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**A BAYESIAN SPATIAL INDIVIDUAL EFFECTS PROBIT
MODEL OF THE 2010 U.K. GENERAL ELECTION**

By

**CHRISTA JENSEN, DONALD LACOMBE AND
STUART MCINTYRE**

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UNIVERSITY OF STRATHCLYDE
GLASGOW**

A Bayesian Spatial Individual Effects Probit Model of the 2010 U.K. General Election

Christa D. Jensen*, Donald J. Lacombe[†] and Stuart G. McIntyre[‡]

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Abstract

The Conservative Party emerged from the 2010 United Kingdom General Election as the largest single party, but their support was not geographically uniform. In this paper, we estimate a hierarchical Bayesian spatial probit model that tests for the presence of regional voting effects. This model allows for the estimation of individual region-specific effects on the probability of Conservative Party success, incorporating information on the spatial relationships between the regions of the mainland United Kingdom. After controlling for a range of important covariates, we find that these spatial relationships are significant and that our individual region-specific effects estimates provide additional evidence of North-South variations in Conservative Party support.

JEL Codes: C11, C21

Keywords: United Kingdom General Election, Bayesian hierarchical modelling, spatial econometrics

*Christa D. Jensen, Graduate Research Fellow, Regional Research Institute, Department of Economics, West Virginia University, PO Box 6825, Morgantown, WV 26506. Phone: +1 (304) 293-8545; Fax: +1 (304) 293-6699; Christa.Jensen@mail.wvu.edu

[†]Donald J. Lacombe is Associate Professor of Agricultural and Natural Resource Economics and Economics and Research Associate Professor, Regional Research Institute, West Virginia University, 886 Chestnut Ridge Road, PO BOX 6825, Morgantown, WV, 26506-6825, +1 (304) 293-8543; Fax: +1 (304) 293-6699, email: donald.lacombe@mail.wvu.edu

[‡]Stuart G. McIntyre, Department of Economics, University of Strathclyde, Sir William Duncan Building, 130 Rottenrow, Glasgow G4 0GE, Scotland, UK; Phone: +44 (0)141 548 3858 (Ext. 3858), s.mcintyre@strath.ac.uk

1 Introduction

The Conservative Party won the 2010 General Election in the United Kingdom, gaining the most votes and seats of any single party. In this election, the Conservatives performed particularly well in some areas of the United Kingdom while performing particularly poorly in others. The suggestion that United Kingdom voting behaviour is characterised by region specific effects is not new. Indeed, there was work done in the 1980s by Curtice and Steed, among others, on this very point¹.

Until the 1980s, United Kingdom voting outcomes were thought to be characterised by, or at least approximated by, a uniform national swing. The idea was that a 1 per cent swing in national support from the Conservative Party to the Labour Party, for example, would more or less be replicated across the country. In this way, national opinion or exit polls could be used to predict the outcome of the election. This idea was typified by the BBC's "swing-o-meter", which they used on election night television programming from the 1950s. What has been clear since the 1980s, is that similarly situated voters (in terms of class, income, education etc.) in different spatial locations behaved differently in the polling station. This paper is an attempt to better understand the regional dimension to this issue.

Johnston and Pattie reconciled modern spatial econometric models with United Kingdom voting behaviour and voting theory². Later work by other authors applies spatial econometric methods to understanding the 2005 and 2010 United Kingdom General Election results³. Cutts and Webber established that party spending on constituency election campaigns had spillover effects and Jensen et al. found that the incumbency of Conservative Party candidates exhibited spillover effects. These two studies aside, the

¹John Curtice and Michael Steed, 'Electoral Choice and the Production of Government: The Changing Operation of the Electoral System in the United Kingdom since 1955', *British Journal of Political Science*, 12(3) (1982), 249-98.

²Ron J. Johnston and Charles J. Pattie, *Putting Voters in Their Place: Geography and Election in Great Britain* (New York: Oxford University Press, 2006)

³David Cutts and Don J. Webber, 'Voting Patterns, Party Spending and Relative Location in England and Wales', *Regional Studies*, 44(6) (2010), 735-60; Christa D. Jensen, Donald J. Lacombe, and Stuart G. McIntyre, 'A Bayesian Spatial Econometric Analysis of the 2010 UK General Election', University of Strathclyde Business School, Department of Economics Discussion Paper #10-24, (2010).

spatial analysis of United Kingdom voting outcomes is still rare despite the fact that it is well suited for such an analysis.

In the United Kingdom, and indeed elsewhere, there are numerous reasons to believe *ex-ante* that there is a spatial dimension to voting outcomes. The media provides one explanation for why this might be the case. Local newspapers and media tend to serve multiple constituencies. For example, Scotland has its own BBC radio station, BBC news bulletins, a privately run free-to-air television broadcaster with its own news programming, and a number of newspapers that are only sold in Scotland. In addition, a number of services that concern voters such as hospitals, policing, and education are controlled at a more aggregate level than the constituency. A hospital closure in one constituency can be expected to affect a number of neighbouring constituencies in the same or a similar way.

This paper examines the effects of a range of economic, socioeconomic, and political variables on the probability of Conservative Party success in the 2010 United Kingdom General Election using a hierarchical Bayesian spatial probit model with two spatial levels: the parliamentary constituency and the region. The model used here accounts for individual unobserved regional spatial effects to provide robust inferences regarding model parameters⁴. This modelling approach provides a new way of estimating regional effects that recognises the spatial relationship between regions of the United Kingdom. This is important where neighbouring regions are similarly affected by particular events or effects, such as an economic downturn, which are expected to inform their electoral choices.

Our results indicate that several covariates are important in explaining the election result and that the individual effects across the eleven United Kingdom regions provide support for the suggestion that unobserved regional spatial effects are an important part of the modelling strategy. This conclusion is in contrast to a recent contribution in the

⁴Tony E. Smith and James P. LeSage, 'A Bayesian Probit Model with Spatial Dependencies', in James P. LeSage and R. Kelley Pace eds, *Spatial and Spatiotemporal Econometrics* (Amsterdam: Elsevier, 2004), 127-162.

literature by Johnston et al.⁵ They use a multi-level model approach that does not model spatial interactions and conclude that regional effects are not important.

Section 2 reviews the literature on regional effects in United Kingdom voting behaviour and section 3 discusses the modelling approach adopted in this paper. The data that are used are then discussed in section 4 before we outline our expectations for coefficient estimates in section 5. Section 6 discusses the results from our analysis and section 7 concludes and offers directions for future research.

2 Literature Review

Several articles have reviewed the literature on the spatial analysis of voting behaviour⁶. Therefore, this literature review will focus on the discussions surrounding regional voting effects. The first instances of analyses that try to understand and analyse regional differences in United Kingdom voting behaviour appeared in the 1980s and 1990s⁷. Curtice and Steed note that little regional variation was observed in the 1950, 1951, and 1955 United Kingdom General Elections. In the United Kingdom General Elections between 1955 and 1979, they observe that regional variations in voting began to manifest themselves as a North-South divide of pro-Labour and pro-Conservative support respectively⁸.

Two possible explanations that they suggest for these regional differences in voting patterns are that the North-South economic disparities were growing at the time and

⁵Ron Johnston, Kelvyn Jones, Carol Propper, and Simon Burgess, 'Region, Local Context, and Voting at the 1997 General Election in England', *American Journal of Political Science*, 51(3) (2007), 640-654.

⁶Johnston and Pattie, *Putting Voters in Their Place*; Johnston et al. 'Region, Local Context, and Voting at the 1997 General Election in England'; Ron Johnston, Kelvyn Jones, and Min-Hua Jen, 'Regional Variations in Voting at British General Elections, 1950–2001: Group-based Latent Trajectory Analysis', *Environment and Planning A*, 41(3) (2009), 598-616; Jensen et al. 'A Bayesian Spatial Econometric Analysis of the 2010 UK General Election'.

⁷Curtice and Steed, 'Electoral Choice and the Production of Government: The Changing Operation of the Electoral System in the United Kingdom since 1955'; Ian McAllister and Donley T. Studlar, 'Region and Voting in Britain, 1979-87: Territorial Polarization or Artifact?', *American Journal of Political Science*, 36(1) (1992), 168-199; Ian McAllister, 'Regional Voting', *Parliamentary Affairs*, 50(4) (1997), 641-657.

⁸Curtice and Steed, 'Electoral Choice and the Production of Government: The Changing Operation of the Electoral System in the United Kingdom since 1955', p. 256

there were differing spatial impacts of the trade “dividend”. Those areas that benefited less from greater trade liberalisation became more supportive of the Labour Party, which favoured protectionism. They also concluded that these regional differences were likely to continue to deepen. Whether these two explanations for the observed regional differences in electoral support for particular parties still hold, or whether alternative effects, for example the growth of distinct regional political cultures in Scotland and Wales and more generally, regional media diversification, provide better explanations for these effects is still open for discussion.

McAllister and Studlar analyse the United Kingdom General Elections of 1979, 1983, and 1987 and find that the observed differences can only partly be explained by region effects. Using micro-level data, they found that controlling for a range of economic, socio-economic and political variables greatly reduced the observed differences in voting patterns in each of these elections. Further, they found that this effect was becoming stronger over time⁹. When they use a political attitudes index as the dependent variable, they find that the region effects weaken, even becoming statistically insignificant in some regions¹⁰.

McAllister argues that regional voting differences have always been present in the United Kingdom, although he finds that they were exacerbated by tactical voting in the 1997 United Kingdom General Election. He concludes that “future British General Elections may have to deal with highly sophisticated regional electorates who vote instrumentally...to achieve a very specific outcome”¹¹. This is not the only factor that is said to exacerbate regional voting patterns.

Many authors note that the voting system that is employed can also exacerbate regional election outcomes¹². The “first past the post” electoral system that is employed

⁹McAllister and Studlar, ‘Region and Voting in Britain, 1979-87: Territorial Polarization or Artifact?’, p. 183

¹⁰McAllister and Studlar, ‘Region and Voting in Britain, 1979-87: Territorial Polarization or Artifact?’, p. 185

¹¹McAllister, ‘Regional Voting’, p. 655

¹²McAllister, ‘Regional Voting’; Allan Craigie, ‘Regional and National Identity Mobilization in Canada and Britain: Nova Scotia and North East England compared’, Ph.D. Thesis, University of Edinburgh, (2010).

in the United Kingdom creates electoral bias and an incentive for voters to vote tactically¹³. McAllister and Craigie argue that electoral bias creates an incentive for voters in different regions to vote tactically and in different ways according to the direction of the electoral bias in their region¹⁴. Such tactical voting works to exaggerate party “stronghold” or “weakhold” effects in different regions. Johnston and Pattie examine the 2010 United Kingdom General Election and suggest that tactical voting is widespread¹⁵.

Johnston et al. examine regional voting behaviour in England during the United Kingdom General Election of 1997. Using a set of custom built regions and neighbourhoods along with Parliamentary constituency and household level data, they examine the spatial level at which voting effects operate. They argue that Parliamentary constituencies are too large to exhibit the kind of “neighbourhood” effects that are commonly considered to explain voting behaviour and that smaller spatial areas must be examined. However, they find evidence that regional voting effects consist of an aggregation of voting effects at smaller spatial scales and suggest that controlling for sub-constituency differences greatly reduces regional effects¹⁶.

A later study by Johnston et al. found that regional effects in the United Kingdom do exist but that the pattern defies the traditional North–South characterisation for the Labour and Liberal Democrat Parties. For the Conservative Party they did find a clear trend of increasing support towards the South¹⁷. From the conflicting recent evidence on regional voting behaviour it is clear that the modelling approach is important. In the next section we outline the modelling strategy adopted in this paper, and how it helps us to better understand the regional dimension to voting outcomes in the United

¹³David Rossiter, Ron Johnston, Charles Pattie, Danny Dorling, Ian McAllister, and Helena Tunstall, ‘Changing biases in the operation of the UK’s electoral system, 1950–97’, *British Journal of Politics and International Relations*, 1(2) (1999), 133-64; Michael Thrasher, Galina Borisyuk, Colin Rallings, and Ron Johnston, ‘Electoral Bias at the 2010 General Election: Evaluating its Extent in a Three-Party System’, *Journal of Elections, Public Opinion, and Parties*, 21(2) (2011), 279-294

¹⁴McAllister, ‘Regional Voting’; Craigie, ‘Regional and National Identity Mobilization in Canada and Britain: Nova Scotia and North East England compared’

¹⁵Ron Johnston and Charles Pattie, ‘Tactical Voting at the 2010 British General Election: Rational Behaviour in Local Contexts?’ *Environment and Planning A*, 43(6) (2011), 1323-40.

¹⁶Johnston et al. ‘Region, Local Context, and Voting at the 1997 General Election in England’, p.649.

¹⁷Johnston et al., ‘Regional Variations in Voting at British General Elections, 1950–2001: Group-based Latent Trajectory Analysis’

Kingdom.

3 Bayesian Probit Model with Individual Effects

The findings of Johnston et al. would seem to suggest that there is little point in pursuing any sort of regional voting analysis unless households and neighbourhoods are separately identified¹⁸. We do not include either of these spatial scales in this paper due to a lack of sub-constituency data and therefore cannot test their conclusions in the context of the 2010 United Kingdom General Election. Instead, we adopt a different modelling approach that allows us to examine whether there is an unexplained “regional” voting effect using a model that includes explicit spatial interaction effects.

In this paper we specify a hierarchical spatial econometric model for eleven regions of the United Kingdom (see Table 1 for a list of regions). It is hard to argue, especially with the advent of devolution in Scotland and Wales in 1999, that Scotland and Wales have not evolved their own distinct political cultures. Jones et al. describe Scotland and Wales as having “cultural foundations” that are different from England¹⁹.

The presence of region specific political institutions with their own regional political class supports the *ex-ante* belief that these regions will have political attitudes that differ from the other regions. We test whether differences in political, economic and socio-economic characteristics at the constituency level are able on their own to explain the observed differences in voting behaviour across space. We believe that the approach taken here is an ideal method for determining whether there are significant regional effects in United Kingdom voting behaviour. Our approach recognises, as an integral part of the modelling strategy, that the regions of the United Kingdom do not exist as spatially independent entities, but instead are closely related with shared experiences.

[Table 1 about here]

¹⁸Johnston et al. ‘Region, Local Context, and Voting at the 1997 General Election in England’

¹⁹Kelvyn Jones, Ron Johnston, and Charles Pattie, ‘People, Places, and Regions: Exploring the Use of Multi Level Modelling in the Analysis of Electoral Data’, *British Journal of Political Science*, 22(3) (1992), 343-380, p. 347

Models for situations involving spatially dependent limited dependent variables usually take the form of a spatial autoregressive (SAR) probit model. However, they can also take the form of a hierarchical Bayesian probit model with a spatially structured random effects vector²⁰. The advantage of the spatially structured random effects model compared to the traditional SAR probit model is that this type of model can produce parameter estimates that allow us to make inferences regarding spatially structured unobserved effects and how these affect the probability of the Conservatives winning for each of our eleven United Kingdom regions.

The model is outlined below, where U_{ik} indexes utility in regions $i = 1, \dots, m$ for individuals $k = 1, \dots, n_i$ within each region²¹. The total number of observations in the model are $N = \sum_{i=1}^m n_i$ and w_{ij} denotes the i, j^{th} elements of the $m \times m$ spatial weight matrix W .

$$\begin{aligned} U_{ik} &= X_{ik}\beta + \xi_{ik} \\ \xi_{ik} &= \theta_i + \varepsilon_{ik} \\ \theta_i &= \rho \sum_{j=1}^m w_{ij}\theta_j + u_i \end{aligned}$$

The model treats the unobserved error component ξ_{ik} as consisting of a region-specific component θ_i as well as an individual effect ε_{ik} . The regional effect parameter, θ_i , captures any unobserved common features for observations located in region i . Additionally, the region-specific component is modeled as a SAR process $\theta_i = \rho \sum_{j=1}^m w_{ij}\theta_j + u_i$, whereby the unobserved aspects of the model are spatially correlated, i.e. individuals located in close proximity (as defined by the W matrix) are likely to be similar as op-

²⁰Smith and LeSage, ‘A Bayesian Probit Model with Spatial Dependencies’; James P. LeSage and R. Kelley Pace, *Introduction to Spatial Econometrics* (Boca Raton: CRC Press, 2009), pp. 316-20.

²¹The nomenclature regarding individuals is simply for ease of interpretation and follows the notation in LeSage and Pace, *Introduction to Spatial Econometrics*. This does not indicate that individual level inferences are being drawn from aggregate data (i.e. the ecological inference problem).

posed to individuals that are farther away. In terms of our empirical application, this model posits that the dependent variable is a function of a set of explanatory variables plus some unobserved effects that are spatially correlated at the *regional* level, i.e. the 11 different regions in the United Kingdom. The term “hierarchical” is used in the description of the model because it accommodates statistical inference at two different levels of aggregation.

The above model can be expressed in matrix notation as follows:

$$\begin{aligned}
 y &= X\beta + \Delta\theta + \varepsilon \\
 \theta &= \rho W\theta + u \\
 u &\sim N(0, \sigma_m^u I_m) \\
 \varepsilon|\theta &\sim N(0, V) \\
 V &= \begin{pmatrix} v_1 I_{n_1} & & \\ & \ddots & \\ & & v_m I_{n_m} \end{pmatrix} \\
 \Delta &= \begin{pmatrix} 1_i & & \\ & \ddots & \\ & & 1_m \end{pmatrix}
 \end{aligned}$$

The model, as illustrated above, can accommodate heterogeneity across the m broader regions (e.g. our eleven regions in the United Kingdom) by allowing for different variance scalars, $v_i, i = 1, \dots, m$ to be associated with each of these regions. The $N \times m$ matrix Δ assigns the same effect parameter to each of the n_i constituencies in region i . Specifically, Δ contains row-elements $i = 1, \dots, m$ that equal one if constituency i is located in region m and zero otherwise. The model interprets the vector θ as indicators for unobservable or unmeasured region-level influences. As stated before, these effects are modeled as following a SAR process whereby neighboring regions are associated with each other.

In terms of model interpretation, the coefficient vector β for the explanatory variable matrix X is interpreted in a manner similar to the standard non-hierarchical, non-spatial probit model. The unobserved effects parameters, θ , are centered on zero such that regions with positive (negative) effects indicate latent factors that positively (negatively) affect the probability of conservative success (failure) that are not included in the explanatory variables matrix X . LeSage and Pace provide additional details regarding the model, including computational aspects as well as extensions²².

4 Data

The data used in this paper come from a number of different sources. The primary source is a database collected and published online by Dr. Pippa Norris of Harvard University, available at <http://www.pippanorris.com/>. The particular dataset used in this study is “May 6th 2010 British General Election Constituency Results Release 5.0”. Data on election results and the explanatory variables relating to candidate sex, candidate race, marginal constituencies, and the percentages of the population that are in senior occupation positions, married, single parents, white, or students are all obtained or calculated from this dataset. The *marginal* variable is a dummy variable indicating whether or not the previous General Election result in the constituency was a close race for the Conservative Party. This variable takes on a value of one if the first or second place finisher was a Conservative Party candidate and the result was decided by 5 per cent or less, i.e. the difference in the percentage of the votes received between the first and second place candidate was less than 5 per cent in the 2005 United Kingdom General Election.

Additional data were obtained from the NOMIS (National Online Manpower Information Service) website, accessible at <https://www.nomisweb.co.uk/Default.asp>. The NOMIS dataset accessed and used in this paper is “claimant count - age and duration”, which provides data on the unemployment benefit claimant count. This dataset

²²LeSage and Pace, *Introduction to Spatial Econometrics*, pp. 316-20

is used to provide a measure of long-term unemployed (taken as those who have been claiming benefits for more than 1 year) as a proportion of total claimants in each constituency. Descriptions of each variable, the expected coefficient signs, and descriptive statistics are presented below in Tables 2 and 3.

[Tables 2 and 3 about here]

Geographical data came from the Ordnance Survey product “Boundary Line”²³. This product provides detailed geographic information on the boundaries of the eleven United Kingdom regions and the Parliamentary constituencies that comprise them as they were in force on 6 May 2010. The spatial weight matrix, W , in our empirical model is a contiguity-based weight matrix based on the centroid coordinates of the eleven United Kingdom regions.

A number of seats experienced significant changes in constituency boundaries between the 2005 and 2010 United Kingdom General Elections. Due to these changes, data for many explanatory variables are not yet available for the 2010 boundary definitions. For example, data on income and education variables are only available for the 2005 constituency boundaries. For consistency, all of the data used in this analysis are those available at the 2010 constituency boundaries, and all are studentized, whereby each variable was transformed by subtracting its mean and dividing by its standard deviation²⁴.

We chose to exclude the eighteen constituencies in Northern Ireland from our analysis as the United Kingdom Conservative Party does not directly field candidates in Northern Ireland. Instead, there is an electoral alliance with the Ulster Unionist Party (UUP) who field candidates with the understanding that any elected UUP Member of Parliament will take the Conservative Party whip and could serve in a Conservative Government²⁵.

²³More details are available from <http://www.ordnancesurvey.co.uk/oswebsite/products/boundaryline/>.

²⁴We do not studentize the dummy variables in our empirical analysis.

²⁵Andrew Porter, ‘David Cameron Launches Biggest Conservative Shake-up for Decades’, *The Daily Telegraph*, Available from: <http://www.telegraph.co.uk/news/politics/conservative/2450913/David-Cameron-launches-biggest-Conservative-shake-up-for-decades.html>

We also exclude two additional constituencies from our analysis: Thirsk & Malton and Buckingham. The election in Thirsk & Malton was delayed by three weeks due to the death of the United Kingdom Independence Party candidate during the election campaign. We excluded this constituency to focus our analysis on votes that were cast simultaneously. The seat of Buckingham was excluded as it was the seat of the sitting Speaker of the House of Commons, John Bercow Member of Parliament. By convention, the Speaker is not contested by any of the three main parties when seeking re-election²⁶. Our analysis was therefore carried out using data on the remaining 630 United Kingdom Parliamentary constituencies.

5 Prior Expectations

5.1 Covariate effects

The expected signs on each of the covariates can be found in Table 2 and are discussed individually in this section. Given the well understood advantages of incumbency for a candidate in an elections, we expect *incumbency* to exert a positive impact on the probability that a Conservative candidate win his or her race. Examples of these advantages include name recognition, public funds to employ a staff to promote the incumbent locally and in the media, and a record in office on which to campaign. Jensen et al. demonstrate that *incumbency* is not only a direct benefit to the incumbent, but also to their party in neighbouring constituencies²⁷.

The percentage of the electorate in a constituency that are in senior occupations, *seniorocc*, is considered to be a good predictor of Conservative Party support²⁸. Married voters are similarly thought more likely to support the Conservative Party. For these reasons we expect positive coefficients on these two variables. In the context of

²⁶The House of Commons Information Office (HOC), *The Speaker, House of Commons Information Office Factsheet M2*, Available from: <http://www.parliament.uk/documents/commons-information-office/m02.pdf>

²⁷Jensen, Lacombe, and McIntyre, 'A Bayesian Spatial Econometric Analysis of the 2010 UK General Election'

²⁸William. L. Miller, Social Class and Party Choice in England: A New Analysis, *British Journal of Political Science*, 8(3) (1978), 259-284.

the 2010 United Kingdom General Election there were additional reasons for each of these groups to vote for a Conservative Party candidate. Of the three main parties (the incumbent Labour Party, the Conservative Party, and the Liberal Democrats), the Conservative Party were the only Party to openly call for the future reversal of the increase in the top rate of personal taxation introduced by the Labour Government in April 2010. As those working in senior managerial or professional occupations are likely to be high earners, this decrease in personal taxation rate provides an additional incentive for supporting the Conservative Party in this election. Also, in advance of the 2010 United Kingdom General Election, the Conservative Party advocated a policy for the recognition of marriage in the tax system. This proposal was rejected by both the Labour and Liberal Democrat Parties and increases the incentive for *married* voters to support the Conservative candidate.

The Conservative Party also made a pledge to retain and even increase university tuition fees. As a result of this pledge, we expect a negative coefficient on the *student* variable indicating that the higher the percentage of students in a constituency, the lower the probability of a Conservative win. The various student demonstrations and protests that took place after the election and in the days preceding the Parliamentary vote on the subject signified the strength of feeling among students on this issue.

In the campaign leading up to the 2010 United Kingdom General Election, the Conservative Party pledged to review the working tax credit and child tax credit systems that were in operation and made no guarantees about their future. Specifically, they wanted to see these tax credits ended for middle earners. Lone parents, whether in a low or middle income level, may have been rightly concerned about reductions in this state subsidy and accordingly be less likely to vote for the Conservative Party. This, along with the fact that during their own campaign the Labour Party committed to retain these tax credits and promised to increase child tax credits by £4 a week for each child by 2012, leads us to believe that the higher the percentage of lone parents in a constituency, the lower the probability that the Conservative Party wins the seat.

The Conservative Party also pledged to put an annual fixed cap on the number of

immigrants allowed into the United Kingdom. The Labour Party opposed this. Instead they believed the best approach to controlling immigration was through a points system, similar to that operated by Australia. Immigration was a key issue for voters in the election campaign. Data released by the Office of National Statistics to the British current affairs magazine “The Spectator”²⁹ during the election campaign showed that 99 per cent of the jobs created during the Labour Party’s time in office (i.e. since 1997) and held by people of working age (ages 16-64 for men and ages 15-59 for women) had gone to foreign born immigrants³⁰.

Polling undertaken by media outlets during the campaign suggested that voters were more likely to support a party pledging to reduce immigration. In one poll, by pollsters Harris, 74 per cent of people surveyed thought that there were too many immigrants and that the incumbent government had been ineffective in addressing this issue³¹. Therefore, given that the incumbent Labour government were seen as being ineffective on this issue, and that the Conservative Party were proposing a fixed cap on immigration, we expect that the *white* variable, as a proxy for the non-immigrant population³², will exert a positive effect on the probability that the Conservative Party candidate wins a seat.

During the 2010 election campaign, the Conservative Party had a number of billboard adverts across the country. One of these carried the blunt message: “Let’s cut benefits for those who refuse work”. This billboard summarised the Conservative position on welfare reform. Those collecting unemployment benefits are expected to accept work if

²⁹Fraser Nelson, ‘British Jobs for British Workers...’, *The Spectator*, (2010), Available from: <http://www.spectator.co.uk/coffeehouse/5895033/british-jobs-for-british-workers.html>.

³⁰This figure is sensitive to the measure of immigration used. The measure “The Spectator” used is the Eurostat (European Statistics Agency) definition of immigration. The alternative measure, which gives a lower per cent here, is “current nationality”. The former measure considers those with a British Passport who were immigrants to still be immigrants, the latter considers them not to be immigrants once they obtain a British passport.

³¹Tim Shipman, ‘Ten-point Lead in Mail Poll Puts Tories on Course for a Majority in Election’, *The Daily Mail Newspaper*, (2010), Available from: <http://www.dailymail.co.uk/news/election/article-1264857/General-Election-2010-Ten-point-lead-Mail-poll-puts-Tories-course-majority-election.html>

³²*white* is an imperfect proxy for the non-immigrant population as immigrants may indeed be white but we do not think that it is unreasonable for capturing the proportion of the “indigenous” population in an area.

it is offered, otherwise face reductions in their welfare payments³³. It is not hard to see that this is a message that would be disagreeable to the long term unemployed, therefore we expect a negative coefficient on the *welfare > 1 year* variable.

In our analysis, we test whether a marginal constituency involving a Conservative candidate in the 2005 United Kingdom General Election (i.e. a constituency where the Conservative Party either won or lost the seat in the 2005 United Kingdom General Election by a margin of less than 5 per cent) had an effect on the probability that the Conservative candidate would win that seat in the 2010 United Kingdom General Election. It seems reasonable to expect that a Conservative voter in a constituency that was labeled marginal in 2005 would be more likely to vote in the 2010 General Election. These votes are expected to increase the probability that the Conservative candidate would win. It is also likely that where the seat was closely fought in the previous election, party campaigning leading into the present election will be strong (which would be the rational response of the political parties involved since these are the most “winnable” seats). Increased spending and activity in a constituency by political parties has been shown to increase that party’s vote share³⁴.

We do not have a strong expectation in either direction for the variables related to the candidate’s race or sex. It may be the case that the Conservative Party are more likely to win a seat if the candidate is female or a minority because it runs counter to the stereotype of the Conservative Party politician. A female or minority candidate could appeal to a broader electorate than a white male Conservative candidate and thus increase the probability of the Conservative Party winning that seat. However, voters could also be less willing to vote for a female or minority Conservative candidate, in which case having such a candidate would make the Conservative Party less likely to win that seat.

³³Welfare payments in this case, and welfare more broadly in this paper, refers to unemployment benefit or job-seekers allowance.

³⁴Edward Fieldhouse and David Cutts, ‘The Effectiveness of Local Party Campaigns in 2005: Combining Evidence from Campaign Spending and Agent Survey Data’, *British Journal of Political Science*, 39(2) (2009), 367-88.

5.2 Regional effects

Since Scotland and Wales have their own regional governments, we expect that these regions have developed their own region specific political attitudes and voting behaviours. We expect that these regions have significant, and in both cases, negative effects on the probability that the Conservative Party wins a seat. The Conservative Party has not been particularly successful in either of these regions in recent elections (although they did win eight seats in Wales in the 2010 United Kingdom General Election).

The North of England has traditionally been a Labour stronghold, the South East a Conservative stronghold, and the South West dominated by the Liberal Democrats. We therefore expect that regions in the North and South West of England exert a negative impact on the chance the Conservative Party wins a seat in the region. Similarly, we expect the South East of England, the East of England and perhaps the Midlands (East and West) to exert a positive impact on the probability of the Conservative Party winning a seat.

In general, we expect that the further South a region is located, the more likely a Conservative win. Indeed, in the North we expect negative region specific effects, these effects becoming less negative and possibly turning positive towards the South. This would be in line with the findings of Johnston et al. and more generally with the literature on North-South effects in United Kingdom voting behaviour³⁵.

6 Results

Results from our analysis are presented in Tables 4 and 5. We first note that the Gibbs sampler was set to run for 51,000 iterations, the first 1,000 of which were discarded to allow for “burn-in” of the sampler. As is true in all Bayesian analyses, the model allows for prior values to be used for the parameters. In this case, priors are specified for the β 's, the error variance σ^2 , the prior that controls the draws for the individual variance

³⁵Johnston et al., ‘Regional Variations in Voting at British General Elections, 1950–2001: Group-based Latent Trajectory Analysis’; Curtice and Steed, ‘Electoral Choice and the Production of Government: The Changing Operation of the Electoral System in the United Kingdom since 1955’; McAllister, ‘Regional Voting’.

parameters, v_i , and finally, the prior on the spatial autocorrelation coefficient, ρ .

Given that we have no real prior information regarding any of the aforementioned parameters, we rely on proper priors with relatively uninformative values for each. The default diffuse parameter values for the β 's have a mean of 0_k and covariance of $1e12 \times I_K$ and we use a prior value of $r = 4$ for the independent χ^2 draws for the individual variance parameters v_i , which represents a prior belief in heteroskedasticity. We use a Gamma prior with values $(0, 0)$ for the error variance σ^2 , and a Beta $(1, 1)$ prior for the spatial autocorrelation parameter, ρ .

As is standard practice in Bayesian regression analyses, we calculated 95 per cent credible intervals from the Gibbs samples for the regression coefficients as well as for the eleven individual regional effects. Those intervals that do not contain zero are considered “significant” in the sense that the variable is associated with explaining variation in the dependent variable. We first briefly discuss the results on the explanatory variables but focus the majority of our results discussion on the results relating to regional effects.

6.1 Covariates

Amongst the ten independent variables used in the regression model, we note that six variables have 95 per cent credible intervals that do not contain the value zero. The *incumbent* variable's positive coefficient estimate is no surprise given the advantages that incumbency entails. Our analysis also confirms that *marginal* seats and explanatory variables indicating voters with “conservative values”, namely *seniorocc* and *married*, exhibited a positive influence on the success of a Conservative candidate. We also find that the *student* variable exerts a negative impact on the probability of Conservative success in a constituency. For reasons discussed in section 5.1, all of these results are consistent with our prior expectations.

[Table 4 about here]

Our results also indicate that if the Conservative candidate was female, the probability of Conservative Party success in that constituency decreases. This result could be due to a lack of support for female candidates among conservative leaning voters, or alternatively, it could represent a “selection” effect whereby female Conservative candidates are more likely to be selected for seats where the Conservative Party is less likely to win.

6.2 Regional Effects

The main reason for employing this particular modelling strategy is to investigate the significance, size, and sign of region specific effects on the probability of Conservative candidate success. The literature has long emphasised the importance of North-South differences in voting behaviour and electoral outcomes in the United Kingdom. To date however, no study has examined the issue of region specific effects, or the presence of regional voting cultures, while incorporating space into the model as we do here. This makes our results particularly important in the context of this debate.

The region specific effects on the probability of the Conservative Party winning a seat are estimated for eleven regions in the United Kingdom. Of these eleven region-specific effects, five have 95 per cent credible intervals that do not contain the value zero, and thus, are considered to be “statistically significant” at the 95 per cent level. For each of the regions, we calculate the unobserved effects on the probability of the Conservative Party success in constituencies that comprise the region during the 2010 United Kingdom General Election. Estimates of these regional effects can be found in Table 5.

[Table 5 about here]

There are no regions that exert a positive and significant influence on the probability of Conservative success. Where these effects are negative and significant, there is a negative impact on the probability of the Conservative Party candidate winning a seat in that region. A number of regions exerted just such a negative effect including the

North East and North West of England, Scotland, Wales, and Yorkshire & the Humber. The largest significant region specific effect is in Scotland at -3.7343 compared to the region with the smallest significant effect, Yorkshire & the Humber, at -0.7059 .

These results for the regions are broadly in accordance with our prior beliefs, and are also consistent with the literature on North-South voting effects. In general, the further North the region, the greater the negative region specific effect on the Conservative Party's probability of winning. Perhaps the only surprising result is that we do not detect any region as having a positive and significant unobserved regional effect on the probability of Conservative Party success.

We noted earlier that Johnston et al. were skeptical of the presence of regional voting cultures in the United Kingdom³⁶. Their study focused only on England, ignoring Scotland, Wales and Northern Ireland. We also do not include Northern Ireland in our study because of its peculiar political system in which the main United Kingdom parties do not compete. However, with the advent of Scottish and Welsh devolution (and the creation of the Scottish Parliament and Welsh Assembly), distinct regional political cultures have emerged that appear to help explain the results of the 2010 United Kingdom General Election.

7 Conclusions

This paper has explored a new method for examining the regional aspect of United Kingdom voting behaviour. Using a model developed by Smith and LeSage, we have examined individual regional effects on the Conservative Party candidate's chances of winning a seat in each of the eleven regions in Great Britain³⁷. Our findings provide evidence of a North-South effect in the probability of success in a United Kingdom General Election for the Conservative Party, controlling for a range of important covariates.

As previously mentioned, it could be that electoral bias or tactical voting are exacerbating regional voting patterns and thus affecting the observed pattern of region

³⁶Johnston et al. 'Region, Local Context, and Voting at the 1997 General Election in England'

³⁷Smith and LeSage, 'A Bayesian Probit Model with Spatial Dependencies'

specific results. A better understanding of what is underpinning the observed pattern of region specific results will be the focus of future research. This research will try to build on advances in spatial econometric modelling that incorporates the advances proposed by multi-level modelling while explicitly recognising the effects of space on voting outcomes³⁸. Other future research will look at the issues of electoral bias and tactical voting as a possible cause for the observed regional individual effects.

³⁸Luisa Corrado and Bernard Fingleton, 'Multilevel Modelling with Spatial Effects', University of Strathclyde Business School, Department of Economics Discussion Paper #11-05, (2011)

Tables

Table 1: List of United Kingdom Regions

Region Names
East Midlands
East of England
London
North East
North West
Scotland
South East
South West
Wales
West Midlands
Yorkshire and The Humber

Table 2: Variable Names, Descriptions, and Expected Signs

Variable (tag)	Description	Expected Sign
% Conservative (win)	Dependent Variable: Seat won by the Conservative candidate (1=yes, 0=no)	N/A
Incumbent (incumbent)	Dummy indicating if seat was held by Conservative Member of Parliament prior to 2010 Election	+
Senior Occupation (seniorocc)	% of those working in senior managerial or professional occupations	+
Married (married)	% population married	+
Student (student)	% population who are students	-
Lone Parent (loneparent)	% population who are lone parents	-
White (white)	% population who are white	+
Welfare >1 year (welfare>1year)	% claiming unemployment for more than 1 year	-
Candidate Race (race)	Dummy indicating if candidate was non-white	?
Candidate Sex (sex)	Dummy indicating if candidate was female	?
Marginal (marginal)	In 2005, the difference between winner and nearest rival (one of whom was from the Conservative Party) was < 5%	+

Table 3: Descriptive Statistics

	Min	Max	Mean	St. Dev.
incumbent	0.00	1.00	0.33	0.47
seniorocc	13.70	48.30	25.45	6.54
married	20.90	62.30	47.57	8.42
student	1.60	22.40	4.58	3.04
lonparent	3.60	16.80	7.18	2.34
white	34.50	99.60	92.39	11.44
welfare>1yr	3.53	35.46	16.40	4.26
race	0.00	1.00	0.07	0.26
sex	0.00	1.00	0.24	0.43
marginal	0.00	1.00	0.15	0.36

Table 4: Results for Covariates

	Lower 95%	Mean	Upper 95%
incumbent*	2.6420	5.0385	9.3546
marginal*	0.9779	1.9777	3.4434
sex*	-2.0290	-1.0918	-0.4074
race	-2.5159	-0.8676	0.4423
seniorocc*	0.3576	0.8615	1.5063
married*	0.1128	0.6545	1.3485
loneparent	-1.0422	-0.3411	0.2760
white	-0.4592	0.0157	0.4992
student*	-1.5279	-0.7522	-0.2419
welfare>1yr	-0.4254	-0.1082	0.1875
ρ^*	0.0400	0.6785	0.9770

Table 5: Individual Effects Estimates

	Lower 95%	Mean	Upper 95%
East Midlands	-0.8636	0.1518	1.1551
East of England	-0.4721	0.5212	1.6529
London	-2.1221	-0.8351	0.2370
North East*	-3.4403	-1.6715	-0.5170
North West*	-4.1671	-2.1819	-0.8753
Scotland*	-6.4332	-3.7343	-2.0953
South East	-1.0101	0.3094	1.7981
South West	-1.8684	-0.4213	1.0440
Wales*	-2.4007	-1.1680	-0.3186
West Midlands	-0.4250	0.2131	0.8825
Yorkshire and The Humber*	-1.5069	-0.7059	-0.0831