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5SSG2063 BA Research Tutorials

Has urbanisation caused a greater  
discrepancy in the translation of votes won  
to parliamentary seats in the UK?

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## 1 Introduction

After the 2015 general election in the UK, media commentators noticed that the UKIP won 13% of the national popular vote, but has only one representative (BBC News, 2015). The mismatch between votes share and seats share has been a rising concern in democracies recently. The UK uses first-past-the-post (FPTP), plurality voting with single member districts (SMDs), so the total seats distribution in parliament can be considerably different from the popular vote.

In the US, one of the reasons of a possible increase in electoral disproportionality is increased clustering of people into urban areas. This self segregation phenomena causes single-member plurality constituencies to be inefficient for a party's seat-votes ratio. The debate has mostly focused on the legal workings of the US electoral systems. Comparatively, there is scant attention paid to the UK.

Representative democracy not being representative is an important problem. The division of space decides control of parliament, either through ignorance or malicious intent. This is important to not just politicians, but in fact the very opposite of that – the people deserve to know whether they are picking representatives or are politicians picking voters.

## 2 Literature review

Partisan gerrymandering is the intentional manipulation of constituency boundaries to serve a partisan goal. Gerrymandering can also happen unintentionally, through self-sorting or self-segregation of the population along ethnic, racial, or political lines (Wang, 2016).

The most plentiful literature in a wider scope is from an American legal perspective (Isacharoff, 2002) because because most states leave redistricting power to the partisan state legislatures rather than an independent body (Rakich et al., 2020). They include political implications for incumbents (Gelman et al., 1994), the impact on political parties (Erikson, 1972), the tactics and strategies that can be used (Owen et al., 1988) (Yoshinaka et al., 2009), or mathematical measures and indicators of gerrymandering (Horn et al., 1993) (Niemi et al., 1990). More recent works has studied the effect of gerrymandering on polarization (McCarty et al., 2009) (Pildes, 2011). Stephanopoulos et al. (2018) presents criteria for a good gerrymandering indicator, but the arguments are based on the efficiency gap, which only works for two-party systems, and one of the criteria is past elections in the US. This is by no means universal and there is a sore imbalance in where the academic debate has focused on.

Within the smaller circle of electoral disproportionality in the UK, there are only a few unique geographers, focused on the direction and magnitude of bias over time. Johnston (2002) found that while the Conservative party has benefited from malapportionment more in the 1950s and 1960s, the bias flipped to favour the Labour party from 1992. Labour has maintained their advantage until 2017 (Johnston, 2015) (Johnston, Rossiter, et al., 2017). Labour

could not keep its surplus votes efficiently distributed and the Conservatives started to waste less votes (Thrasher et al., 2016). While the parties' benefit has fluctuated, the Liberal Democrats has consistently suffered from plurality voting (Johnston, Borisjuk, et al., 2012). There is a considerable gap in literature about self-sorting and self-segregation of the population, leading to unintentional gerrymandering.

The fluctuations in electoral bias in the UK suggests that electoral disproportionality is based on wider political factors. However, the need for redistricting is due to the population growth and its ever-changing distribution. In the United States, Johnston, R. et al. (2016) found an increase in spatial polarization and Chen et al. (2013) found that support for the Democratic Party were concentrated in urban areas, gerrymandering themselves and making it difficult to draw maps that reflect the popular vote. There is no parallel for such works for the UK, which is where we aim to cover with this research paper. This paper aims to clarify the relationship between urbanization and self-gerrymandering in the UK, because there are contradictory knowledge between the UK and the US. Based on the few literature for the UK we expect that there is little to no correlation between electoral disproportionality and urbanization as it is dominated by politics, while the debate in America suggests that there is a relationship.

### **3 Methodology**

American researchers and lawyers has used the efficiency gap to measure partisan gerrymandering, but it only works for a two-party system (Stephanopoulos et al., 2015). After the rise of the SNP and the UKIP/Brexit party, it is no longer clear whether the UK is a two-party system or a three party system (Thrasher et al., 2016) (Borisjuk, Johnston, et al., 2010). The Gallagher index works for multi-party democracies so there is no need to make assumptions, such as considering only the Labour-Conservative vote and seat share.

The Gallagher Index was proposed by Michael Gallagher (1991) to measure electoral disproportionality, given by equation 1. The Gallagher index and the Loosemore-Hanby index are the most commonly used in literature (Borisjuk, Rallings, et al., 2004). Unlike the Loosemore-Hanby index, large discrepancies are weighed more than many small ones. The Rae index measures disproportionality by party, so multi-party democracies will score better only because there are many more small parties. In contrast, Gallagher's method measures disproportionality by election. The Gallagher index ranges from 0 to 100, which is important because the Saint-Laguë index is unbounded, making it difficult to interpret values.

The advantage of using these mathematical indices is that they are easy to calculate, as only the overall nationwide election results are needed. Compared to conducting surveys, interviews, and focus groups on a sample of voters, mathematical indices are also much more time and cost efficient, more objective, is easily generalizable, and works well with statistical analysis. On the other hand, our research will miss out on how the voters themselves feel

$$G_e = \sqrt{\frac{\sum_p (V_p - S_p)^2}{2}} \quad (1)$$

Equation 1: The Gallagher Index  $G$  for an election  $e$ , where  $V_p$  is the percentage of votes won by party  $p$  and  $S_p$  is the percentage of seats won by party  $p$ .

about the electoral system, their electoral constituency and their representative.

Urbanization will be measured by the proportion of population living in urban areas. The data is from the World Bank and starts from 1960 to 2019 for the UK (World Bank, 2018). The election results under consideration will therefore start with the election of 1964 to the election of 2019. The most straightforward measure for the concept of urbanization is the number of people living in urban areas, relative to total population. It is easily accessible from a reliable source, but it depends on the definition of urban. The dataset uses the definition from each country, but this is not a problem as we are not comparing between countries.

The Gallagher Index will be calculated for every election between 1964 and 2019. Parties that make up at least 99% of the popular vote will be included for calculation. Every indice value will be joined with the urbanization value for the year of the election. A least-squares linear regression will be used to test if there is a correlation between proportion of population living in urban areas and the Gallagher Index. If necessary, the data might be transformed to improve the linear fit or normalized to satisfy three assumptions in linear regression.

## 4 Findings and discussion

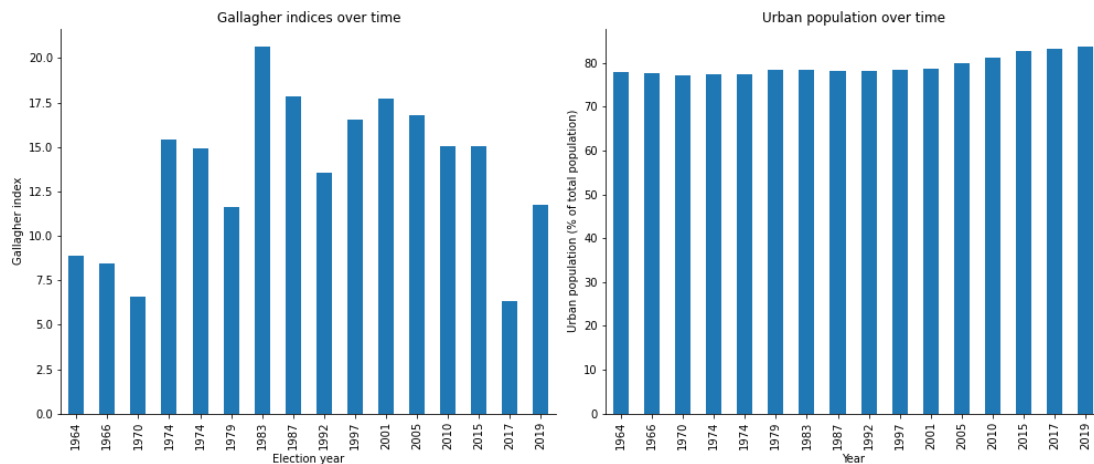


Figure 1: Change in the Gallagher Index and urban population by year

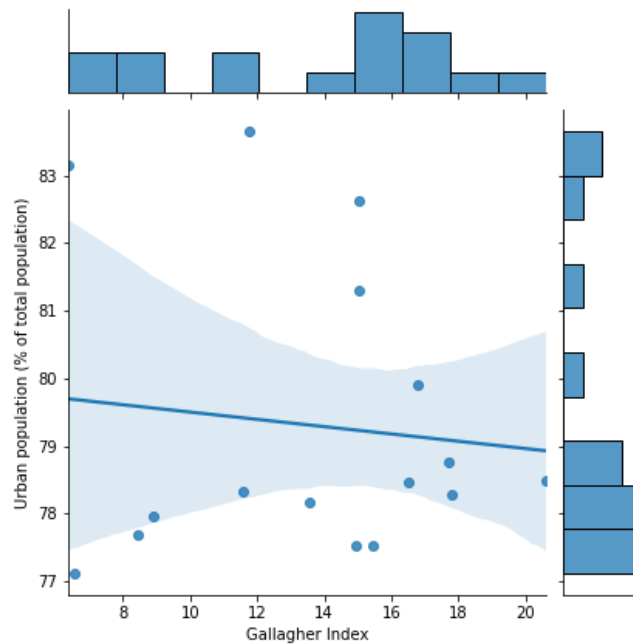


Figure 2: Joint plot showing a linear regression between the Gallagher indices and urban population. A 95% confidence interval is shaded. Histograms are shown for both variables.

By plotting the change in the Gallagher indices and urban population by year, some preliminary analysis and expected findings can be reported (See Figure 1). The urban population has steadily increased over time, but the Gallagher indices fluctuated, so there appears to be no strong linear correlation between them, if at all. Some normalization or transformation should be needed, if possible.

Figure 2 shows the scatter plot of the indices against urban population, with a linear regression best fit line, shaded by a 95% confidence interval. There is no linear correlation because the correlation coefficient is too low and all assumptions are violated. The R-squared value is 0.011. The gradient is -0.209 with a p-value of 0.695 and a 95% confidence that it is between -1.33 and 0.91, so there it is not possible to say whether there is a positive or negative correlation. The histogram on the top shows the distribution of the urban population points. It is not normally distributed as it has a positive skew and a significant cluster at higher values. The histogram on the right shows the distribution of the indices. It is not normal, vaguely showing a bi-modal distribution. The first assumption (for small datasets) that both variables are normally distributed is violated.

The second assumption of the linear regression is that the standardized residuals are normally distributed. Figure 3(a) shows that their distribution is clearly not normal. The third assumption is that the residuals are independent of each other and distributed with no pattern according to a normal distribution. Figure 3(b) shows that the residuals has an n-shaped

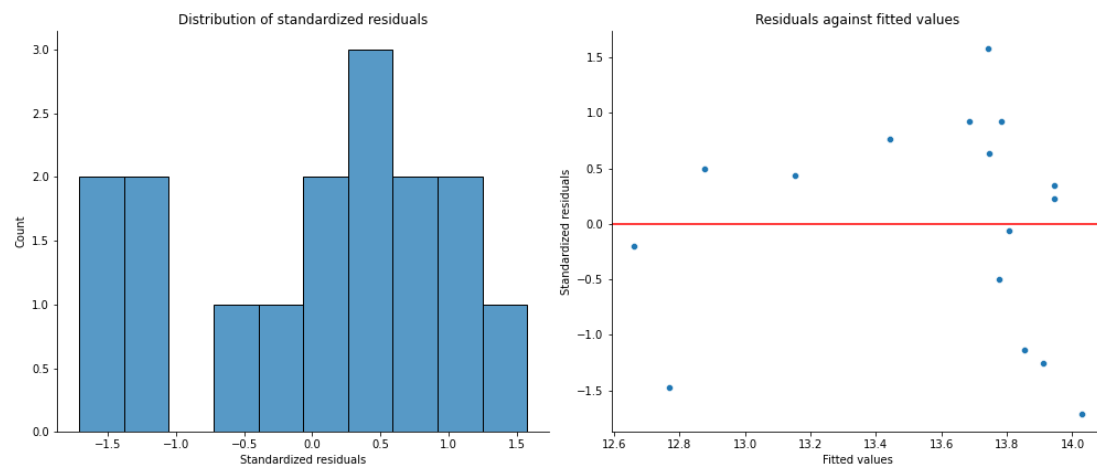


Figure 3: a) A histogram showing the distribution of standardized residuals;  
b) A scatter plot showing how standardized residuals match with fitted values

pattern, therefore the assumption that the two variables has a linear relationship is also broken.

Figure 4 is another visualization of the distribution. The red line indicates what a perfectly normal data set would look like. For both variables, there are significant deviations above and below the red line, making normalization tricky. Neither a logarithm, reciprocal, or a box-cox transformation were able to both reduce the skew and improve the normality for both variables, because both have bi-modal distributions (slightly for the urban population dataset, stronger for the indices). Therefore, there is no possible further analysis or transformation to find a better linear fit. The null hypothesis that there is no linear correlation cannot be rejected due to very low correlation coefficient, very large p-value, very large confidence interval, the violation of all three assumptions, and the inability to transform the data.

## 5 Limitations and conclusion

The aim of this research is to investigate whether urbanization has caused electoral disproportionality. For every election since 1964, we found no possible linear correlation between the urban population (as proportion of total population) and the Gallagher indices. The null hypothesis that there is no linear correlation cannot be rejected due to very low correlation coefficient, very large p-value, very large confidence interval, the violation of all three assumptions, and the inability to transform the data.

This agrees with the debate about constituency boundaries and gerrymandering in the UK, and disagrees with the debate in the US. One reason is because the US has a two-party system but the UK is in between a two and three party system.

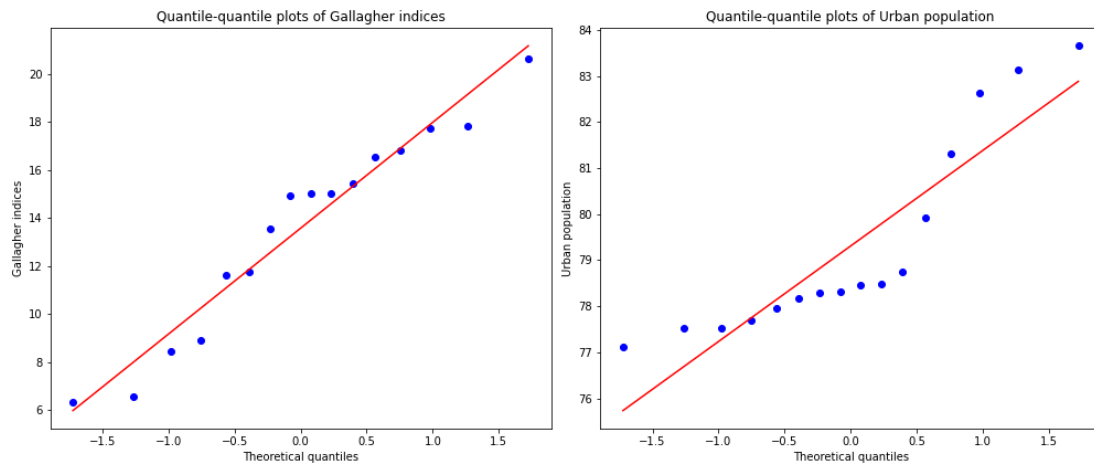


Figure 4: A quantile-quantile plot showing the theoretical normal distribution values with a) the Gallagher indices; b) the urban population values

The sources were limited by only having 16 data points for the urban population starting from 1960. Ironically, the urban population is also subject to the MAUP because the UK has to be divided into districts which are then categorized as urban or rural. The division of those districts will affect the result.

The methodology was also limited by the narrow focus. The concept of urbanization was represented by a single measure, the percentage of urban population. The rate of change or number of urban centres could be considered. Further analysis could be done on different demographics and different countries could show subnational differences. Furthermore, further analysis could use different measures of electoral disproportionality. Such a statistics-focused study also fails to capture the human experiences with the election process in full depth, the media coverage of election results, and the responses from leaders, representatives, and voters. The issues that were pivotal to each election should be considered for further study.

## References

- BBC News (2015). *Nigel Farage resigns as UKIP leader as the party vote rises*. URL: [bbc.co.uk/news/uk-politics-32633719](http://bbc.co.uk/news/uk-politics-32633719).
- Borisyuk, G., C. Rallings, and M. Thrasher (2004). "Selecting indexes of electoral proportionality: General properties and relationships". *QUALITY & QUANTITY* 38.1, 51–74.
- Borisyuk, G., R. Johnston, et al. (2010). "A method for measuring and decomposing electoral bias for the three-party case, illustrated by the British case". *Electoral Studies* 29.4, SI, 733–745.
- Chen, J. and J. Rodden (2013). "Unintentional Gerrymandering: Political Geography and Electoral Bias in Legislatures". *Quarterly Journal Of Political Science* 8.3, 239–269.
- Erikson, R. (1972). "Malapportionment, Gerrymandering, And Party Fortunes In Congressional Elections". *American Political Science Review* 66.4, 1234–1245.
- Gallagher, M. (1991). "Proportionality, disproportionality and electoral systems". *Electoral Studies* 10.1, pp. 33–51.
- Gelman, A. and G. King (1994). "Enhancing Democracy Through Legislative Redistricting". *American Political Science Review* 88.3, 541–559.
- Horn, D., C. Hampton, and A. Vandenberg (1993). "Practical Application Of District Compactness". *Political Geography* 12.2, 103–120.
- Issacharoff, S. (2002). "Gerrymandering and political cartels". *Harvard Law Review* 116.2, 593–648.
- Johnston, R. (2002). "Manipulating maps and winning elections: measuring the impact of malapportionment and gerrymandering". *Political Geography* 21.1, pp. 1–31.
- (2015). "Which Map? Which Government? Malapportionment and Gerrymandering, UK-Style: (The Government and Opposition/Leonard Schapiro Memorial Lecture, 2014)". *Government and Opposition* 50.1, pp. 1–23.
- Johnston, R., G. Borisyuk, et al. (2012). "Unequal and Unequally Distributed Votes: The Sources of Electoral Bias at Recent British General Elections". *POLITICAL STUDIES* 60.4, 877–898.
- Johnston, R., D. Rossiter, and C. Pattie (2017). "When Is a Gerrymander Not a Gerrymander: Who Benefits and Who Loses from the Changed Rules for Defining Parliamentary Constituencies?" *Political Quarterly* 88.2, 211–220.
- Johnston, R., D. Manley, and K. Jones (2016). "Spatial Polarization of Presidential Voting in the United States, 1992-2012: The "Big Sort" Revisited". *Annals of the American Association of Geographers* 106.5, 1047–1062.
- McCarty, N., K. T. Poole, and H. Rosenthal (2009). "Does Gerrymandering Cause Polarization?" *American Journal Of Political Science* 53.3, 666–680.
- Niemi, R. et al. (1990). "Measuring Compactness And The Role Of A Compactness Standard In A Test For Partisan And Racial Gerrymandering". *Journal Of Politics* 52.4, 1155–1181.



- Owen, G. and B. Grofman (1988). "Optimal Partisan Gerrymandering". *Political Geography Quarterly* 7.1, 5–22.
- Pildes, R. H. (2011). "Why the Center Does Not Hold: The Causes of Hyperpolarized Democracy in America". *California Law Review* 99.2, 273–333.
- Rakich, N. and E. Mejía (2020). *Republicans Won Almost Every Election Where Redistricting Was At Stake*. URL: [fivethirtyeight.com/features/republicans-won-almost-every-election-where-redistricting-was-at-stake/](https://fivethirtyeight.com/features/republicans-won-almost-every-election-where-redistricting-was-at-stake/).
- Stephanopoulos, N. O. and E. M. McGhee (2015). "Partisan Gerrymandering and the Efficiency Gap". *University of Chicago Law Review* 82.2, 831–900.
- (2018). "The Measure of a Metric: The Debate over Quantifying Partisan Gerrymandering". *Stanford Law Review* 70.5, 1503–1568.
- Thrasher, M. et al. (2016). "Electoral bias at the 2015 general election: reducing Labour's electoral advantage". *Journal of elections public opinion and parties* 26.4, 391–411.
- Wang, S. S.-H. (2016). "Three Tests for Practical Evaluation of Partisan Gerrymandering". 68 (6).
- World Bank (2018). *Urban population (% of total population)*. URL: [data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS](https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS).
- Yoshinaka, A. and C. Murphy (2009). "Partisan gerrymandering and population instability: Completing the redistricting puzzle". *Political Geography* 28.8, 451–462.