Voting patterns, party spending and space in England and Wales

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Abstract

There is a growing body of literature which suggests that voting patterns are not independent from space yet few empirical investigations exist which take explicit account of space. This article examines the determinants of voting patterns across constituencies in England and Wales using spatial econometric methods. The results suggest that while socioeconomic factors are key determinants of party vote shares in constituencies, there is strong spatial autocorrelation in voting patterns. We find that each major political party is influenced by space to different extents with the Liberal Democrats visibly exploiting spatial autocorrelation to increase their vote shares.

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1. Introduction

There is a growing body of literature which suggests that voting patterns are not independent from space. Some scholars claim that voting is a learned activity which takes place in a number of different contexts and through a range of mechanisms at a variety of different scales (COX, 1969; TAYLOR and JOHNSTON, 1978; JOHNSTON *et al*., 2005b). Such contextual effects complement compositional effects and can result from people interacting with their material environment, social networks or political parties through, for example, place-specific campaigns (JOHNSTON and PATTIE, 2006). These processes occur in places, making it unsurprising that there is an increasing amount of empirical evidence supporting the proposition that spatial variations in voting patterns exist.

With socio-economic and demographic information for areas easily obtainable from the UK Census, it is unsurprising that the majority of aggregate analyses of voting patterns in the UK are conducted at the constituency scale. However, few aggregate analyses that employ regression techniques to analyse party support explicitly take account of spatial effects. The purpose of this paper is threefold: first we discuss the consequences of failing to account of these spatial effects in aggregate models of party support in the 2005 general election in England and Wales, then we demonstrate how regression models can take account of spatial effects, and finally we present evidence that ignoring spatial effects may well bias results.

This paper has the following structure. In the next section we review the theoretical literature which suggests that there is a geographical element to voting in the United Kingdom. Then, in Section 3, we hypothesise the relationships between the variables discussed in the theoretical section and discuss reasons why we should take space into account. In Section 4 we present geographical evidence which indicates that there are clusters of areas which appear to have high vote shares for a specific party. Such spatial heterogeneity and autocorrelation should be considered when empiricists attempt to investigate the drivers of vote shares and patterns of political support. The spatial regression technique and the results of our econometric estimations are presented in Section 5. Section 6 concludes.

2. The Geography of Voting in Great Britain

A growing body of literature has repeatedly illustrated that there are spatial patterns of voting above those that reflect compositional effects (JOHNSTON and PATTIE, 2006). Central to this argument is that voting is a learned activity which takes place in a number of different contexts and through a range of mechanisms at a variety of different scales. These contextual effects complement compositional effects and result from, for example, people interacting with their material environment, with others in social networks or from political parties interacting with people during place-specific campaigns (CUTTS, 2006a). Accordingly there is a large and increasingly empirical literature emphasising the existence and intensity of spatial variations vote shares.

Much scholarly attention has focused on variations in voting across regions (JOHNSTON *et al*., 1988). There have been long standing inter-regional variations in Great Britain's voting patterns (FIELD, 1997) with evidence of a 'north-south' divide: Labour dominating the

industrial northern regions, inner city London and South Wales, while the Conservatives get much stronger support in the southern regions (JOHNSTON *et al*., 1988; CURTICE and STEED, 1982). These differences were accentuated during the 1980s with intra- and inter-regional variations in urban-rural differences: Labour became increasingly popular in major cities while the Conservatives dominated in suburban areas, rural towns and villages. The Conservatives reaped electoral support from all classes in southern regions (areas of relative economic prosperity following the growth of the service sector) while it saw a relative decline in support across all classes in northern regions and South Wales (areas of relative economic depression following the closure of primary and traditional manufacturing industries). However, since 1987, there is evidence that inter-regional differences have closed (CURTICE and PARK, 2000; JOHNSTON *et al*., 2005a) with evolving economic forces only partly explaining this reversal. During the 1990s, the rise of 'new Labour' altered voters' perceptions. By presenting itself as a 'catch-all party', capable of strong government and leadership, together with an economic strategy that promoted rather than penalised affluent workers in the southern regions, Labour successfully appealed directly to particular types of people in particular types of area which led to less pronounced inter-regional differences (HEATH *et al*., 2001; JOHNSTON and PATTIE, 2006).

Even though these differences remain apparent, there is still uncertainty about why differences exist and whether such regional variations are 'real' (JOHNSTON *et al*., 2005a). Regional variations may reflect differences in political cultures. As similar types of people become socialised into local attitudes and values, regional differences in voting patterns can occur. During the 1980s, inter-regional differences may have reflected changing inter-constituency population characteristics as a result of inter-regional migration and economic restructuring (CURTICE and STEED, 1982). More recently, some scholars have claimed that people vote according to their perceptions of national and personal economic circumstances, and that such perceptions are spatially, in particular regionally, variable (JOHNSTON and PATTIE, 1997, 1998). However, this has been contested by claims that people behave in a similar manner in different regions according to their individual characteristics, thereby ruling out any substantial regional effect on voting (MCALLISTER and STUDLAR, 1992). Other studies have reached different conclusions regarding explanations of regional differences (JOHNSTON and PATTIE, 1998; RUSSELL, 1997).

While the most recent general elections have seen regional variations remain largely constant, inter-constituency variations in party support have become ever more apparent (JOHNSTON and PATTIE, 2006). The constituency scale has long been the dominant feature of Great Britain's electoral geography with the majority of aggregate analyses occurring at this level because of the paucity of data at smaller geographical levels. At this scale, early studies provided circumstantial evidence that similar people vote differently in different types of places (COX, 1969; CREWE and PAYNE, 1971). Using a combination of constituency and British Electoral Studies (BES) survey data, BUTLER and STOKES (1969, 1974) put forward arguments consistent with classic neighbourhood effects in their pioneering work on British electoral behaviour: in strong Labour and Conservative areas there was pressure in the local milieu for electors to remain with the local majority view. These arguments were developed by MILLER (1977, 1978), who claimed that class polarisation was greater at the constituency context than the individual level. He accounted for this spatial polarisation by associating these observed patterns with neighbourhood effects, specifically the role of the environment in

structuring social contacts (family, friends, locality etc) and how social interaction with those members of an area's minority class is likely to convert these people to the dominant viewpoint. Without any evidence that such processes operated, these findings were not immune from criticism (DUNLEAVY, 1979; 1980), despite further evidence that socio-demographic composition could not account for party support at the constituency level (JOHNSTON *et al*., 1988). By combining constituency level data to individual respondent's information from the BES over the period 1964-97, a later study showed significant across-constituency variation in Labour and Conservative support and stressed both the influence of social interaction (supporting the neighbourhood hypothesis put forward by MILLER) and variations in the marginality of the electoral contest on voting patterns (ANDERSEN and HEATH, 2002).

Other studies of inter-constituency variations in party support have focused on party activity rather than socio-demographic composition. To reap electoral rewards, parties campaign differentially across constituencies, focusing their activity in marginal seats. While it is important for parties in marginal seats to win over new voters or shift established voting intentions, it is also vital for them to identify and then mobilise supporters thus ensuring they vote on election day. Over the last two decades, numerous studies have found that where a party campaigned more intensively, relative to its opponents, the greater its electoral payoff (JOHNSTON and PATTIE, 1995; DENVER and HANDS, 1997; FIELDHOUSE and CUTTS, forthcoming). There is also evidence that parties through sophisticated local targeting strategies and grassroots campaigning now successfully operate at much smaller spatial electoral scales (below the constituency level) in order to maximise their potential rewards (CUTTS, 2006b).

In recent times, attempts to identify the 'real' spatial variations in voting at British general elections have focused on smaller geographical scales. For instance, innovative research saw the use of 'bespoke neighbourhoods'[1] with convincing evidence of small scale spatial variations in voting (JOHNSTON *et al*., 2000; 2001; 2004; 2007). People from similar social backgrounds were found to vote differently depending on their local context, and these neighbourhood effects operated at a variety of scales nesting within each other (JOHNSTON and PATTIE, 2006). Later research using the British Household Panel Survey also found that voting decisions were affected by interaction with neighbours and friends, and contact with party activists in various settings (JOHNSTON *et al*., 2005b).

> 'The more people had contact with their neighbours the more likely they were to vote as there neighbours did, according to the neighbourhood characteristics that they shared' (JOHNSTON and PATTIE, 2006, p104).

Other evidence stressed the importance of smaller spatial scales on voter participation (FIELDHOUSE and CUTTS, 2007), while similar sophisticated models of voting seem to show that, contrary to earlier findings, inter-regional variations in voting patterns are no more than aggregation effects as any geography to voting operates at much smaller spatial scales (JOHNSTON *et al*., 2007).

[1] See JOHNSTON and PATTIE (2006) for a detailed explanation of how bespoke neighbourhoods are constructed and an overview of their use in a number of recent studies.

To summarise, there is considerable evidence that voting patterns at British elections are intrinsically spatial, at scales ranging from the locale to the regional. Given this, it is paramount that explanatory statistical models of voting take account of possible spatial effects. Despite recent innovations, there is no official general election voting data at any smaller areas below that of the parliamentary constituency. With socio-economic and demographic information for areas easily obtainable from the census, it is unsurprising that the majority (although not all as shown above) of aggregate analyses are conducted at the constituency scale but it is surprising that few aggregate analyses that employ regression techniques to analyse party support take account of spatial heterogeneity. We fill this gap in the literature.

3. Understanding Patterns of Party Support in 2005

To examine what factors shaped the underlying pattern of party support in 2005 we use linear regression models of party vote share in the 2005 general election. Our initial models include socio-demographic factors and the local political context to explain the types of area in which each party did better or worse.

Our vote share linear regression models are built over two stages to reflect a number of well established arguments. This approach also enhances clarity by showing how variables in the model are affected by the inclusion of others. First we include social cleavage variables to reflect the fact that they are relatively stable and exogenous. Parties tend to do better in areas with large numbers of the social groups who tend to support that party. The importance of social cleavages on voting behaviour has long been established – at the ecological level, parties often perform well or do badly in areas depending on the people that live there (CUTTS, 2006b). While both Labour and the Conservatives have strong electoral foundations based on social cleavages, the Liberal Democrats have been found to lack a similar solid social base (CREWE and KING, 1995; CURTICE, 1996). Nonetheless, there is some evidence that Liberal Democrat voters tend to be more middle class, highly educated and likely to work in the public sector (RUSSELL and FIELDHOUSE, 2005). Yet, evidence from the 2005 BES suggests that there are no socio-demographic groups that can be considered part of the Liberal Democrats natural heartland, with the party only doing best amongst those highly educated individuals with degrees (FIELDHOUSE *et al*., 2006).

We employ nine variables taken from the 2001 census that reflect the main socio-economic correlates of variations in voting behaviour in Great Britain, many of which have been used in aggregate analyses examining voting patterns in recent general elections (JOHNSTON *et al*., 1998; RUSSELL and FIELDHOUSE, 2005; FIELDHOUSE *et al*., 2006). In 2005, Labour was expected to lose support in predominantly Muslim and student areas to the Liberal Democrats, given the Liberal Democrats' opposition to tuition fees and the War in Iraq. We include three census variables to ascertain whether the Liberal Democrats did perform better and Labour did worse in areas with large numbers of students, workers in education and constituencies with large Muslim electorates.

At the second stage of the model we include reported party campaign spending to reflect the intensity of local party activism. Since the 1950s, the impact of local party activism on party support has been contested (BUTLER and STOKES, 1969). However since the mid 1990s, a growing body of literature has repeatedly demonstrated the electoral benefits of intense

constituency campaigning (WHITELEY and SEYD, 1994; JOHNSTON and PATTIE, 1995; DENVER and HANDS, 1997), so much so that these originally labelled 'revisionist' viewpoints have now become part of the mainstream. However there has been disagreement over how to best measure campaign effort. Here we use party spending as a surrogate measure of campaigning. It has been consistently demonstrated that the amount a party spends is significantly related to its electoral performance: the more a party spends, relative to its opponents, particularly if it is the challenger, the better the outcome for it (PATTIE *et al*., 1995; JOHNSTON and PATTIE, 1995). Moreover, party spending has the advantages of completeness of coverage and relatively little measurement error, and has proven validity when measured against alternative measures of campaign intensity (DENVER and HANDS, 1997; WHITELEY and SEYD, 2003). A recent analysis of campaign effort in the 2005 general election found that spending was the indicator most highly correlated with the campaign variable (FIELDHOUSE and CUTTS, 2008, forthcoming). We therefore include party spending for all three parties to reflect the intensity of local activism. Given previous findings at recent elections, we would expect local representation and grassroots campaigning to be particularly salient for the Liberal Democrats than for the other main parties (RUSSELL and FIELDHOUSE, 2005; CUTTS, 2006a; 2006b).

Although much of the empirical analyses on party vote share in the UK is at the level of the parliamentary constituency, it appears that such analyses typically do not take into account either the spatial nature of these parliamentary constituencies – whether one parliamentary constituency is contiguous to another – or whether the spatial heterogeneity of the dependent variables has a direct effect on voting patterns. If scholars are to be sure of the effect of socio-economic correlates then such estimates need to be made once the influence of space has been taken into account.

Spatial forces

Standard (non-spatial) econometric estimates of the effect of explanatory variables on vote share will be inefficient if the residuals are spatially autocorrelated. One of the clearest expositions of the reasons why residuals can be spatially autocorrelated has been provided by VOSS *et al*. (2006), and based on the work by WRIGLEY *et al*. (1996), who emphasise the importance of, amongst other things, *feedback*, *grouping forces* and *grouping responses*.

VOSS *et al*. (2006) state the potential for *feedback* forces to influence individuals and households preferences and activities. *Ceteris paribus*, the smaller the spatial scale of analysis then the greater the potential feedback because of the higher likelihood and frequency of contact between voters. For reasons related to the adoption/diffusion theory (RODGERS, 1962) and the agent interaction theory (IRWIN and BOCKSTAEL, 2004), we should expect there to be the potential for spillovers of voting behaviour with a positive correlation in political party vote shares between contiguous parliamentary constituencies. If a political party is thought to be positively contributing to the life of voters, then this positive impression of that political party is likely to be shared with friends and neighbours, including friends and neighbours within the area and within contiguous areas who interact most with these voters.

Geographically close parliamentary constituencies with similar political party vote shares might be influenced by *grouping forces*. Clusters of high vote shares might be due to a number

of reasons including the spatial grouping of political party spending. For instance, if a political party, such as the Liberal Democrats, wishes to spend relatively high amounts on campaigning in one area then it may well also be wise for that political party to spend relatively high amounts in that parliamentary constituency's contiguous constituencies in order to reap the rewards from spatially autocorrelated coercive political forces.

Of course, this type of coercive political behaviour may well be reacted to in similar fashions across parliamentary constituencies due to similar socioeconomic backgrounds or political persuasions of voters. Such *grouping responses* can be positive or negative and should inform political parties on the likelihood of campaign spending being effective.

4. Exploratory spatial data analysis

Many scholars have contributed to the theoretical and empirical literatures concerning the factors that affect party vote shares. However few of these scholars explicitly take account of geography in their empirical analyses. This is surprising given the political make-up of the 2005 general election constituency map in England and Wales. Labour continues to maintain a stranglehold of its industrial heartland areas in the North (Greater Manchester, Merseyside, South and West Yorkshire, Tyne and Wear), large areas of the West and East Midlands and the traditional industrial areas of South Wales as well as parts of inner city London. By contrast the Conservatives remain strong in the shire districts of England and suburban areas, particularly constituencies in the South East and Greater London. In 2005, the Conservatives fell back in many Northern constituencies and currently have only three seats in Wales and no seats in a number of major urban centres (Birmingham, Newcastle, Leeds, Liverpool, Manchester, and Sheffield). The Liberal Democrats have a distinctive geography of seats based on historical voting patterns and contemporary advances (RUSSELL and FIELDHOUSE, 2005). Party strength still lies in the nonconformist 'Celtic fringe', specifically the south west of England and rural parts of Wales. However, since 1992, the Liberal Democrats have captured additional seats in the south east and London, while in 2005 they achieved electoral breakthroughs in constituencies where there were both large numbers of students and those working in the public sector such as education and health (FIELDHOUSE *et al*., 2006).

As regards the 2005 geography of the vote, Labour continues to do much better in the south, albeit not as well as four years previously, but still better than 1992. This largely reflects the success of Labour's key seats strategy devised in 1997 to target specific marginal seats mainly in the south east, London and parts of the midlands, and their ability to successfully defend large numbers of them in the two subsequent general elections. Where the Liberal Democrats have built 'electoral credibility' through local election gains or the stewardship of local councils, or developed strong local organisations in new types of area (e.g. university seats) which enhance the party as a credible alternative, the party has managed, often through intensive local campaigning, to secure increases in support and made parliamentary advances.

Moran's I scatter plots

One way of examining the geography of voting patterns is to exploit the spatial nature of the data set. After standardising the variables, we are able to investigate the extent that the party vote share of each political party in each parliamentary constituency is correlated with the

party vote share of the same political party in contiguous parliamentary constituencies. Taking the Liberal Democrats, the Conservatives and the Labour parties in turn, this part of the exploratory data analysis is presented in Figures 1–3.

{Insert Figures 1–3 about here}

In each case the standardised vote share of the political party in 2005 in a parliamentary constituency is presented on the x-axis, while the y-axis shows the standardised value of the average political vote share for that party of that parliamentary constituency's neighbouring constituency as defined by the queen contiguity weights matrix. [As the data are standardised the units on the graph are expressed in standard deviations from the mean.] The upper right quadrant of the Moran's I scatter plot shows those parliamentary constituencies with an above average vote share for that political party which shares its boundaries with neighbouring parliamentary constituencies that also have above average values of the same party's vote share (high-high). The bottom left quadrant shows parliamentary constituencies with below average vote share for a political party with neighbouring parliamentary constituencies also with below average values (low-low). The bottom right quadrant displays parliamentary constituencies with above average vote share surrounded by parliamentary constituencies that have below average vote shares (high-low) and the upper left quadrant showing the opposite. The slope of the regression line through these points expresses the global Moran's I value (ANSELIN, 1996).

Figures 1–3 support the notion that there is spatial autocorrelation in voting patterns: in each case the Moran's I statistics are positive and statistically significant with values of 0.2956, 0.5975 and 0.5692 for the Liberal Democrats, Conservatives and Labour parties respectively. Two important extra observations can be made from these 'global' figures. First spatial autocorrelation of party vote share is strongest for the Conservatives and weakest for the Liberal Democrats. Second, the distribution of points on the scatterplots illustrates different degrees of heteroskedasticity with the Liberal Democrats fan being particularly explosive; this indicates that the vote share for this party is localised and targeted, as indicated by the intensity of points in the low-low quadrant and dispersed points in the high-high quadrant. This is distinctly different from the Moran's I scatter plots that are produced from data for the Conservative and Labour parties, which adds to our intuition that there may be different drivers of vote shares for different political parties.

Numerous scholars have shown that local party activism has a significant effect on party vote shares (DENVER and HANDS, 1997; JOHNSTON and PATTIE, 1995; WHITELEY *et al*., 1994). Here we use party spending as a surrogate measure of the strength of local campaigning (JOHNSTON and PATTIE, 1995; FIELDHOUSE and CUTTS, 2008 forthcoming). Given that party vote shares appear to have an element of spatial autocorrelation, there is an argument that effective local campaigning should also be spatially autocorrelated. To investigate this issue we replicate the earlier analysis through the use of Moran's I scatter plots for data on campaign spending by each political party, as shown in Figures 4–6. The results support the notion that there is spatial autocorrelation in party spending: in each case the global Moran's I statistics are again positive with values of 0.2646, 0.4530 and 0.2919 for the Liberal Democrats, Conservatives and Labour parties respectively.

{Insert Figures 4–6 about here}

Three further points concerning these scatter plots are worthy of note. First campaign spending by the Liberal Democrats is highly targeted, with the majority of points in the low-low quadrant illustrating lots of parliamentary constituencies where their campaign spending is low which are also surrounded by parliamentary constituencies where their campaign spending is also low. Second, the difference between the Liberal Democrats and the Conservatives is stark. It appears the Conservatives spend their money in most areas but target specific areas for relatively low amounts of spending, as illustrated by the sparcity of points in the low-low quadrant. Third, the two patterns identified above don't apply to the Labour party. The Labour party appears to have a relatively even split between the high-high, high-low, low-high and low-low quadrants. This suggests that campaign spending is not always directly related to local party performance, an argument we develop later.

LISA cluster maps

An accompaniment to the Moran's I scatter plot is the LISA cluster map; three such maps are presented in Figures 7–9 from which we can identify the spatial distribution of high-high, low-low, high-low and low-high political party spending contiguity patterns across parliamentary constituencies in England and Wales. In Figures 7–9, areas coloured red represent high spending in constituencies with high spending in its surrounding constituencies (high-high); dark blue areas represent patterns of low spending in a constituency with low spending in its surrounding constituencies (low-low); light blue areas represent low spending in a constituency with high spending in its surrounding constituencies (low-high); pink areas represent high spending in a constituency with low spending in its surrounding constituencies (high-low).

{Insert Figures 7–9 about here}

When these three figures are examined together several important points can be made. First, the Liberal Democrats appear to be more active in parliamentary constituencies that are located in the South West of England (traditional heartland) and to a much lesser extent in the East Midlands. The LISA map for the Liberal Democrats appears to be more clearly defined than for the other two (major) political parties and such positive spatial autocorrelation on party spending is evidence of knowledge of spatial dependence of voting patterns by this political party and supports the idea that the Liberal Democrats has a clearly defined local perspective. Second, it appears that the South West of England is predominantly a two party fight, with both the Liberal Democrats and the Conservatives actively contesting seats in this region. By contrast, the Labour party is spending particularly low levels across this entire region. Third, Conservative party spending figures suggest that local Conservative party campaigning is particularly intense in the shire, rural and semi-rural parliamentary constituencies. Dark blue (low-low) areas are confined to relatively urban parliamentary constituencies for Conservative party spending patterns. Fourth, the Conservative party spends relatively little in the urban areas of South Wales, undoubtedly a consequence of Labour's traditional strength in these areas. Fifth, Labour party spending appears to be focused in London and along the M62 corridor between Rochdale and Bradford. As noted earlier, this geographical spread reflects the Labour party's focus on key target seats, many of which it converted in 1997, and for the most part has successfully defended in the two subsequent general elections.

The exploratory evidence presented above clearly indicates the presence of a geographical element to party vote shares and party spending patterns across England and Wales. If models are to be estimated and based on a correct functional form then they should be estimated with geography having an explicit role. In the next section we present estimates of regressions to identify the impact of geography and party spending on party vote shares. Of particular interest will be whether there has been any systematic over (or under) estimation of certain socio-economic covariates in models of vote share if the impact of geography is not accounted for explicitly in the estimations.

5. Regression Analysis

The purpose of this section is to compare and contrast the results of four regressions for each political party. To undertake this task we adopt a regression analysis stance and compare and contrast the results from OLS and spatial regression models. To undertake this task we employ the GeoDa open source software.[2]

Spatial regression method

Spatial regression can be used to investigate the influence of spatially evolving relationships. Two types of regression models are typically employed: the spatial error model and the spatial lag model. If there were strong theoretical reasoning to believe that the errors of an OLS regression would be spatially autocorrelated then the appropriate technique is to estimate a spatial error model, which is commonly specified as follows:

$$y = X\beta + u \tag{1}$$

where y represents the dependent variable, X represents the independent variables and the constant term, β is the regression parameters which are to be estimated and u is the error term. This error term is presumed to have a covariance structure as given by:

$$u = \rho Wu + \varepsilon \tag{2}$$

where ρ is a spatial lag parameter to be estimated, W is a weights matrix defined by the area's neighbourhood such that Wu captures the spatial lags of the model's disturbance term, u, and ε is the independently distributed error term. Elements w_{ij} from the W matrix capture the influence on area i of its neighbours, j. Under this specification spatial autocorrelation in the dependent variable is the result of exogenous influences captured in the error term and not directly from the explanatory variables. This typically occurs because the list of explanatory variables does not contain a variable which captures the spatial autocorrelation that appears in the dependent variable.

[2] This software was developed at the Spatial Analysis Lab at the University of Illinois and can be downloaded for free from: https://www.geoda.uiuc.edu/

It is possible to estimate a model which explicitly captures the spatial autocorrelation. The type of model which captures spatial autocorrelation as an explanatory variable is a spatial lag model of the form:

$$y = \lambda Wy + X\beta + u \quad (3)$$

In this formulation, *Wy* captures the spatially-weighted average of the dependent variable for an area's neighbouring locations and λ is the spatial lag parameter to be estimated.

Are space and campaign spending important drivers of party vote share?

First we replicate work which does not explicitly take into account spatial autocorrelation or campaign spending. We then add each of these variables into the estimations until we end up with a full model that includes the traditional socio-economic covariates together with both campaign spending and space. These results are presented in Table 1.

{Insert Table 1 about here}

The table is separated into three distinct sections with each section corresponding to one of the three major political parties. Four columns of regression results are presented for each political party. The first column is based on the previous literature which emphasises the importance of socio-economic characteristics driving variations in vote share across parliamentary constituencies; these literature-driven variables are the components within the *X* matrices in equations (1) and (3). Then we augment this model with the queen contiguity variable using spatial regression. Of note is whether the magnitude and significance of the socio-economic variables change systematically once the geographical variable is included in the model and, of course, whether the geographical variable is important itself. The third column presents re-estimates of the first column using OLS methods but this time we include campaign spending by each political party as additional explanatory variables. Finally we re-estimate this column using spatial regression to include the geographical contiguity variable. In each case we employ the queen contiguity weight matrix.

2005 party vote share appears to be influenced by a range of factors for each political party, and this is in line with the literature review above. Of immediate interest are the changes in the log-likelihoods. Large positive increases in log-likelihood values are apparent for all political parties with the inclusion of the spending and/or spatial weights variable. The magnitude of these changes in log-likelihood values is greatest for the Conservative party and smallest for the Liberal Democrats, although this low value for the Liberal Democrats might be due to the concentration of this party in the South West. Nevertheless, this alone indicates that the inclusion of the spending and spatial weights variables drastically improves the predictive power of the model for each political party.

As noted by previous studies (FIELDHOUSE *et al*., 2006), the Liberal Democrats obtained higher vote shares in parliamentary constituencies which had higher proportions of students and inhabitants with degrees. Areas with more inhabitants working in agriculture and with more pensioners are also more likely to generate higher vote shares for the Liberal Democrats. Of particular interest is whether the inclusion of campaign spending affects vote share. The

results indicate that higher own party expenditures and lower campaign spending by the other two political parties both increase a party's vote share; this is consistent across all three parties. However, the inclusion of the spending variables may well be correlated with the earlier explanatory variables. The effect of campaign spending appears to dilute the socio-economic controls, the educational control and the student control. Once we re-estimate the regressions using spatial regression techniques, irrespective of whether we include campaign spending, we find that the importance of the pensioners, agriculture, degrees, manufacturers and students has been over-stated; out of these variables, only *Degrees* and *Students* remain statistically significant at the traditional confidence levels. This implies that through the lack of appreciation of spatial factors, or of the spatial autocorrelation of the explanatory variables across space, other scholarly work may over-estimate the importance of these explanatory variables. An additional observation is that the importance of large proportions of individuals working in education only becomes an important explanatory variable for the Liberal Democrats once the geographical weights matrix has been included in the econometric analysis.

Supporting the proposition that the campaign spending variables may be correlated with the other explanatory variables is the multicollinearity condition number. The values of this statistic increase from below 4 to above 4 for all of the three political parties when campaign spending alone is included in the model. Nevertheless the critical value for this statistic is much larger than 4, which indicates that multicollinearity is probably not strongly influencing the results.[3]

Our results suggest that the progressive reduction in the importance of the explanatory variables is not systematically present for the Conservatives when we include these extra explanatory variables of campaign spending and space. In addition to this observed stability we find the spending variables and the spatial matrices remain important explanatory variables of the Conservative party vote share. By contrast the regression results for the Labour party illustrate that the inclusion of (either and both) campaign spending and the spatial weights matrix do reduce the magnitude of several of the theoretical literature based explanatory variables; in spite of this the majority of these variables remain statistically significant.

To summarise this section, the results of the 2005 vote share regressions suggest that i) space and campaign spending are importance covariates in the modelling of political party vote share across England and Wales; ii) the importance of education is over (under) stated for the Liberal Democrats and Labour (Conservative) party vote shares before campaign spending and space are included in the model; iii) all industry proxies appear to be overstated if space is omitted from the model; iv) the effect of home ownership on vote share appears to be over-stated when employing OLS methods, but nevertheless remains important when we use a spatial regression

[3] According to Julia Koschinsky the condition number in GeoDa indicates that multicollinearity might be a problem around a value of 30, so values below 30 are not suggestive of multicollinearity (http://sal.uiuc.edu/pipermail/ openspace/2006-January/000676.html). However documentation from Brown University (http://www.s4.brown.edu/S4/Training/Modul2/GeoDa3FINAL.pdf) indicates that one should be alarmed when the multicollinearity condition number is greater than 20. In no instances in our results is this the case.

approach; and v) campaign spending is important even after spatial autocorrelation. In spite of the observation that space is an important driver of party vote shares, the Breusch-Pagan test statistic (not reported for brevity) consistently indicates that there is still heteroskedasticity in the model even after introducing the spatial lag or spatial error terms. In each case the likelihood ratio tests indicate that the spatial effects models are improvements over the corresponding OLS models.

Assessing the improvement in the models

One method of identifying whether the performance of the model has improved through the inclusion of the campaign spending variable and the use of spatial modelling is to examine the predicted values. For brevity we compare the performance of the first and last regressions for each political party with the actual spatial variation in vote share. LISA cluster maps of the predicted values for the first sets of results – based on the theoretical model by FIELDHOUSE *et al*., (2006) – are presented in Figures 13–15 and predicted values for the final sets of results are presented in Figure 16–18. For comparison we present LISA cluster maps of the actual vote share for each political party in 2005 in Figures 10 – 12.

{Insert Figures 10–18 about here}

The performance of the FIELDHOUSE *et al*. (2006) theoretical model for the Liberal Democrats is shown in Figure 13. Areas of good predictive performance exist (such as the South West), but so do areas of important inaccuracies (such as Wales but also for a large area from Hull to Lancaster). Our augmentation of their model to include party spending and estimated using spatial regression are presented in Figure 16. When our predicted values are compared with the actual results there is a high level of similarity, and much smaller inaccuracies in predictions. Our model correctly predicts much of the vote share in the South West and does not over-predict the values for Wales or North Yorkshire. However there are some inaccuracies in the West Midlands. We take the view that no model perfectly captures reality, but it appears that the introduction of spending and spatial factors appear to have greatly improved the model's predictive capacity.

Although FIELDHOUSE *et al*. (2006) focused on the Liberal Democrats, we continue to use their model to identify the predictive performance for the other two main political parties. For the Conservative party, the actual vote share patterns are presented in Figure 11; their model's predictions are presented in Figure 14 and the pattern of predictions of their model with our spending and spatial augmentations is presented in Figure 17. Our extensions of this model to include space and political party spending have only a limited amount of success when it is applied to the Conservative party. The extensions capture more of the spatial pattern around Peterborough, Cambridge and Northampton but perform relatively poorly around Reading, Oxford, Huddersfield and for whole swathes of Wales. Our conclusion from these maps is that the incorporation of spatial and spending effects does not drastically improve a model which is not necessarily geared around explaining Conservative party vote share – the underlying theoretical model should be the correct one in the first instance.

In spite of the results of the model for the Conservative party, we reapply the FIELDHOUSE *et al*. (2006) theoretical model to predict Labour party vote share. The results of their model

predict the low vote share for much of the South West and the South Downs, and the high vote shares in the urban centres of Liverpool, Manchester, Sheffield and Doncaster. However the model under-predicts the vote share in parts of Wales and for a whole corridor of parliamentary constituencies from Bridlington to Morecombe and, at the same time, over predicts vote share along a corridor between Oxford and Southampton. When we introduce space and party spending into the model we find a large improvement in the model. The model now appears to accurately predict the Labour party vote shares for much of England and Wales with a few exceptions, most notably the under prediction of the Labour party vote share between the Vale of York to Morecombe and a few parliamentary constituencies in East Anglia.

Our analysis of the predicted residuals from the application of the augmented FIELDHOUSE *et al*. (2006) model to all three major political parties illustrates that the incorporation of spending and spatial effect into the model improves the model's performance, although the performance is particularly improved for the Liberal Democrats and the Labour parties and less so for the Conservative party. It also illustrates that this FIELDHOUSE *et al*. model could be applied to predict the Labour party vote share as well as the Liberal Democrats, as it was originally proposed for. However this does lead us to question whether the spatial effects of the explanatory variables vary between these political parties. For instance the spatial heterogeneity of explanatory variables may well vary in importance for each political party.

Spatial autocorrelation of explanatory variables

It is important to identify the source of this spatial autocorrelation in the model. In an attempt to identify whether the covariates are particularly influenced by space we estimate a further set of three regressions. We are attempting to identify what factors affect party vote share so we include the covariates discussed throughout as before but we also include compound variables where the aforementioned covariates are multiplied by the queen weight matrix. Hence, we are explicitly including both the traditional socio-economic explanatory variables of party vote share along with the spatial autocorrelation of each explanatory variable. The results, generated in STATA v9, are presented in Table 2.

{Insert Table 2 about here}

According to the log-likelihood test, the models for the Liberal Democrat and Labour parties are improved through the inclusion of these extra compound explanatory covariates. This is not the case for the regression of the Conservative party vote share. The results of the regression for the Conservative party indicate that the non-compound variables remain at a similar magnitude and statistical significance. Along with this covariate stability are indications that space is still important; this can be identified through the Moran's I (residuals) statistic and that there appears to be an impact of spatial autocorrelation of the covariates, including the campaign spending covariates. Such results indicate that there can be confidence that the socio-economic covariates may be stable irrespective of the inclusion of spatial factors.

The most interesting set of results from this table is the analysis of Liberal Democrat support. Once we take into consideration the impact of spatial autocorrelation through the socio-economic explanatory variables, we come to the conclusion that space plays a vital role in the Liberal Democrats' electoral performance. It appears that the main factor behind Liberal

Democrat support is party spending; this is the case for own party spending and for own party spending with spatial autocorrelation. The magnitude of the coefficient for the Liberal Democrat campaign spending variable is the largest of any political party. Here we can conclude that local party activism, through the proxy party spending, is the most important influence of Liberal Democrat vote share, once spatial variation has been taken into account. Bearing in mind many, if not all, aggregate analyses of Liberal Democrat support have ignored possible spatial effects, this finding strengthens recent scholarly evidence regarding the importance of place based local activism on Liberal Democrat electoral performance (RUSSELL and FIELDHOUSE, 2005; CUTTS, 2006a, 2006b)..

6. Conclusion

There is a growing body of literature which suggests that voting patterns are not independent from space. Voting patterns can be spatially dependent because people interact with their material environment (JOHNSTON and PATTIE, 2006). Although many studies indicate that spatial factors might be influencing party vote shares, few empirical studies take explicit account of spatial factors in their empirical analyses.

This paper has sought to take explicit account of spatial heterogeneity in vote share across constituencies in England and Wales at the 2005 general election. Building on the theoretical and empirical contributions in the literature to date, this paper integrates spatial autocorrelation into the modelling analysis through the use of spatial regression. Our results indicate that the importance of spatial autocorrelation varies for each political party. As shown by the regression results, one of the major consequences of ignoring spatial effects is biased results, with the determinants of party vote share being either over or under stated when space is omitted from the analysis. Moreover, likelihood ratio tests confirm that the spatial effects models are marked improvements on the original OLS models. Similarly, an examination of predicted residuals for all the three parties reiterates the improvement in model performance after taking account of spending and spatial effects.

Space is found to play a vital role in the Liberal Democrats' electoral performance. It appears that the main factor behind Liberal Democrat support is party spending; this is the case for own party spending and for own party spending with spatial autocorrelation. This provides further proof that intensive grassroots campaigning is particularly salient to the electoral fortunes of the Liberal Democrats. This is in contrast to the drivers of the vote shares for the Conservative party, which appears to be much less influenced by spatial factors, and for the Labour party, where space plays an important but smaller effect. In summary, this paper provides a blueprint for future aggregate analyses of party performance at the constituency level. It is clear that future regression models of voting at the constituency scale must explicitly take account of spatial heterogeneity in order to correctly identify the strength and importance of factors that affect parties' electoral performance.

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Figure 1: Moran's I scatter plot of Liberal Democrats party performance in 2005

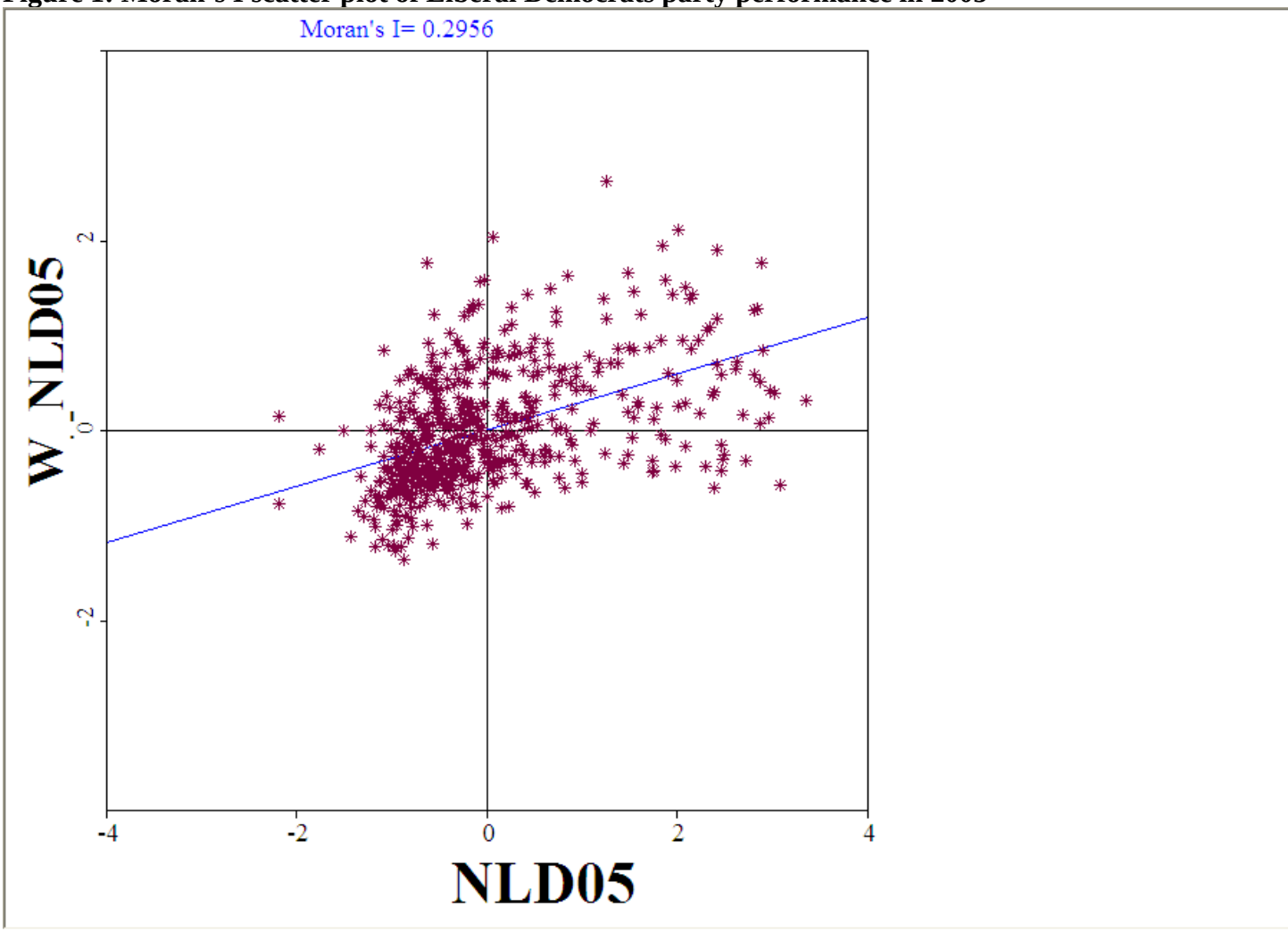

Figure 2: Moran's I scatter plot of Conservatives party performance in 2005

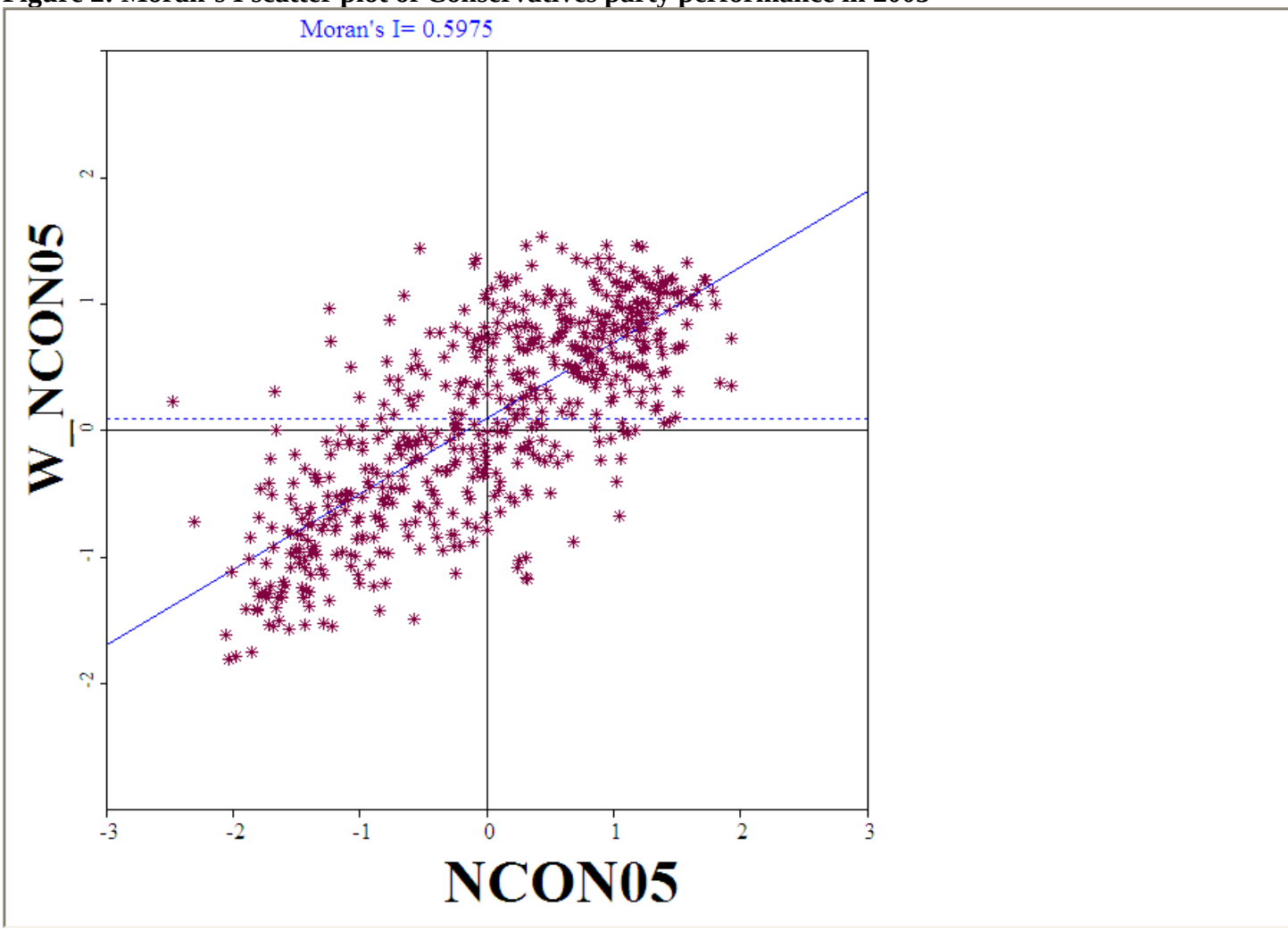

Figure 3: Moran's I scatter plot of Labour party performance in 2005

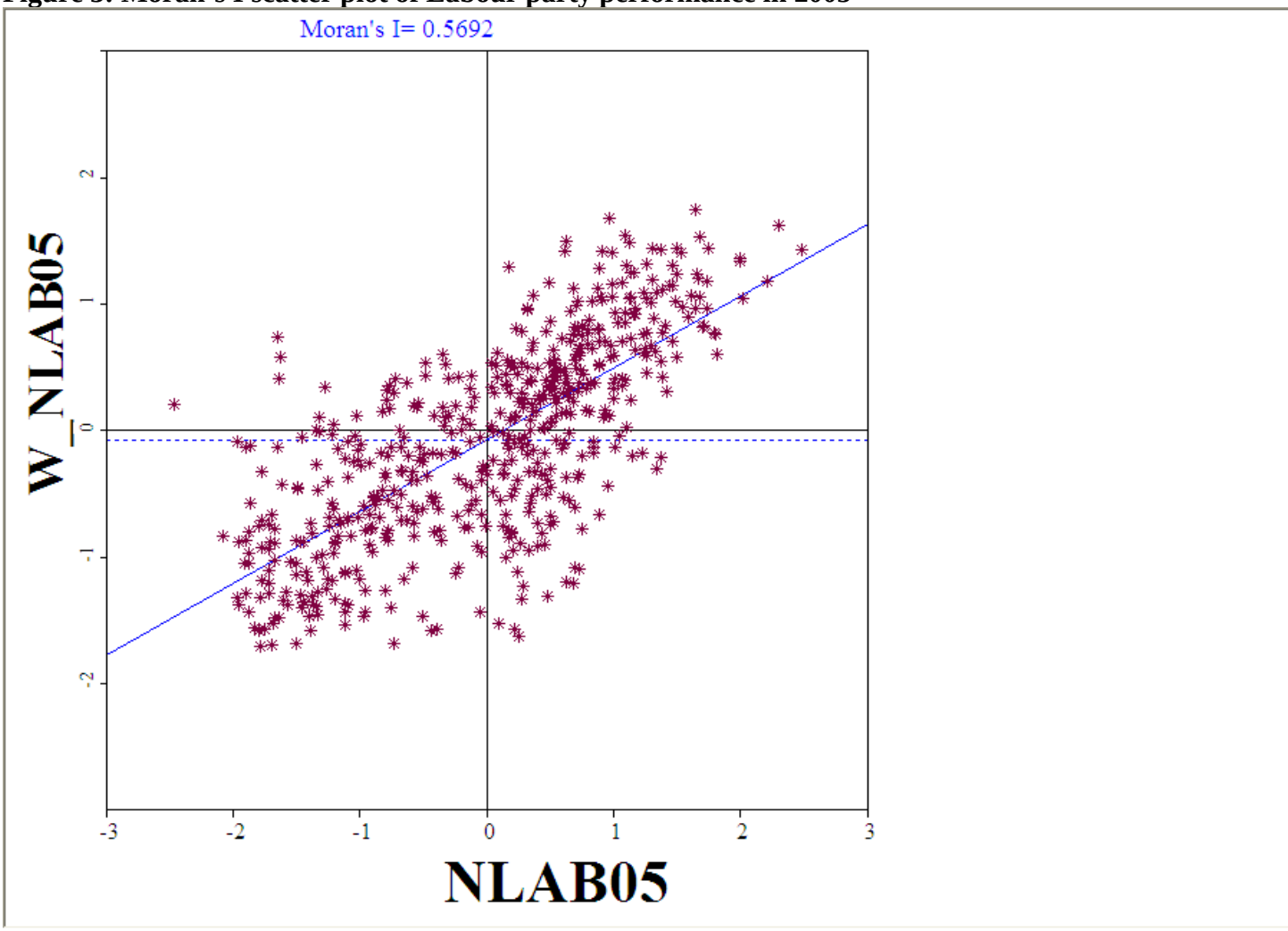

Figure 4: Moran's I scatter plot of Liberal Democrat party spending in 2005

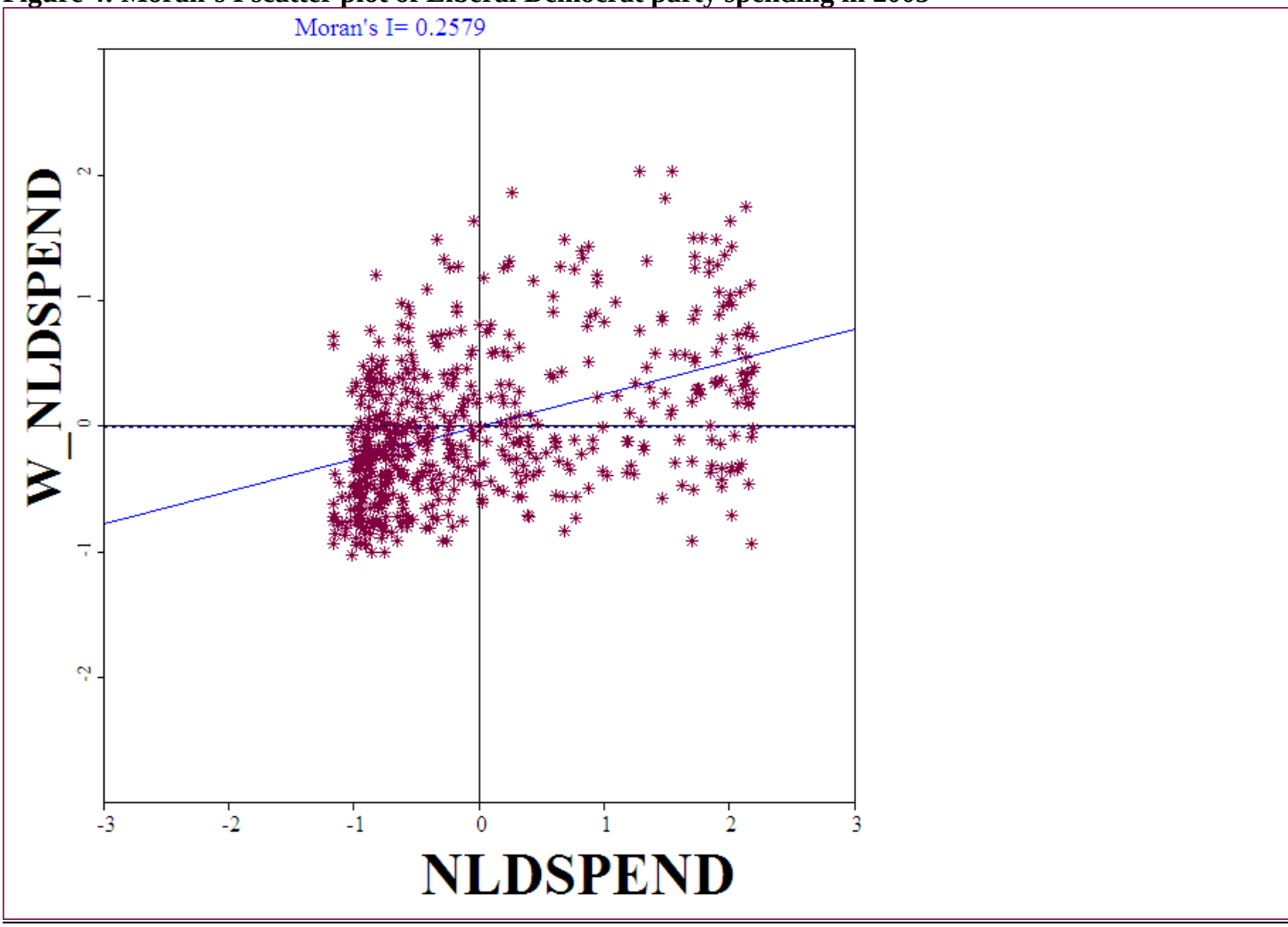

Figure 5: Moran's I scatter plot of Conservative party spending in 2005

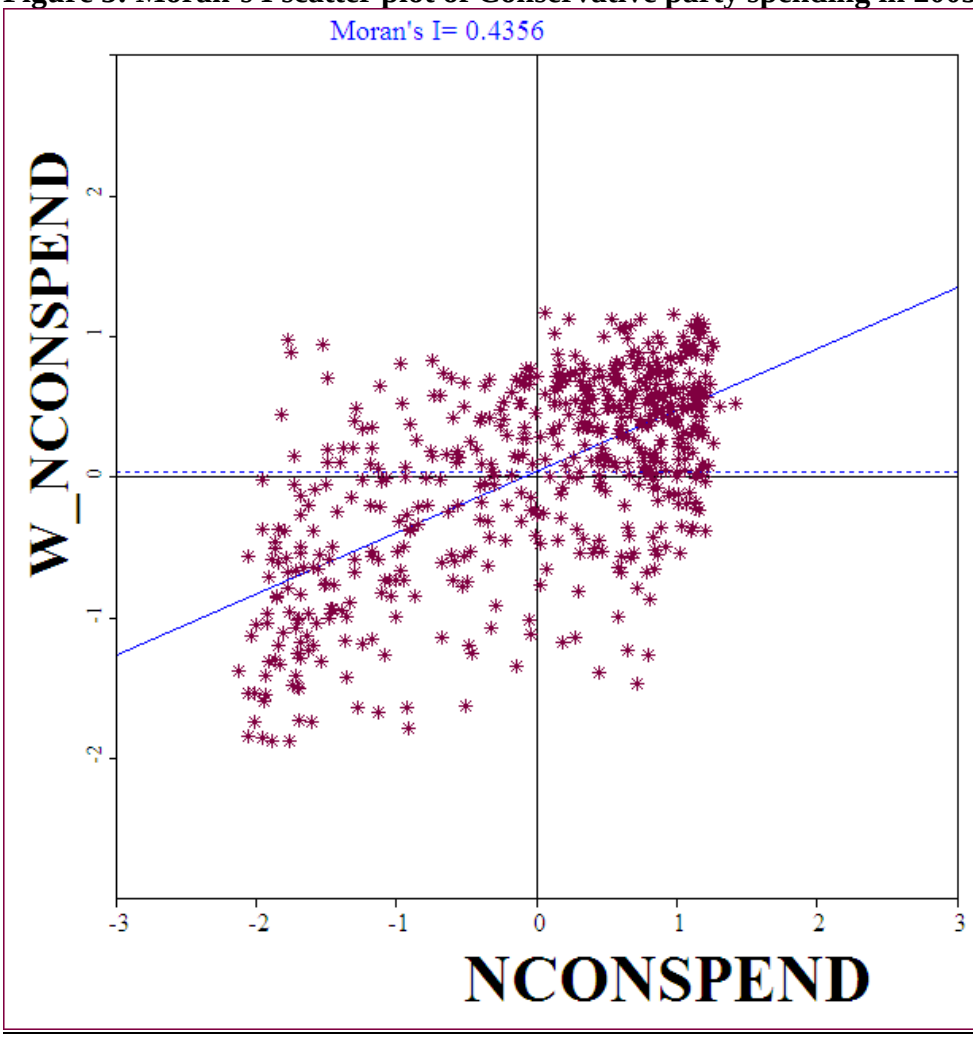

Figure 6: Moran's I scatter plot of Labour party spending in 2005

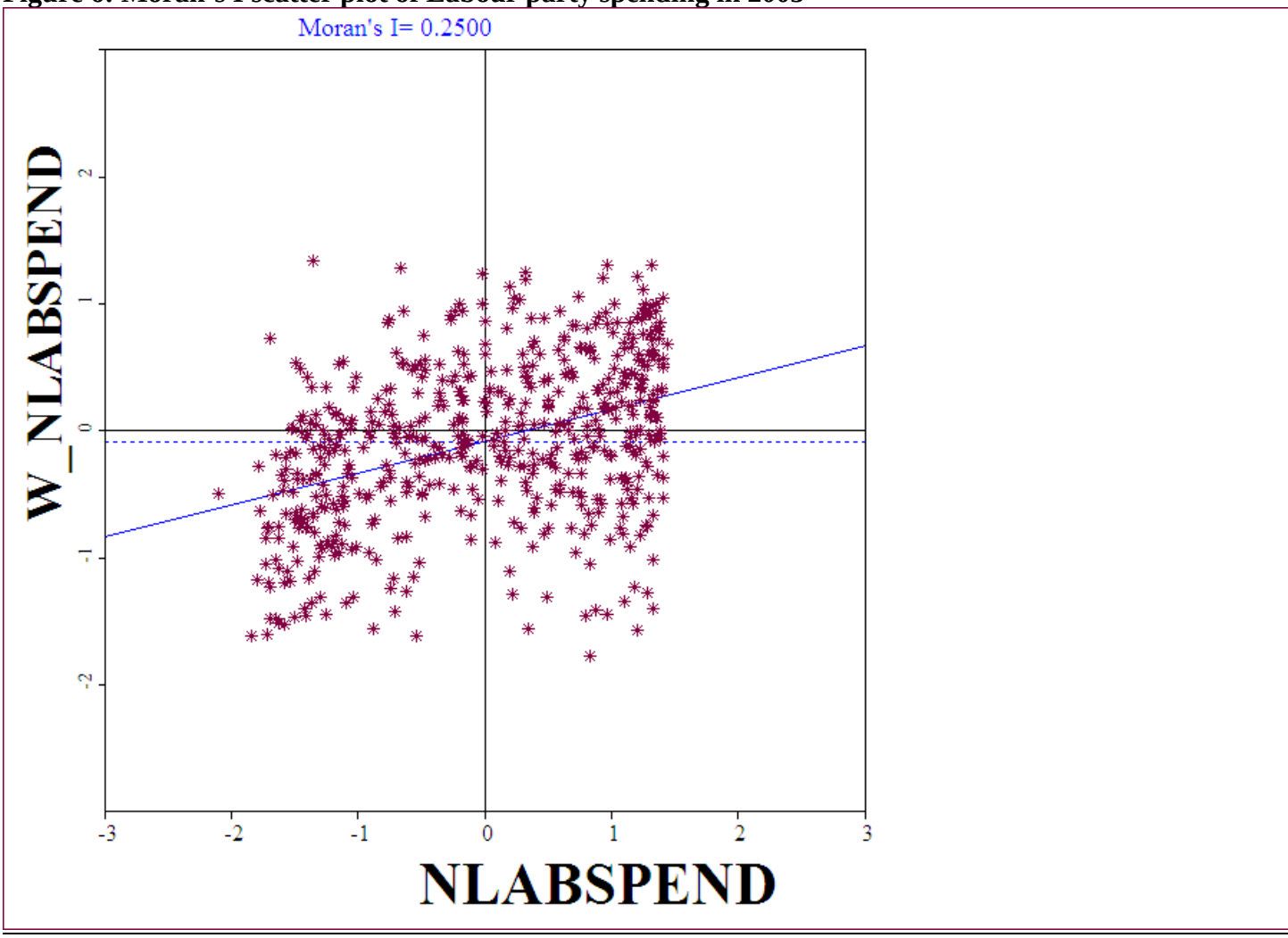

Figure 7: LISA cluster map of Liberal Democratic Party spending

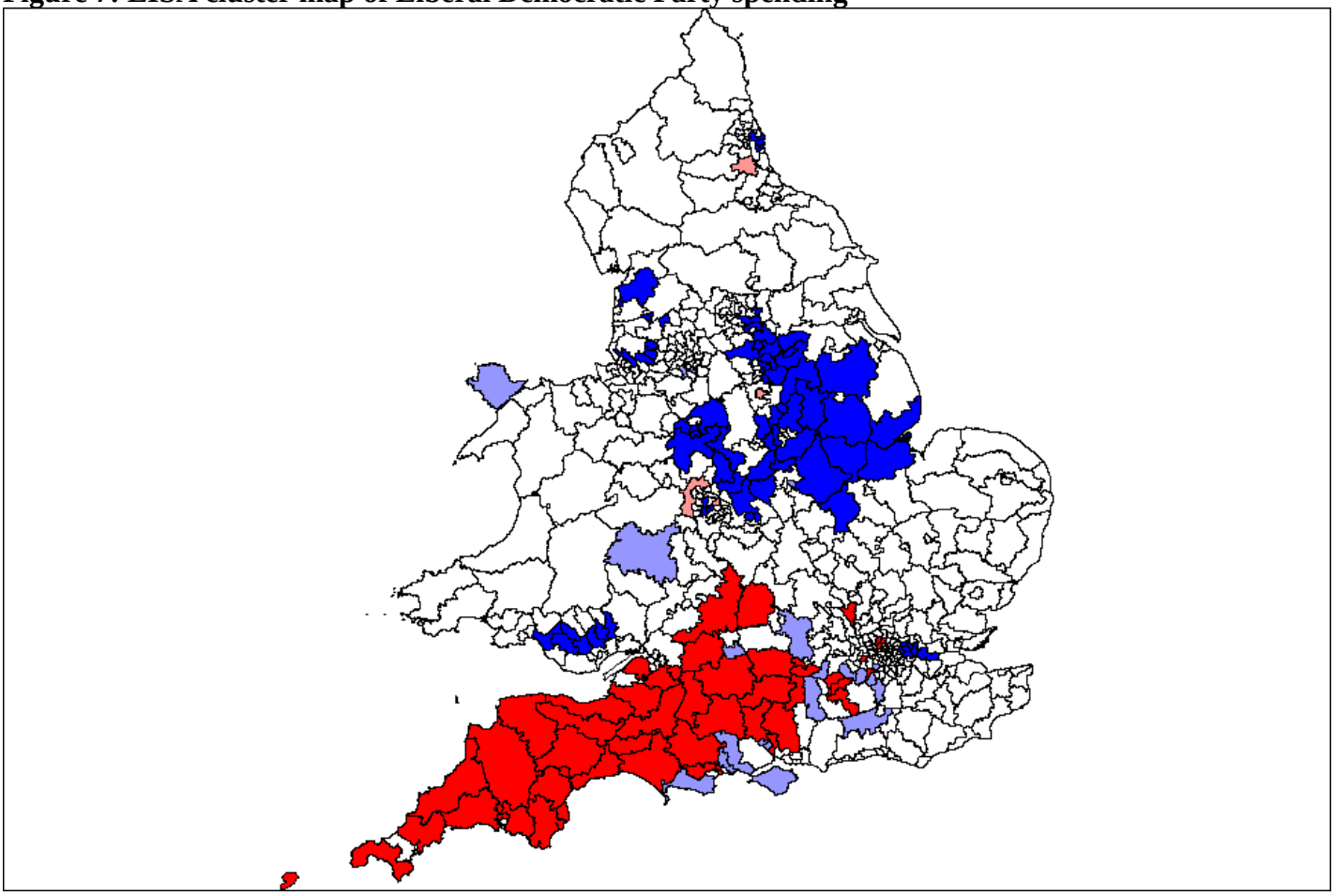

Figure 8: LISA cluster map of Conservative Party spending

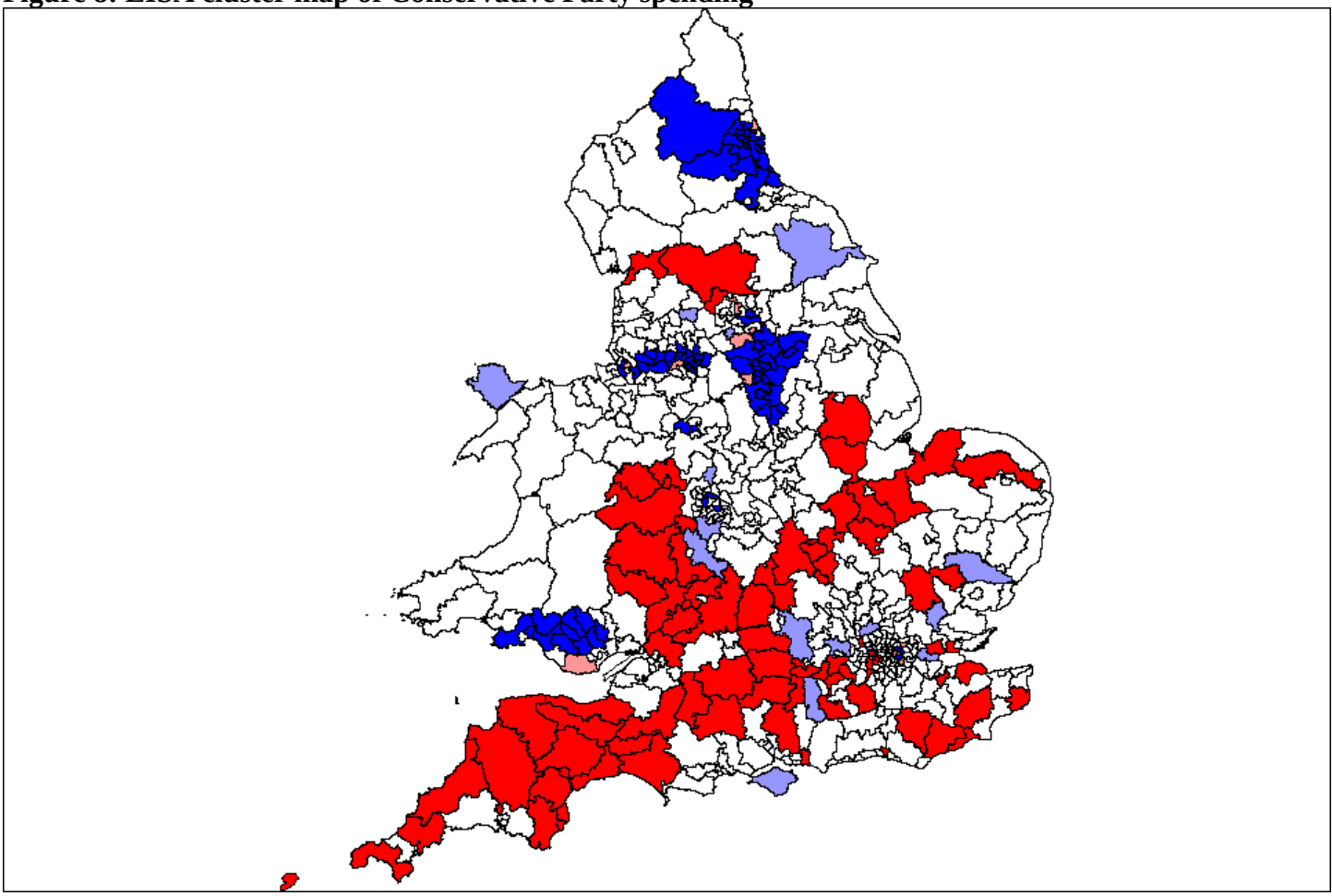

Figure 9: LISA cluster map of Labour Party spending

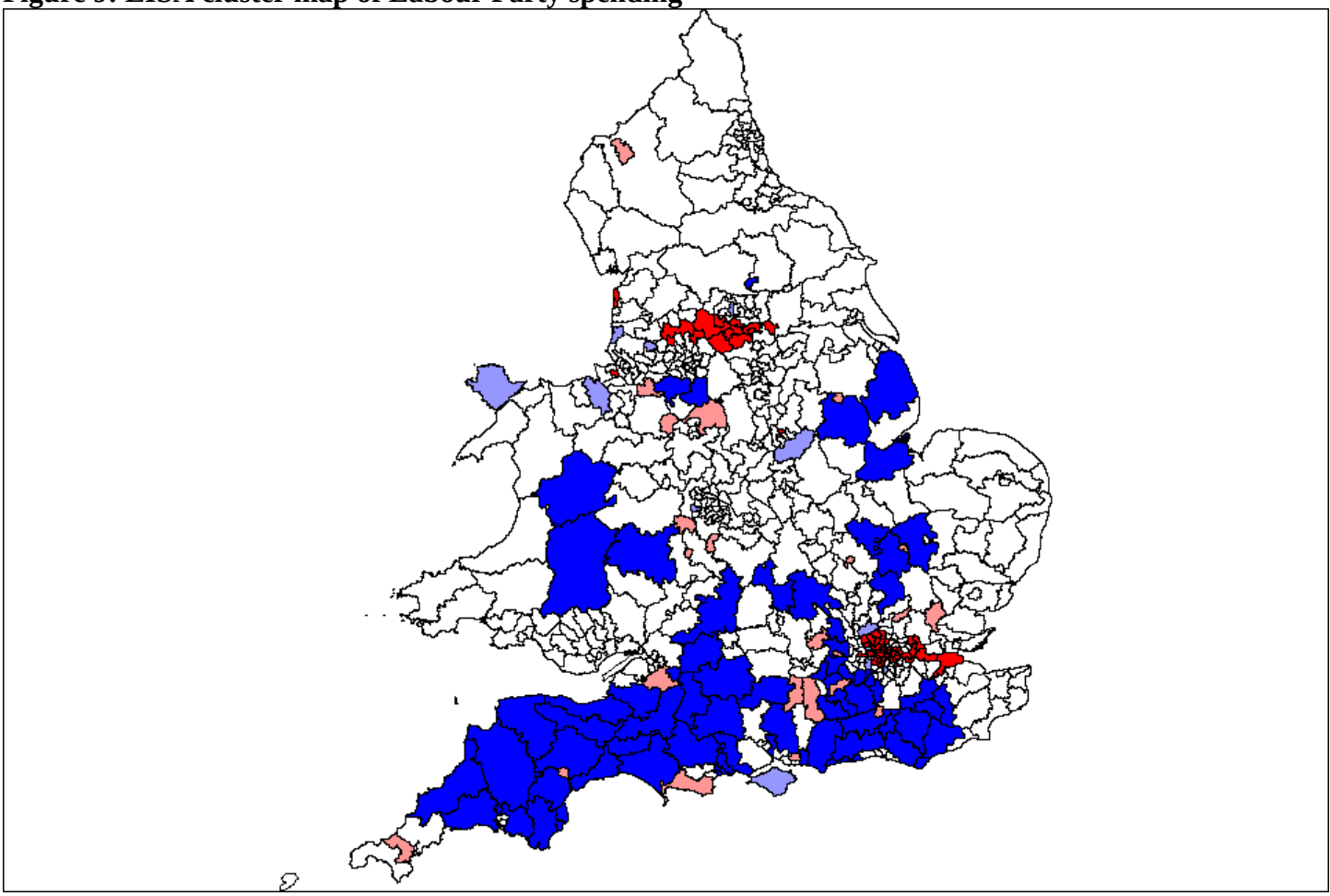

Figure 10: LISA cluster map of Liberal Democrat actual values

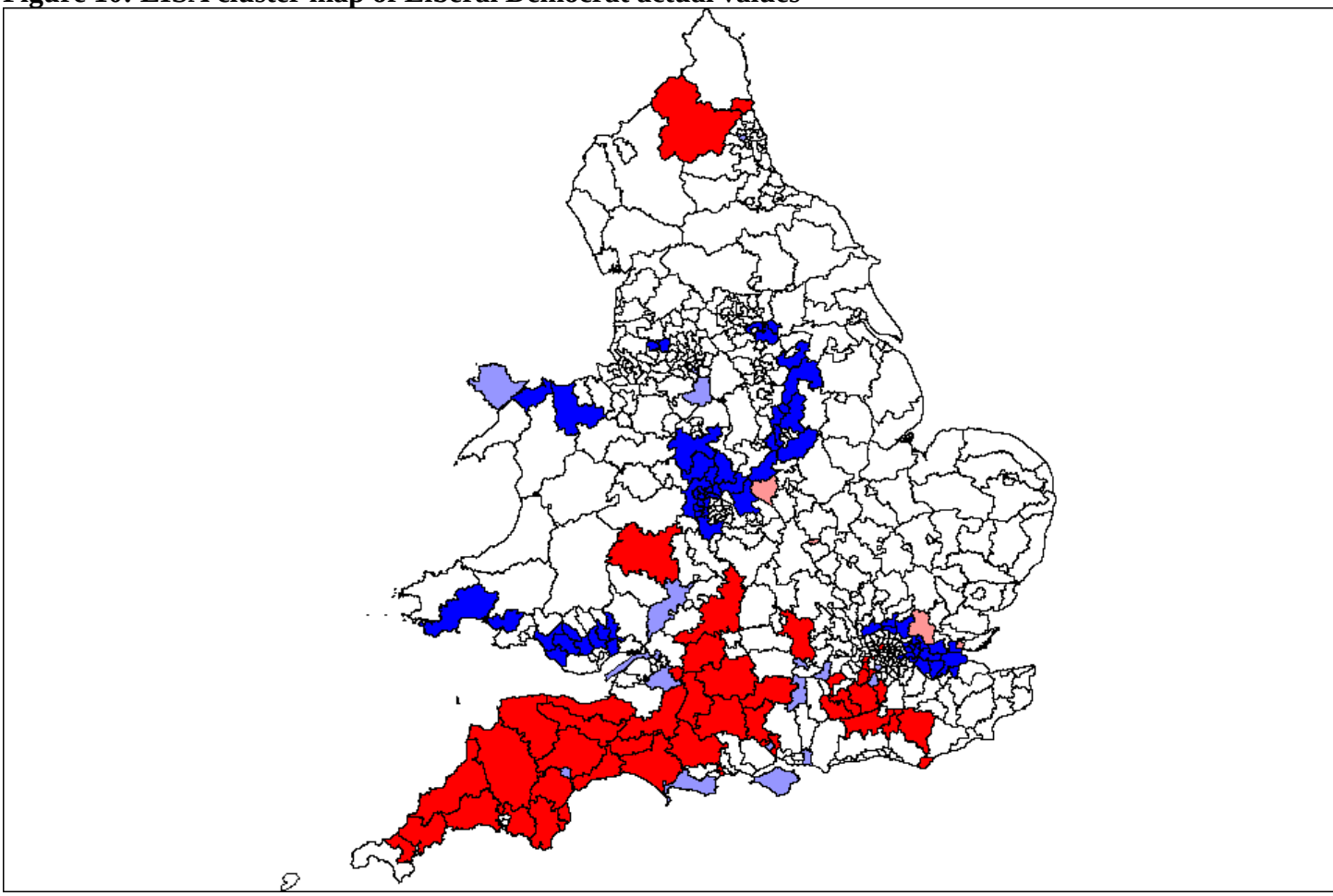

Figure 11: LISA cluster map of Conservative actual values

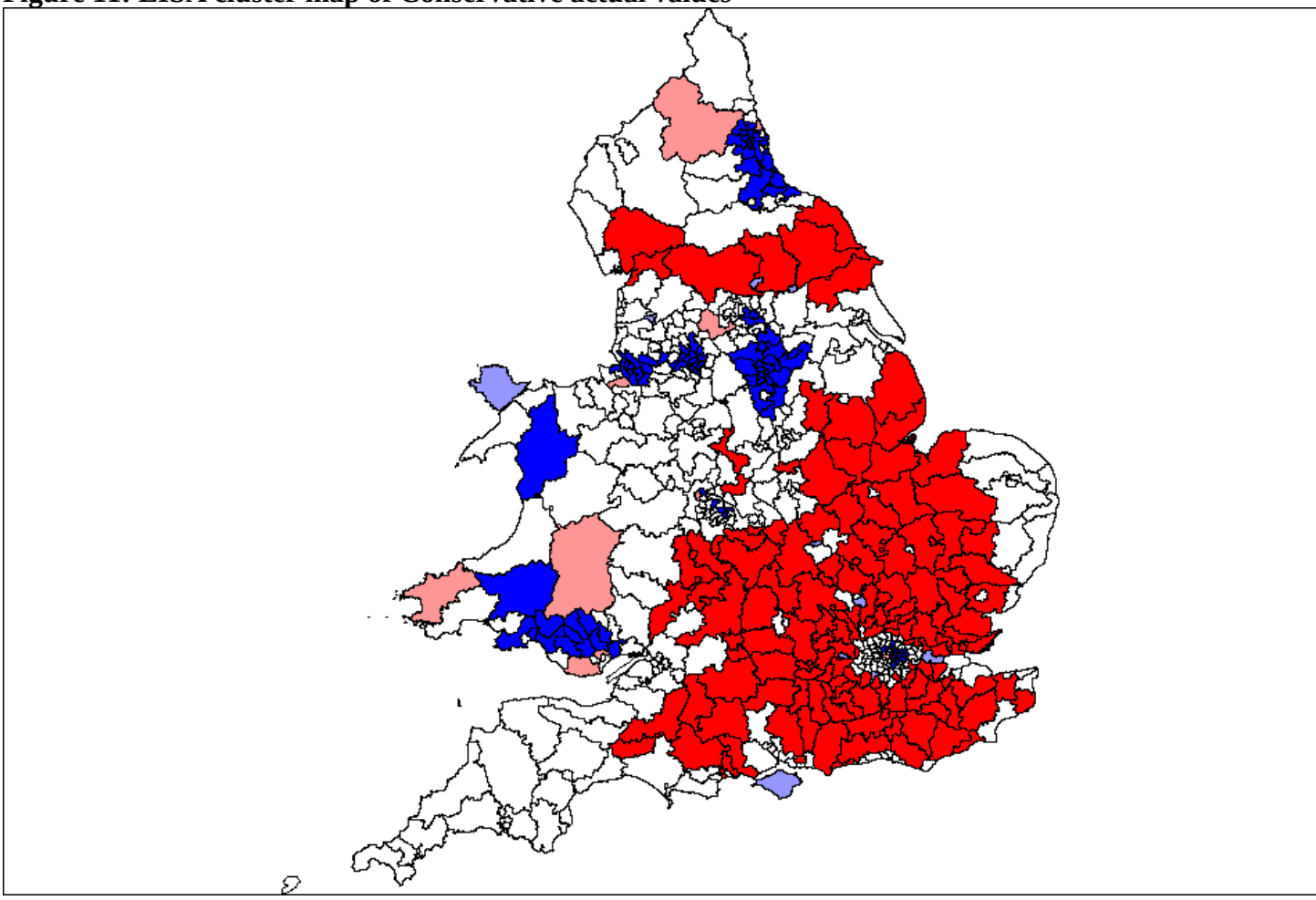

Figure 12: LISA cluster map of Labour actual values

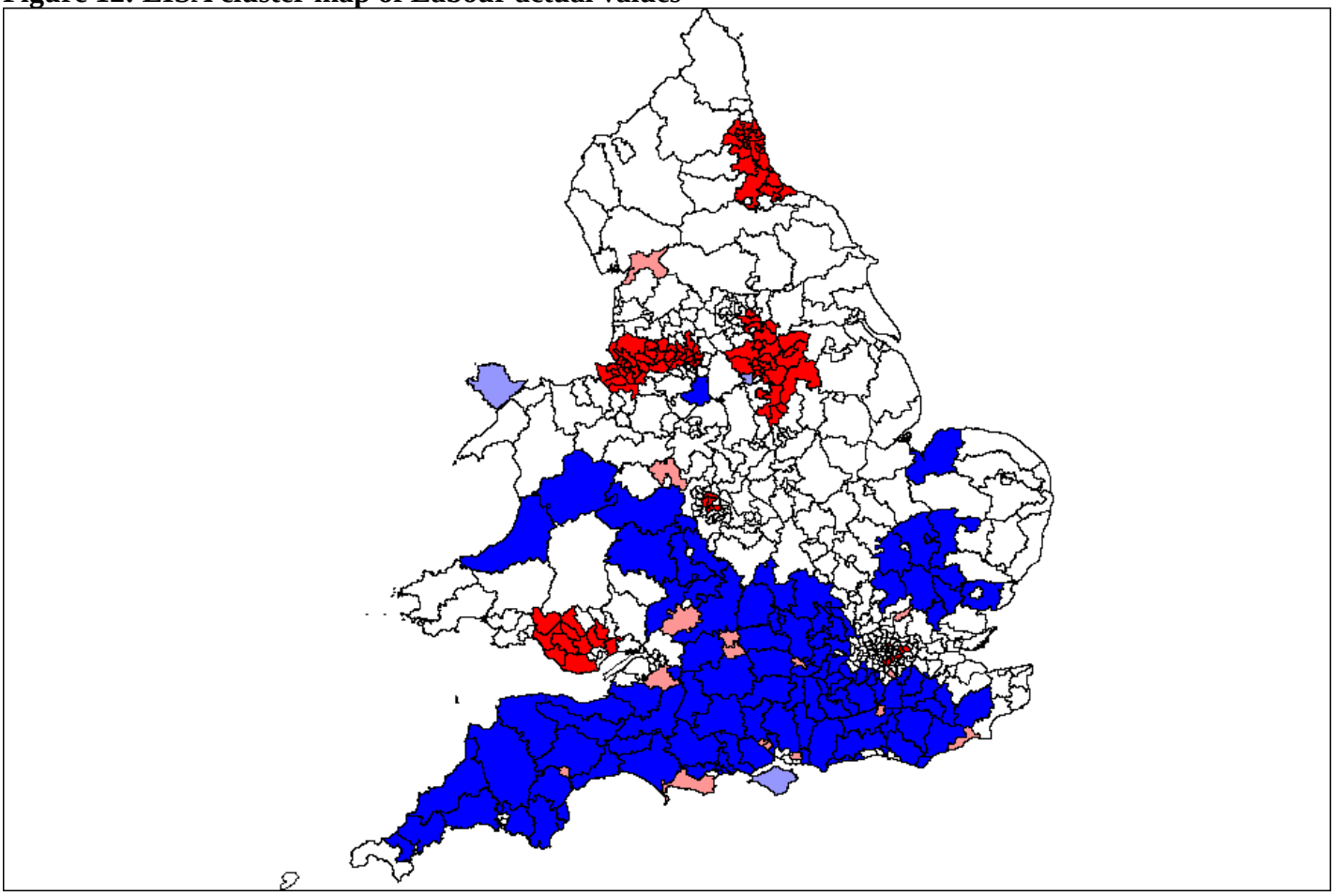

Figure 13: LISA cluster map of Liberal Democrat predicted values based on the FIELDHOUSE *et al*. (2006) model

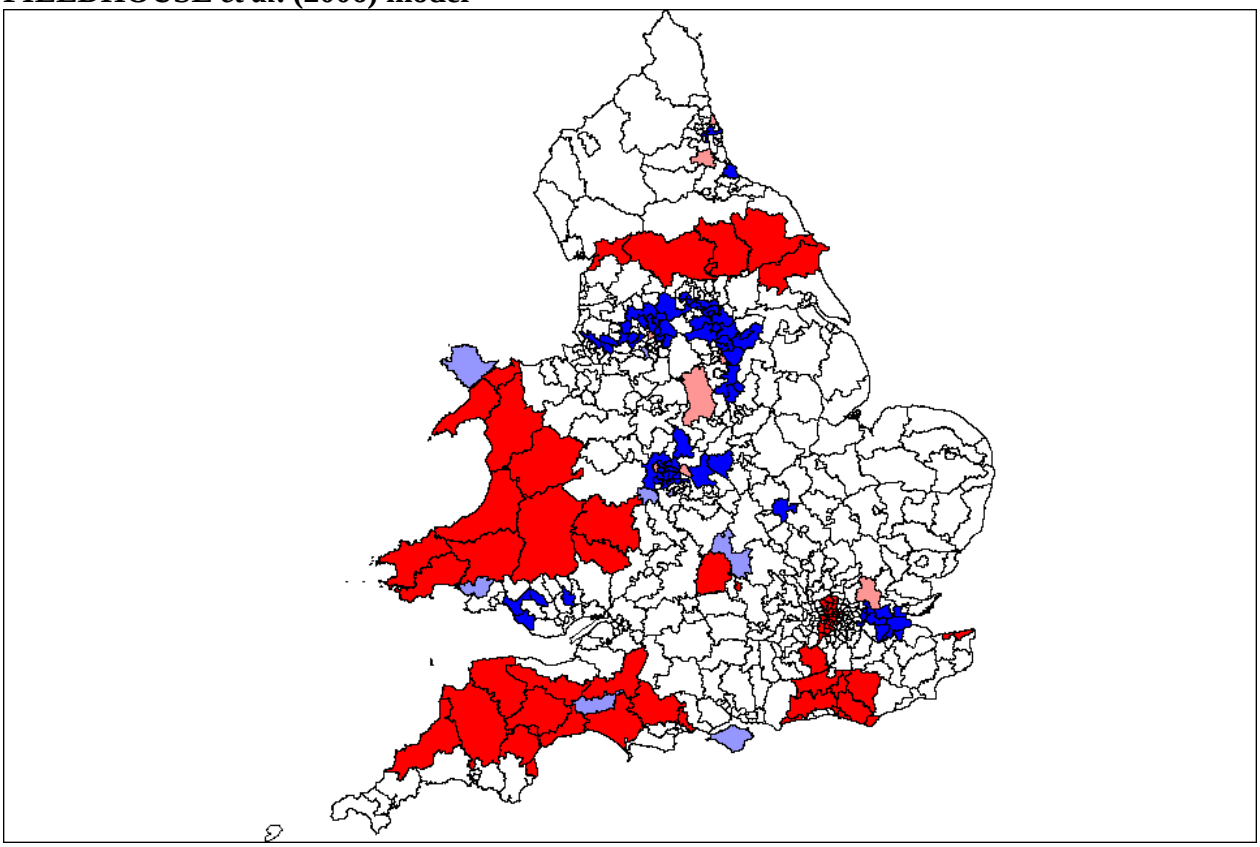

Figure 14: LISA cluster map of Conservative predicted values based on the FIELDHOUSE *et al*. (2006) model

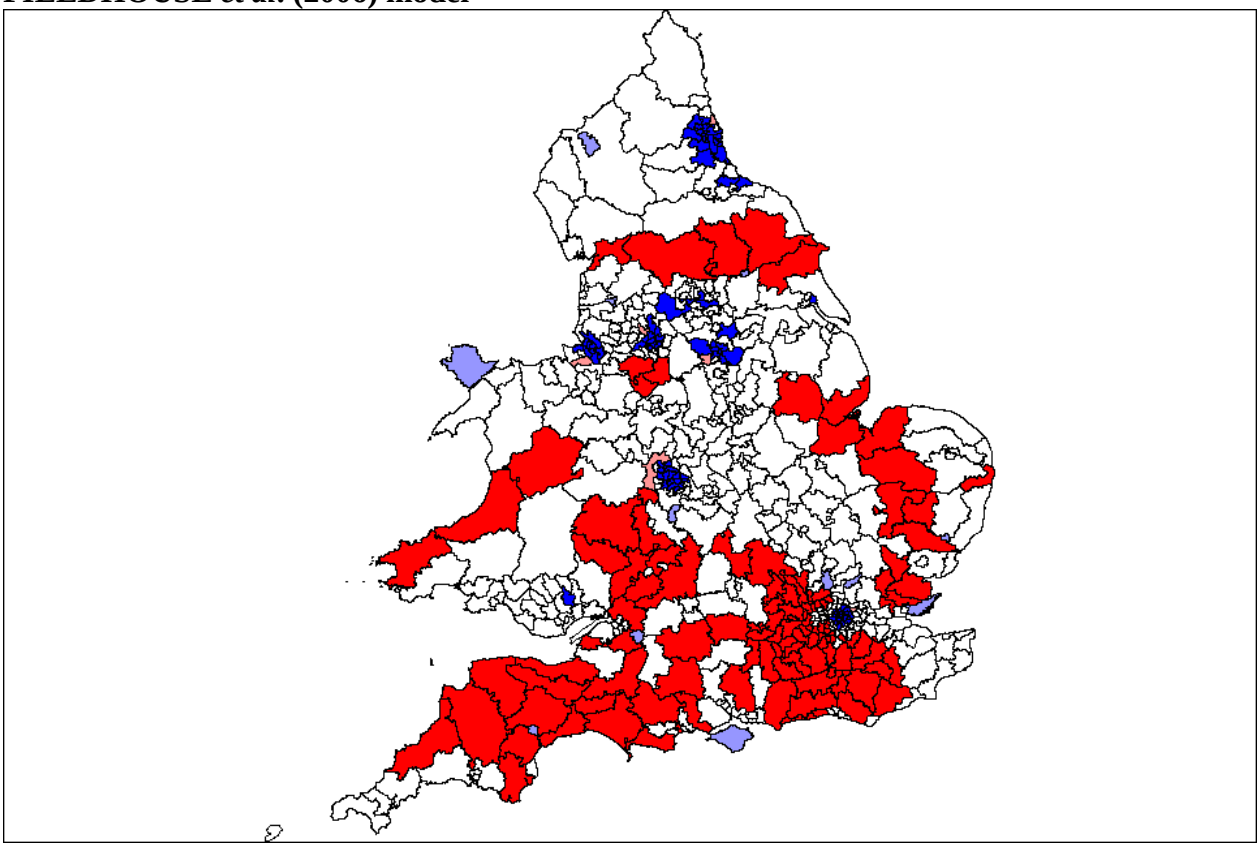

Figure 15: LISA cluster map of Labour predicted values based on the FIELDHOUSE *et al.* (2006) model

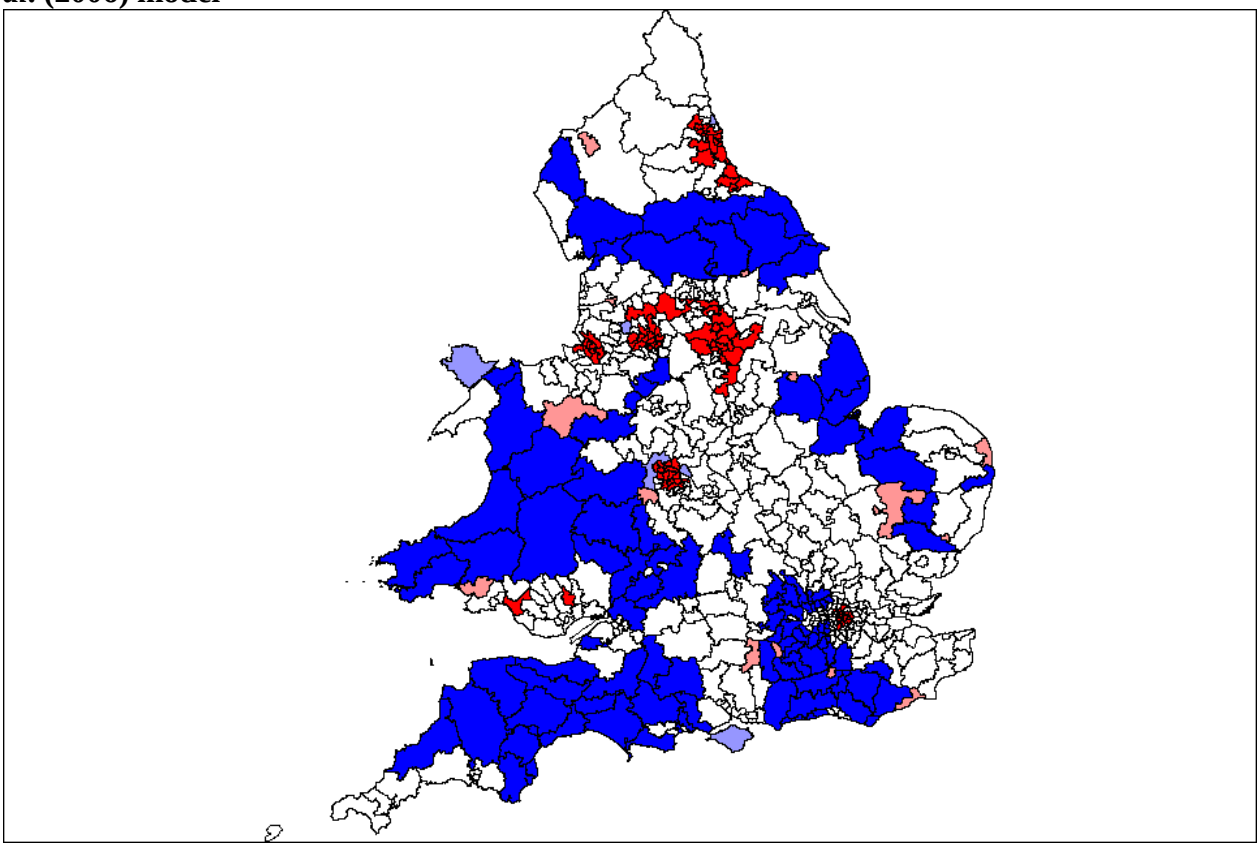

Figure 16: LISA cluster map of Liberal Democrat predicted values based on final model

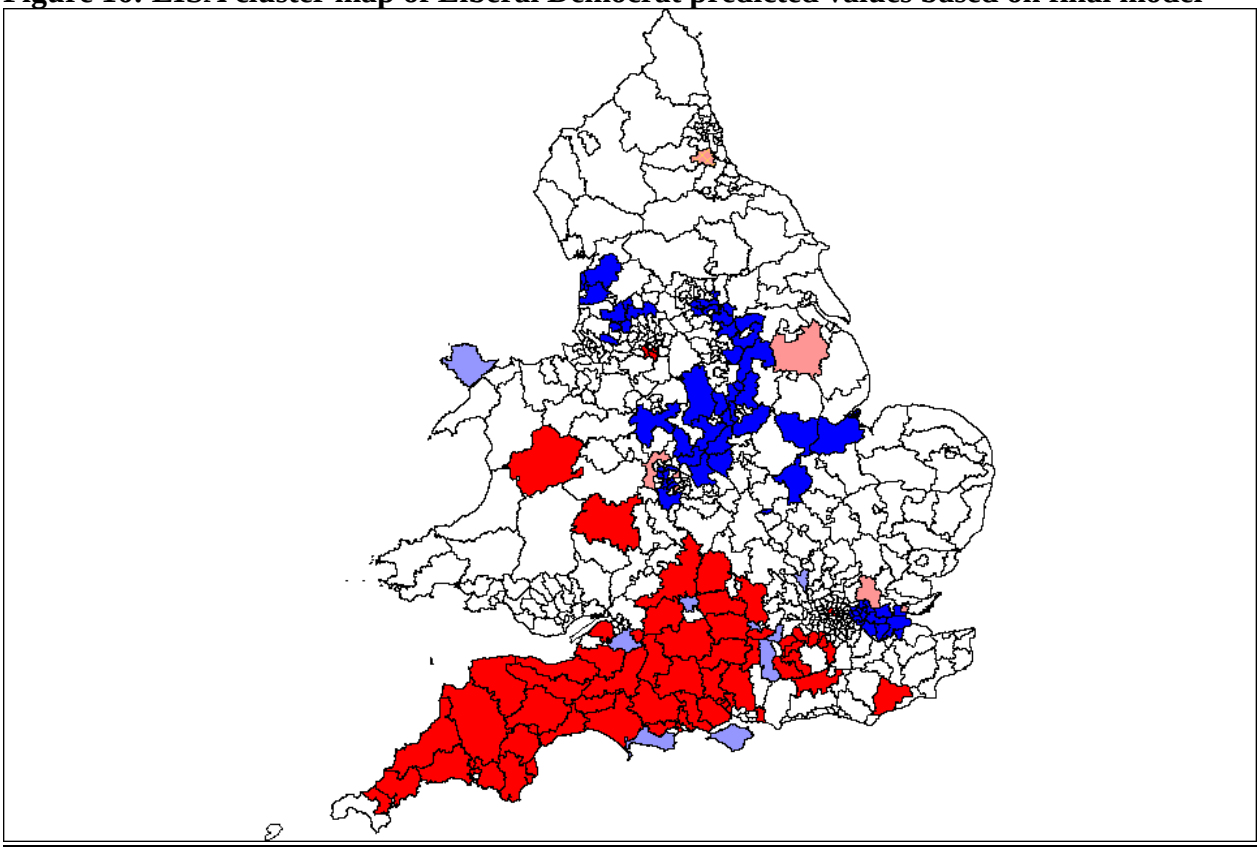

Figure 17: LISA cluster map of Conservative predicted values based on final model

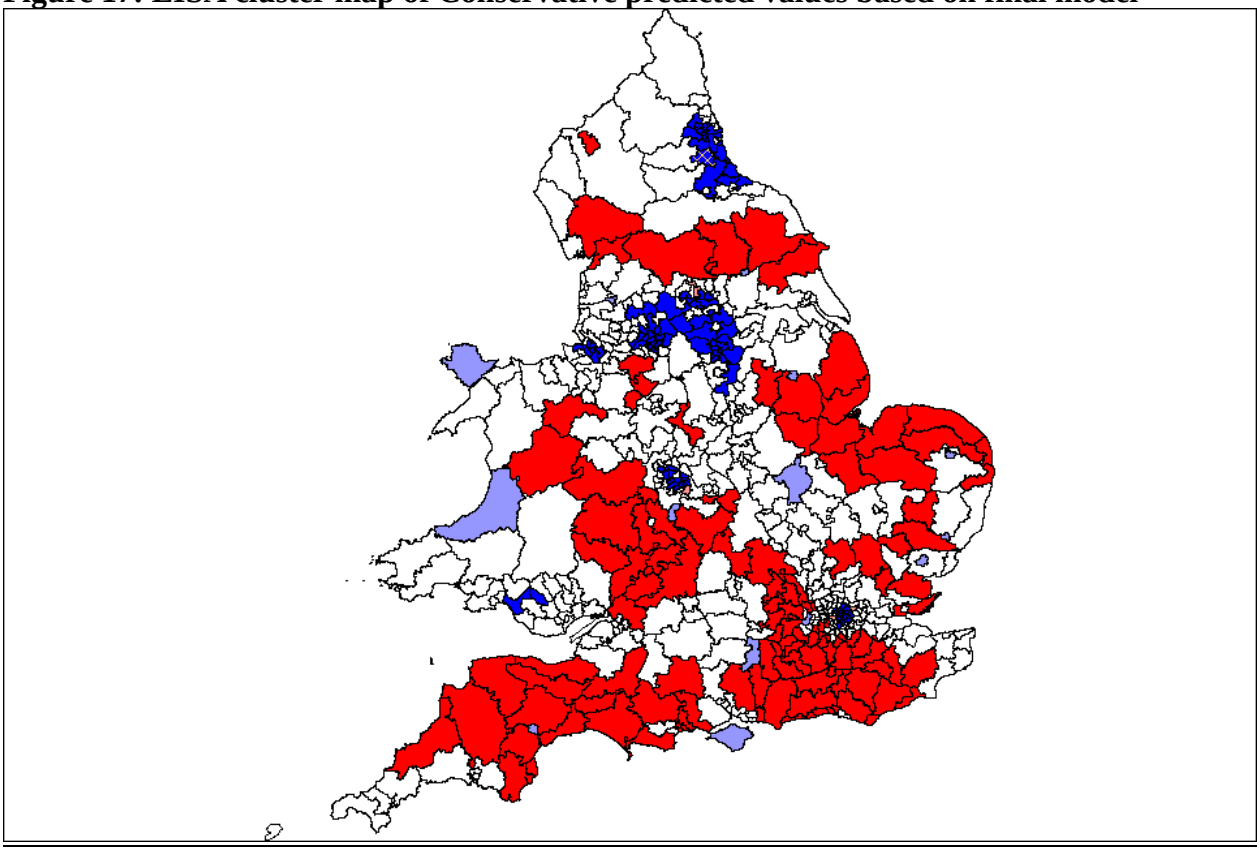

Figure 18: LISA cluster map of Labour predicted values based on final model

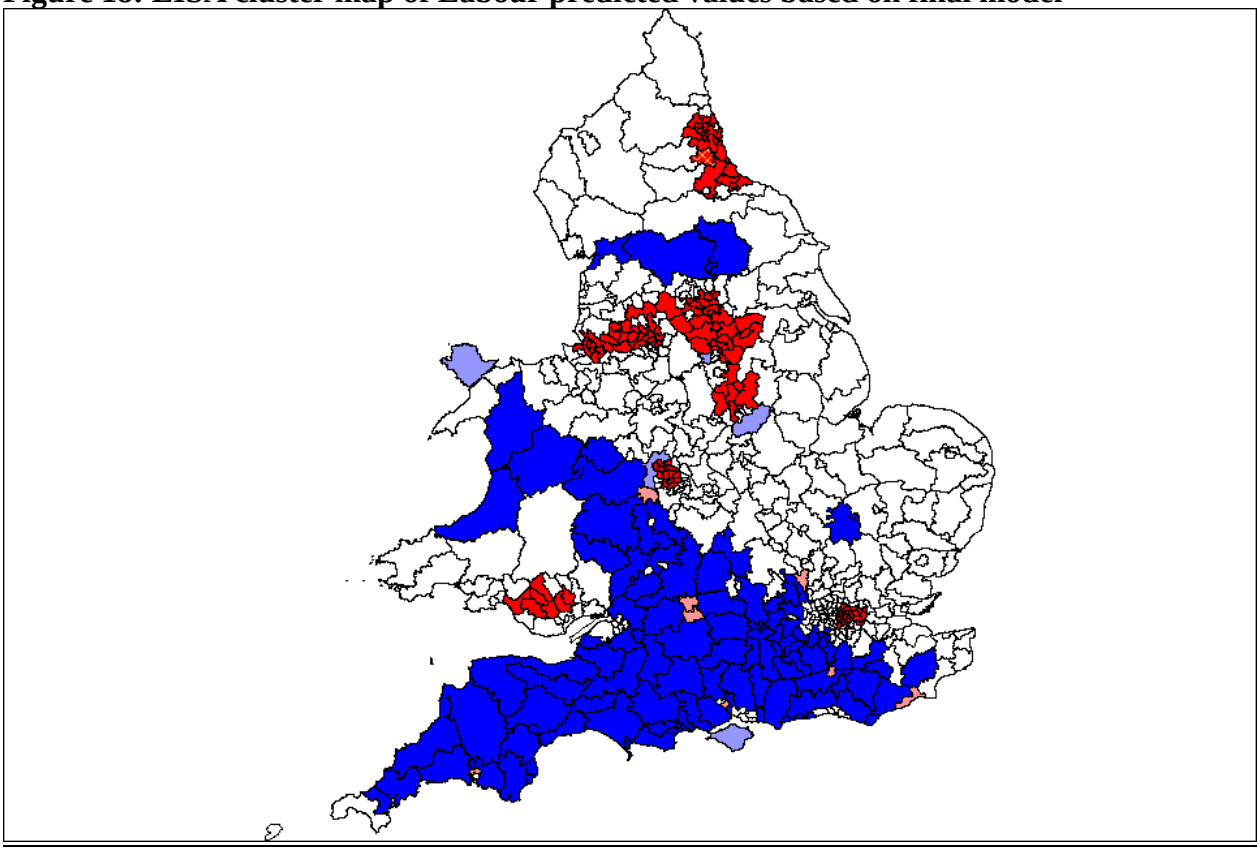

Table 1: Vote shares

Political party	Liberal Democrats				Conservatives				Labour			
Method of Estimation	OLS	Spatial Lag	OLS	Spatial Lag	OLS	Spatial Error	OLS	Spatial Error	OLS	Spatial Error	OLS	Spatial Lag
Intercept	-0.000 (0.037)	0.001 (0.053)	0.000 (0.021)	0.000 (0.020)	-0.000 (0.027)	-0.070 (0.077)	0.000 (0.020)	-0.004 (0.058)	0.000 (0.026)	-0.002 (0.057)	0.000 (0.029)	0.026 (0.016)
Degrees	**0.252** (0.054)**	**0.190** (0.050)**	**0.073* (0.032)**	**0.061* (0.032)**	**0.358** (0.039)**	**0.364** (0.046)**	**0.198** (0.033)**	**0.291** (0.039)**	**-0.428** (0.038)**	**-0.039** (0.047)**	**-0.216** (0.029)**	**-0.194** (0.026)**
Manufacturing	-0.094 (0.048)	-0.051 (0.045)	-0.017 (0.027)	-0.005 (0.027)	**-0.183** (0.035)**	**-0.143** (0.041)**	**-0.147** (0.027)**	**-0.135** (0.034)**	**0.168** (0.034)**	**0.126** (0.052)**	**0.098** (0.024)**	**0.072** (0.021)**
Agriculture	**0.165** (0.044)**	**0.131** (0.041)**	0.025 (0.026)	0.021 (0.026)	**0.180** (0.032)**	**0.225** (0.030)**	**0.051** (0.026)**	**0.136** (0.027)**	**-0.341** (0.031)**	**-0.320** (0.045)**	**-0.172** (0.023)**	**-0.133** (0.021)**
Pensioners	**0.194* (0.054)**	**0.134** (0.050)**	0.016 (0.031)	0.003 (0.030)	0.046 (0.039)	**0.173** (0.035)**	0.027 (0.031)	**0.146** (0.030)**	**-0.197** (0.038)**	**-0.193** (0.038)**	**-0.081** (0.027)**	**-0.070** (0.024)**
Students	**0.174** (0.061)**	**0.157** (0.056)**	0.064 (0.034)	0.063 (0.033)	0.041 (0.044)	0.039 (0.032)	0.038 (0.034)	**0.054* (0.027)**	**-0.143** (0.043)**	**-0.119** (0.036)**	**-0.075** (0.030)**	-0.036 (0.027)
Muslims	0.008 (0.046)	0.010 (0.043)	-0.030 (0..026)	-0.028 (0.025)	0.001 (0.033)	-0.037 (0.028)	0.007 (0.026)	-0.023 (0.024)	**-0.112** (0.033)**	**-0.068* (0.031)**	**-0.094** (0.023)**	**-0.095** (0.020)**
WorKING in education	0.072 (0.053)	**0.102* (0.049)**	0.053 (0.030)	**0.064* (0.030)**	**-0.278** (0.039)**	**-0.244** (0.036)**	**-0.188** (0.030)**	**-0.196** (0.030)**	**0.161** (0.038)**	**0.102** (0.038)**	**0.111** (0.027)**	0.041 (0.024)
Home ownership	0.023 (0.051)	0.030 (0.048)	-0.017 (0.032)	-0.010 (0.031)	**0.661** (0.037)**	**0.445** (0.036)**	**0.423** (0.032)**	**0.362** (0.031)**	**-0.507** (0.037)**	**-0.369** (0.039)**	**-0.324** (0.028)**	**-0.266** (0.025)**
Lib Dem campaign spending	–	–	**0.746** (0.024)**	**0.719** (0.025)**	–	–	**-0.218** (0.025)**	**-0.205** (0.020)**	–	–	**-0.293** (0.022)**	**-0.259** (0.020)**
Conservative campaign spending	–	–	**-0.135** (0.027)**	**-0.135** (0.027)**	–	–	**0.490** (0.028)**	**0.292*** (0.024)**	–	–	**-0.251** (0.024)**	**-0.158** (0.022)**
Labour campaign Spending	–	–	**-0.259** (0.025)**	**-0.246** (0.024)**	–	–	**-0.223** (0.025)**	**-0.153** (0.020)**	–	–	**0.298** (0.022)**	**0.266** (0.019)**
Spatial error	–	–	–	–	–	**0.758** (0.032)**	–	**0.725** (0.034)**	–	**0.637** (0.041)**	–	–
Spatial lag	–	**0.402** (0.050)**	–	**0.140** (0.036)**	–	–	–	–	–	–	–	**0.323** (0.028)**
Moran's I (residuals)	0.223**	–	0.063**	–	0.500**	–	0.366**	–	0.418**	–	0.294**	–
Lagrange multiplier diagnostic tests:	**Spatial Lag*****	–	**Spatial Lag*****	–	**Spatial Error****	**–**	**Spatial Error****	–	**Spatial Error*****	**–**	**Spatial Lag*****	–
Likelihood ratio test for spatial weights matrix	–	60.54**	–	15.22**	–	303.32**	–	215.44**	–	187.87**	–	123.78**
F-statistic (prob.)	20.84***	–	159.37***	-	103.28***	–	157.31***	–	109.81**	–	215.904	–
Log-likelihood	-732.734	-702.464	-402.191	-394.58	-549.007	-397.347	-404.986	-297.267	-538.484	-444.548	-334.362	-272.472
R^2	0.229	0.330	0.759	0.766	0.596	0.795	0.756	0.854	0.611	0.745	0.810	0.850
AIC	1483	1425	828	815	1116	812	833	618	1095	907	693	571
Multicollinearity condition number	3.814	–	4.217	–	3.814	–	4.468	–	3.814	–	7.623	–

Table 2: Spatial Models of 2005 Party Vote Share

Political party	**Liberal Democrats**	**Conservative**	**Labour**
Intercept	-0.004 (0.022)	-0.002 (0.019)	0.010 (0.018)
Degrees	0.051 (0.059)	**0.285** (0.053)**	**-0.225** (0.048)**
Manufacturing	-0.028 (0.050)	**-0.112** (0.045)**	0.041 (0.041)
Agriculture	0.038 (0.035)	**0.134** (0.032)**	**-0.207** (0.029)**
Pensioners	-0.027 (0.040)	**0.161** (0.036)**	**-0.121** (0.033)**
Students	0.043 (0.037)	0.052 (0.033)	**-0.065* (0.030)**
Muslims	-0.045 (0.032)	-0.013 (0.028)	**-0.055* (0.026)**
WorKING in education	0.079 (0.043)	**-0.200** (0.039)**	0.055 (0.035)
Home owner	-0.039 (0.043)	**0.310** (0.038)**	**-0.239** (0.034)**
Lib Dem campaign spending	**0.721** (0.026)**	**-0.207** (0.023)**	**-0.283** (0.021)**
Conservative campaign spending	**-0.142** (0.031)**	**0.352** (0.027)**	**-0.133** (0.025)**
Labour campaign spending	**-0.246** (0.026)**	**-0.172** (0.023)**	**0.261** (0.021)**
Degree * queen weight matrix	0.085 (0.077)	**-0.269** (0.069)**	0.093 (0.062)
Manufacturing * queen weight matrix	0.026 (0.064)	-0.046 (0.057)	0.072 (0.052)
Agriculture * queen weight matrix	-0.059 (0.048)	**-0.194** (0.043)**	**0.107** (0.039)**
Pensioners * queen weight matrix	0.120 (0.062)	**-0.276** (0.056)**	0.063 (0.050)
Students * queen weight matrix	-0.093 (0.081)	-0.114 (0.072)	0.065 (0.066)
Muslims * queen weight matrix	0.086 (0.055)	0.056 (0.049)	**-0.150** (0.045)**
WorKING in Education * queen weight matrix	0.027 (0.071)	0.099 (0.063)	0.004 (0.057)
Home owner * queen weight matrix	0.047 (0.067)	0.026 (0.059)	-0.045 (0.054)
Lib Dem campaign spending * queen weight matrix	**0.110* (0.049)**	**-0.095* (0.044)**	0.051 (0.039)
Conservative campaign spending * queen weight matrix	-0.041 (0.052)	**0.463** (0.046)**	**-0.350** (0.042)**
Labour campaign spending * queen weight matrix	-0.025 (0.049)	**-0.220** (0.043)**	**0.190** (0.039)**
Moran's I (residuals)	0.050**	0.323**	0.241**
F-statistic (prob.)	81.790	108.93	138.81
Log-likelihood	-392.194	-327.662	-270.301
R^2	0.77	0.81	0.84
AIC	830	701	587
Multicollinearity condition number	11.564	11.564	11.564

Notes (for Tables 1 and 2): standard errors in parentheses; * and ** indicate statistical significance at the 5% and 1% level respectively; all continuous variables are standardised; queen contiguity weight matrices employed in non-OLS estimations; in all cases lagrange multiplier test results are supported by robust LM test results; there are 569 observations in each regression.