q - m/2 \end{array}$$

So the two coefficients in the equation are such that the second is half of and the negative of the first.

In the empirical cases discussed earlier, this is approximately the case.

Case III

A special case of Case II which gives nice equations!

If $a=b=0.75$ then $m=-0.5$.

Note $1-a=1-b=0.25$

Expressed in percentages, $a=b=75$ and $1-a=1-b=25$

This gives the two equations.

$$\begin{array}{ll} dP & = -0.5P+25 \\ dQ & = -0.5Q+25 \end{array}$$

In the empirical cases discussed earlier, the coefficients are of this order of magnitude. An earlier section reported rather higher values for a and b , $a=87$ and $b=86$.