

# **Modelling the geographic distribution of places of birth of UK members of parliament over time**

## **Introduction**

The central governing body of the UK, the UK government, derives its democratic authority from the approval of Parliament. Parliament, being bicameral, is composed of three entities [1]: the House of Commons, the House of Lords, and the Monarchy. Every UK citizen is entitled to input on how they are governed [2] which is primarily embodied by their right to vote. Ensuring this vote translates to meaningful representation can be challenging. In the UK, this vote is represented by an elected member of Parliament (MP) that represents the elector's constituency in a first-past-the-post voting system. Consequently, every constituency is represented to ensure that all constituency areas, and by extension the population, are represented in government. However, the degree to which this system produces geographically representative MPs is dubious.

This report causally models the geographical distribution of MP's place of birth, at a regional and historical county level, temporally from the first Parliament to present day. This analysis facilitates an evaluation of how geographically representative the MPs elected over time have been and highlights areas that are underrepresented or overrepresented.

Fair representation, as asserted by Philips [3], is achieved by there existing a loose correspondence between the experiences of those in government and their electorate [4]. This analysis provides an important dimension in answering how well the UK government has achieved fair representation. It finds specific relevance in understanding whether the historic regional funding bias [5] can be attributed to the geographic representativeness of MPs.

## **Material and Data**

Wikidata, an open knowledge base containing structured data, was the starting source of data for this report. Queries to Wikidata were made using the SPARQL Endpoint interface to Python [6] which is a Python wrapper around a SPARQL service. These queries gathered the Wikidata identifiers of the MPs, the Parliament they served in, the electoral district, the parliamentary party and the place of birth if known. However, the returned data for the place of birth was sparse and so supplementary sources were incorporated.

To mitigate the complexity of ensuring separate sources referred to the same entity, only sources that linked to Wikidata were considered. The genealogy websites Wikitree [7] and Geni [8] in combination with the Rush Parliamentary Archive [9] database and Wikipedia [10] were chosen. Wikidata stores an identifier that uniquely identifies the entity for these websites.

Wikitree, Geni and Rush contained structured data which allowed the place of birth (which was consistently on the same place on the page) to be extracted by sending a get request to the page (using the requests library [11]) and extracting the content using the BeautifulSoup [12] library. Wikipedia, on the other hand, contained both structured and unstructured data. The structured data was in the form of an infobox which was extracted through the same procedure as the other sources except pattern matching (using regular expression library [13]) was used to distinguish place of birth from date of birth.

To extract the place of birth from unstructured text part of speech (POS) tagging was used. POS is the process of labelling words in a text as a specific part of speech through considering the definition and context [14]. This was done by utilising Spacy's [15]

pretrained English pipeline ‘en\_core\_web\_sm’ which uses statistical models to make predictions of which tag is most appropriate. To utilise POS to return the place of birth, the dependency tree (for sentences that had the word born or its synonyms in it) created by POS was parsed (see Figure 1). The place of birth is the n-gram that is an object of a preposition and its parent is an adposition. The adposition’s parent also needs to be the verb born.

To model this data, the geopolitical divide chosen was both the regions of the UK and historical counties. As asserted by the National Statistics Office [16], these are stable regions which is important for discussing temporal trends so different periods can be compared appropriately. To find the relevant administrative geography that the place was contained within the Index of Place Names (IPN) was queried.

The number of MPs born in an area is population dependent and thus should be normalised with population data. Population data for Great Britain is collated by the resource Vision of Britain [17] - a web-based portal of the GBH-GIS Project Great Britain Historical GIS. When population data was missing it was imputed using either linear, quadratic, or cubic interpolation depending on which fit the data most appropriately [18]. When the population data did not map exactly to historical counties (which was rare) the population was divided in proportion to land surface area.

To obtain population data for Northern Ireland, first the images of census data from [19] were pre-processed and then Optical Character Recognition was performed using Python-tesseract. However, this method occasionally extracted incorrect numbers and the data was too extensive to be checked manually. A freedom of information request to Northern Ireland Statistics and Research Agency (NISRA), revealed this information was not held by this body as the administrative geographies in Northern Ireland have not aligned with counties since the Local Government Act -Northern Ireland- 1972. Therefore, as it would be extremely difficult to estimate the population data at a historical county level, Northern Ireland was analysed at a country level as to not make inaccurate predictions with data from NISRA.

## **Analysis**

To model the geographical distribution a variety of visual tools were employed: namely Multiple Correspondence Analysis (MCA) [20] (Figure 2), Multiple Factor Analysis (MFA) [21] (Figure 3), Principle Component Analysis (PCA) [22] (Figure 4) and choropleth maps. MCA extends correspondence analysis and facilitates the analysis of relationships between categorical variables. It can be viewed as a more general form of PCA where the variables are categorical as opposed to quantitative. MFA analyses the relationship between blocks of variables and pursues a visual representation of the general structures in these blocks. These tools facilitate the visualisation of any inherent structures in this high-dimensional data. The Python libraries Prince [23] and Scikit-Learn [24] implementations were utilised to achieve this.

The choropleth maps were plotted using historical county shapefiles [25] and geopandas [26]. For each Parliament, the number of MPs born in a historical county divided by the population of that county was mapped (Figures 5 -10). As there was such discrepancy between Middlesex and the other counties, subtle differences between other counties were not clearly visualised. Therefore, the data was scaled using a power transform [27] to better visualise the subtle trends.

First one can look at Figures 11 and 12. Initially, one can see Scotland and the Eastern region are well represented whilst northern England and western regions like the West Midlands and Northern Ireland have the least amount of representation making up approximately 10% of

the 5<sup>th</sup> Parliament and 15% of the population at that time. The Eastern region stays well represented from the 10<sup>th</sup> to the 20<sup>th</sup> Parliament, joined by the East Midlands and the South West. Northern regions such as Yorkshire, the North East and Northern Ireland are the least represented in these Parliaments (making up approximately 11% of the 15<sup>th</sup> Parliament and 14% of the population). From the 20<sup>th</sup> to the 30<sup>th</sup> Parliament it is clear that some northerly regions, like Scotland and the North West, regain representation whilst easterly regions like Yorkshire and the North East continue to be the least represented. Between the 30<sup>th</sup> and 40<sup>th</sup> Parliaments, the northern regions Scotland and the North West continue to be well represented (making up approximately 27% of the 35<sup>th</sup> Parliament and 23% of the population) and eastern regions like Yorkshire and the South East are the least represented (making up approximately 15% of the 35<sup>th</sup> Parliament and 26% of the population). From the 40<sup>th</sup> to 50<sup>th</sup> Parliament, Wales becomes one of the most represented (making up approximately 11% of the 45<sup>th</sup> Parliament and 4% of population) and Eastern England and the West Midlands become some of the least represented regions (making up approximately 9% of the 45<sup>th</sup> Parliament and 18% of population). In the most recent Parliaments, northerly regions like Scotland, the North West, the North East and Wales are well represented whilst easterly regions like Yorkshire, Eastern and South East are the least represented.

A striking trend is the non-linear evolution and consistent overrepresentation of London (seen in Figure 12) which peaks at around the fourth Parliament (where 31% of MPs were born in London despite London making up approximately 5% of the population in 1807) and proceeds to decrease. This trend is also shown in Figures 5 - 10 and Figure 4 as London's distance from the other points indicates its dominant representation. This can be explained the work of by Kjaer and Pedersen [28] whereby the closer geographical relationship between the politician born in London and the Houses of Parliament means that the costs associated with pursuing a legislative career are lower - making it more likely that they will pursue a career in politics.

Furthermore, one can see that South Eastern regions are well represented initially, with this representation decreasing in modern day (Figure 11). This can be explained by the introduction of the 1911 Parliament Act [29] whereby MPs were afforded a salary. Previously being an MP had only been viable for well-off men with independent means however the 1911 Parliament Act ensured that ordinary people could sustainably pursue a career in Parliament. This meant that, in general, the overrepresentation of richer regions, like the South East and London [30] decreases as observed.

One can also observe the trend whereby certain neighbouring regions (such as Scotland and the North West or the East and West Midlands) display a similar pattern. This can be seen in Figure 4 where one can observe neighbouring regions are sometimes in proximity. As [31] outlines, people find their local social circles very influential which in combination with spatially bias information flows [32] gives rises to similar voting trends between neighbouring areas [33]. Local voting trends are significant as these correlate to the MP elected which is responsible for the geographical biases observed. This effect is observed in variable amounts because of differing infrastructure links between regions.

An additional striking point is the decrease in disparity in the representation seen in Figure 12. Figure 3 visualises this whereby one can see three significant clusters where similar Parliament numbers cluster together. For early Parliaments one can see this first cluster is more spaced out which is due to the larger range of representation found in early Parliaments. The third cluster, representing the most recent Parliaments, is quite tightly packed which signifies the decrease in disparity. One can expect this effect as the number of MPs in parliament is reasonably consistent (with variation between 615 and 707 [34]), however the

population is increasing. Subsequently, this ratio of number of MP per 10000 people decreases. Northern Ireland is the exception as the Great Famine caused a large decrease in population. This decrease in disparity also indicates that geographically, overtime, Parliament has become more representative. This can be attributed to the Reforms Acts [35] which were a result of the social changes associated with industrial growth and the decline of agriculture [36]. As voting rights became more representative [37] [38], the MPs voted in became more representative. This because similarity between a voter and a candidate is an important factor for the voter [39].

One can now ask to what degree these regional biases vary by political party. A lot of Labour MPs were born in Yorkshire initially and overtime more this expanded to include the surrounding areas Lancashire, Northumberland, and Durham (seen in Figure 14). Conservatives are more likely to be born in Southern areas such as Kent (seen in Figure 15). Projecting this data, in Figure 2 indicates evident clumping but it does not allow for meaningful conclusions.

## **Evaluation**

To evaluate these findings one can utilise the TRACE framework [40]. This report gave a reasonable formulation of the problem by stating the type of model (causal) and outlining questions it focused on answering. However, this report did not provide a specification of necessary outputs because they are quite general. Model description was adequately met as the graphing tools were outlined with detail appropriate to the word limit. This model employed certain simplifying assumptions. For example, not all MPs would have served the full term and so arguably even if they were born in that region, they would not have fully represented that region. However, this simplification is justified as modelling this would have been complex and the effect is not significant. The implementation verification was achieved by defining requirements for all functions (akin to an Agile Scrum methodology) and clearly separating sections.

To evaluate the data one can first evaluate the data constraints. Firstly, the temporal quality of data is not consistent. Civil registration regarding the details of birth become mandatory upon the introduction of the Registration of Births and Deaths Act 1874 [41]. Before this, data was recorded by various churches and was not standardised and so the quality is likely poor. Therefore, the assumption that each time period could be compared fairly is null. This undermines the confidence in precise statistics however because of the volume of data collected, especially in earlier years, the general regional trends are likely to hold.

The second limitation is a regional bias in recording. Specifically in earlier periods, more affluent and populous areas had better recording equipment and higher literacy rates which makes recording and storing this place of birth data much more likely for MPs from richer areas. This undermines the result that richer areas were initially overrepresented however as the reasoning is justified it still likely holds but to a lesser extent.

Furthermore, to evaluate the quality of data this report utilises, Wikidata, as the primary data source, can be evaluated. Positively, Wikidata helps avoid ambiguity because of its structured nature and because each entity is uniquely identified with unique identifiers to other sources. Therefore, this report is confident that the data gathered is the data that was intended to be gathered. Wikidata also uses a sophisticated automated vandalism detection tool that detects 89% of vandalism attempts [42]. This forms a reasonable argument for the reliability of the data gathered from Wikidata.

On the other hand, Wikidata (as the data repository for all Wikimedia projects) inherits a gender bias whereby women's biographies are less likely to be recorded [43]. This could contribute to women being less likely to be featured in this report's analysis because there was no recorded place of birth which makes the conclusions less representative. Furthermore, as Wikidata is a secondary knowledge bases that hosts and links to knowledge, the quality of the data provided is dependent on the secondary knowledge. However, because Wikidata does not require (only encourages) users to cite a reliable source, often the reference to the source of knowledge is missing – leaving no indication of the strength of the source employed. Therefore, to assess the quality of the data employed one can use the pretrained ORES algorithm Wikidata provides. The average score of the MPs included in this analysis is 3.56 (out of 5), with a very small amount of regional variation but a significant temporal bias with the score increasing over time. This indicates a reasonable standard which is augmented when one considers the dependency this report had on other sources (such as Parliamentary Rush) hence the quality of data is sufficient to make general trends reliable.

Next one considers model output corroboration. This report finds Scotland, the North West and London are quite well represented in the present Parliament which is in line with chart 3 presented in [44]. Easterly regions and the Midlands are underrepresented in chart 3 which is what this report finds. However, the order in which the regions are over and underrepresented do not line up exactly. However, one can attribute this to the fact that this chart presents data on 473 MPs whilst this report has gathered data on 655 (including MPs that were replaced due to illness). It likely that the regions that do not exactly line up have an absence in data. Furthermore, these results are mirrored in [45] whereby Gandy finds Scotland, London, Wales and the North West have the highest number of mean national population rates (per million) for MPs. There is again a disparity in ordering which can be attributed to differing sources where [45] uses sources that require a financial payment.

One can also loosely compare this report to literature that looks at how locality influences a politician's chances of election. For this report to concretely conclude on the effect of locality further analysis and data (regarding the electoral district of MPs) would be required. Moreover, it would be difficult to quantify to what degree voters were aware of an MPs place of birth and so isolate the effect of locality especially in early Parliaments where access to databases or resources that store this information was limited. However, one can broadly say that if there was general trend of preference for MPs that were more local, this would be reflected in a reasonably geographically representative Parliament which, except for London, is what this report loosely observes in the present Parliament. This falls in line with the trend observed by other literature [46] [47]. However, only loose model corroboration can be concluded with respect to this literature because this report does not explore locality sufficiently.

## **Conclusion**

This report has modelled the geographic distribution of MPs overtime from the first Parliament to modern day Parliament. It has found that the representativeness, in terms of the place of birth, of MPs has improved however there is still disparity in the modern day and fair representation [3] (particularly with the overrepresentation of London) has not been achieved. This report recommends that greater effort should be put to decrease the cost associated with pursuing a legislative career in these underrepresented regions so Parliament can become more geographically representative. It also finds that the most represented regions (such as Scotland) do not align with regions associated with the funding bias and hence the regional funding bias is not caused by the skew in MPs place of birth.

This report has acknowledged its limitation, mainly composed of data constraints, and placed itself in the context of additional literature. It found that the data is of reasonable quality and the results presented are reasonably in line with additional literature with the differences being attributable to the differing data sources.

To extend this report, one could analyse the degree to which gender and age affects the regional distribution. Moreover, one could look at politician mobility and the relationship between the constituency the MP represents and place of birth and the changes in this relationship over time. Finally, this report postulates the voting trends that give rise to regional biases however one could also analyse structural trends - such as a high number of seats for sparse populations - that cause varying levels of representation.

## Figures

Figure 1: Dependency Tree

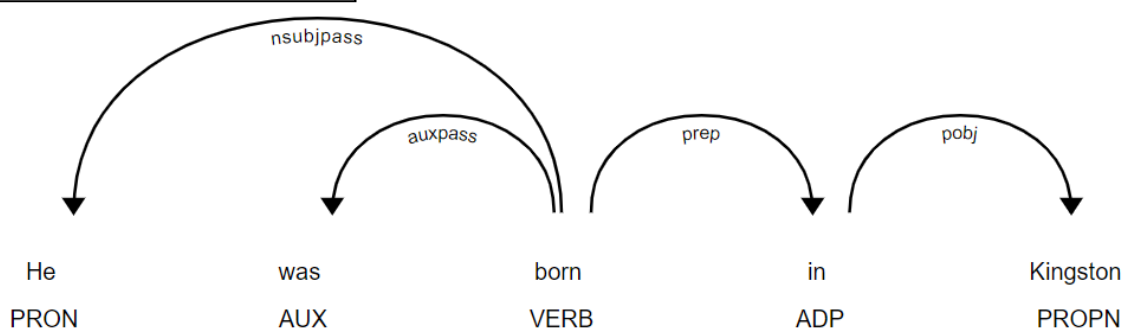


Figure 2: MCA visualising political party, region and Parliament number

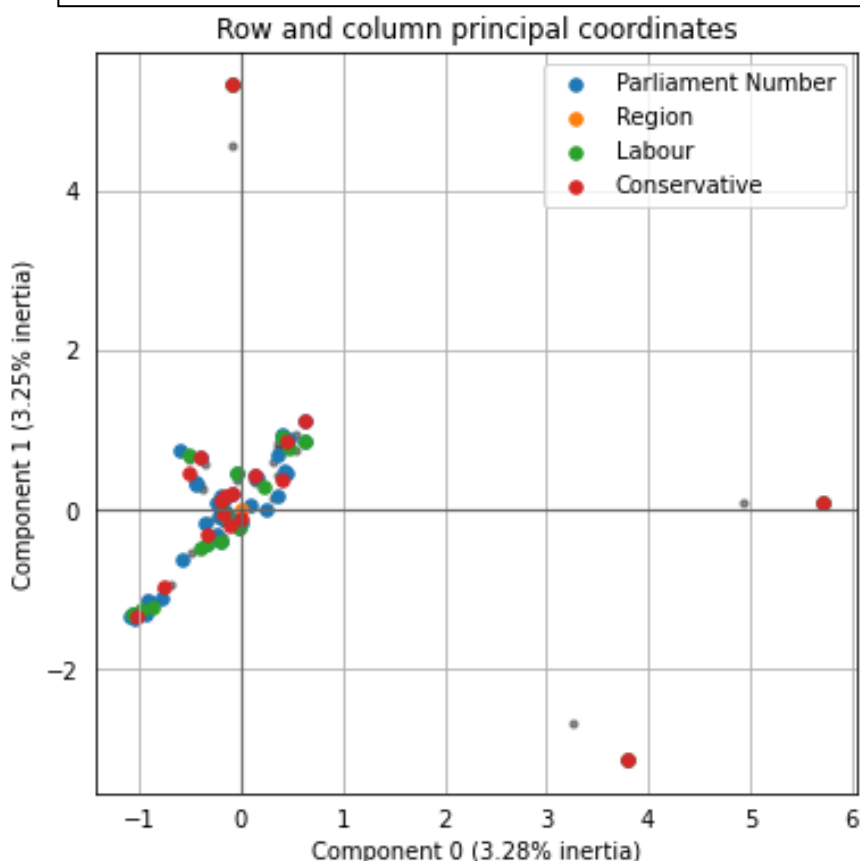


Figure 3: MFA visualising Parliament number where variables had been grouped by region

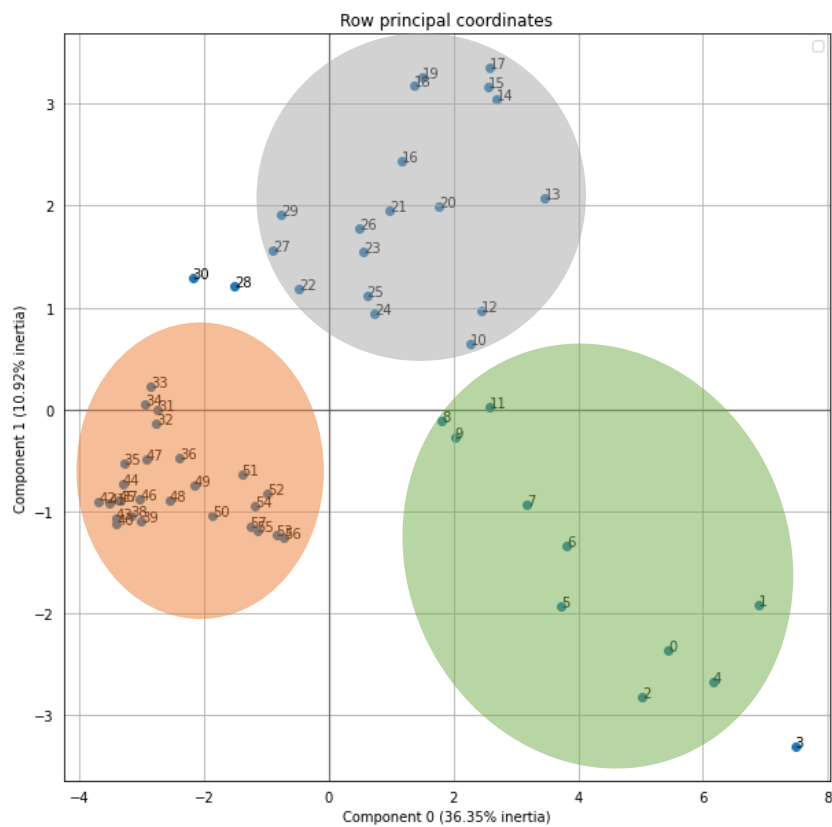


Figure 4: PCA projecting number of MPs born in region per 10000 of the population in region and parliament number

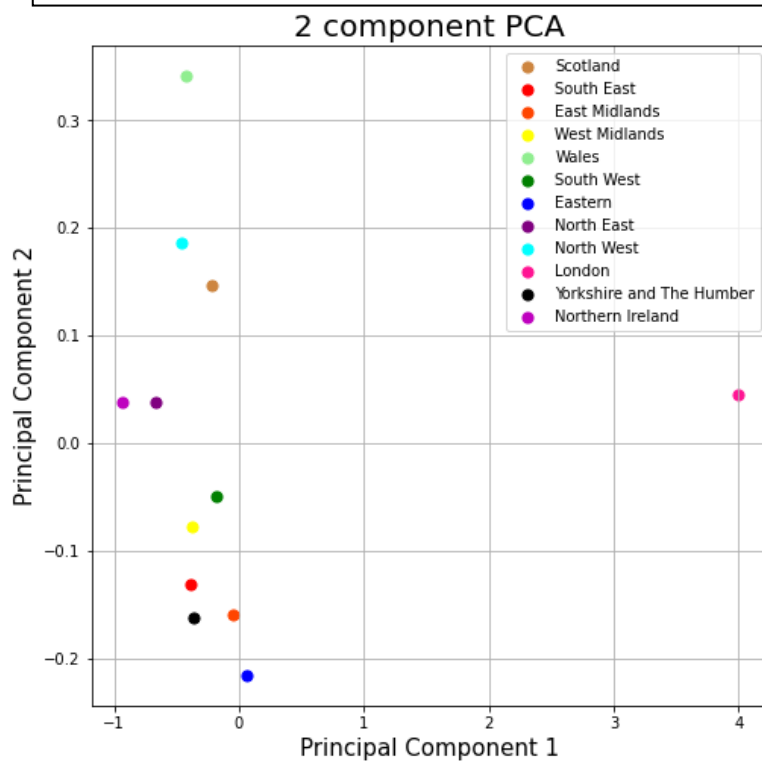


Figure 5 – 10: Choropleth for different Parliament numbers. The power transformation of the number of MPs born per 1000 population in each county has been plotted

Figure 5: Parliament number 7

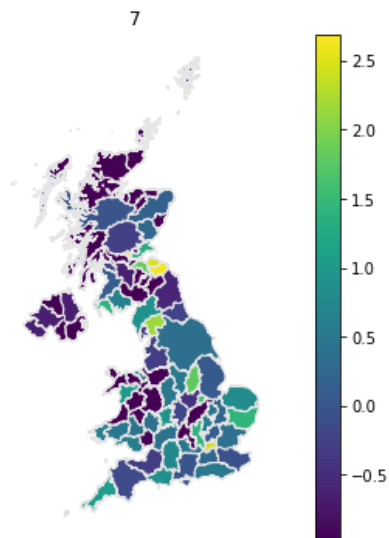


Figure 6: Parliament number 18

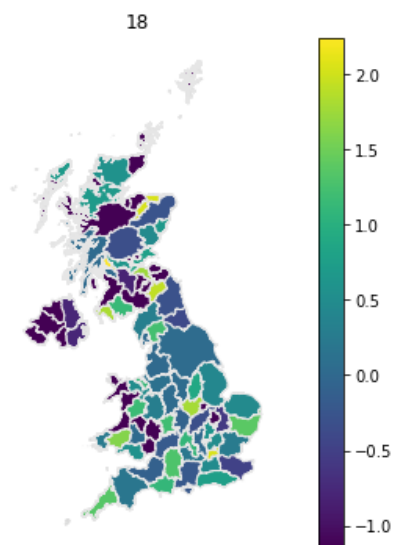


Figure 7: Parliament number

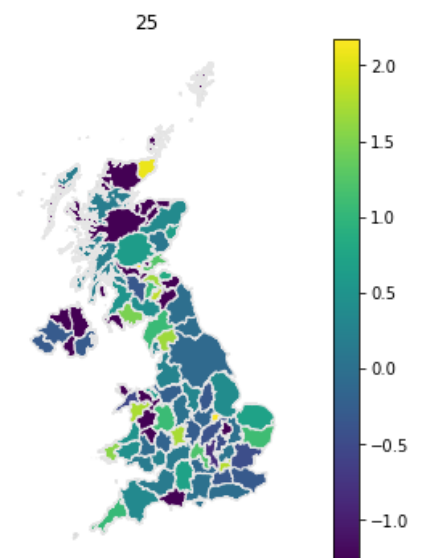


Figure 8: Parliament number 34

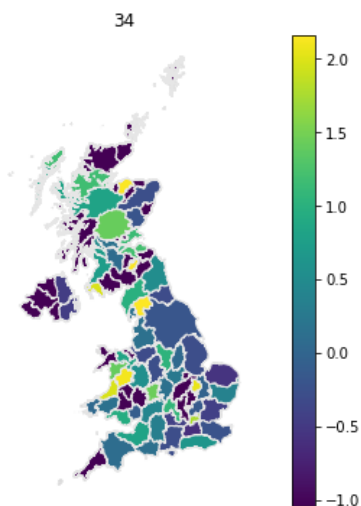


Figure 9: Parliament number 42

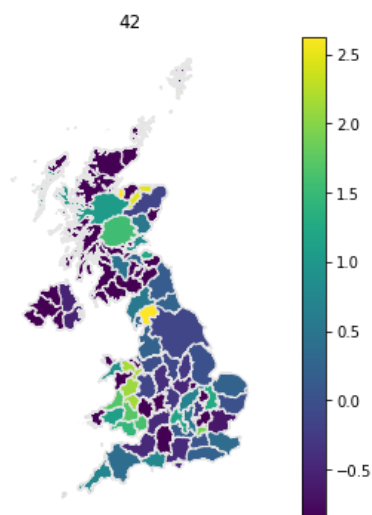


Figure 10: Parliament Number 54

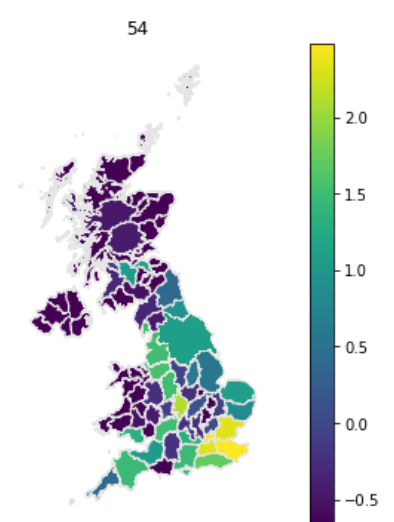




Figure 11: Number of MPs born per 10000 of population by region (without London)

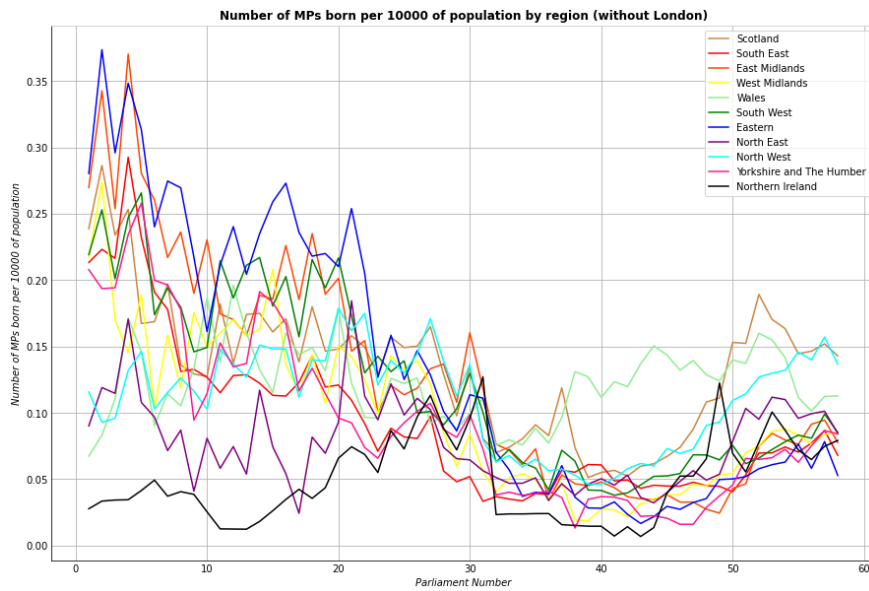


Figure 12: Number of MPs born per 10000 of population by region (with London)

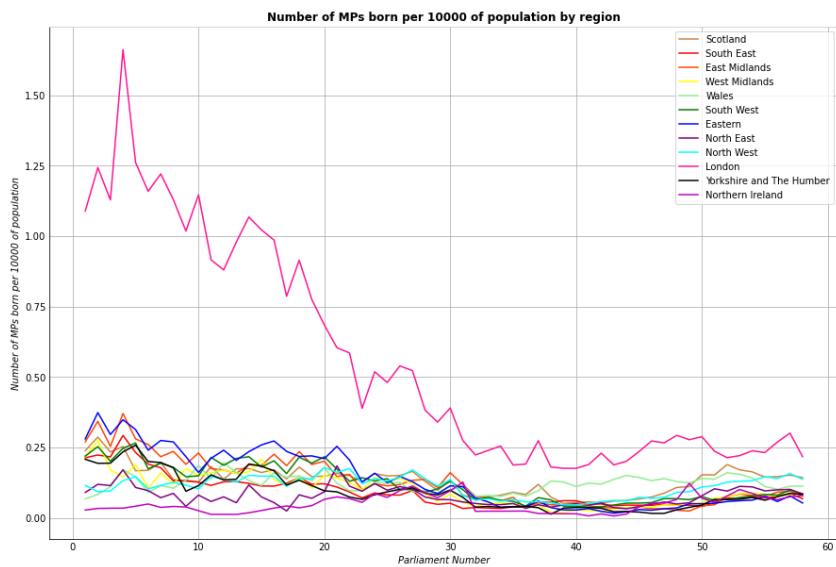


Figure 13: The power transformation of the number of MPs born per 1000 population in each county has been plotted for the Conservative Party in 54<sup>th</sup> Parliament

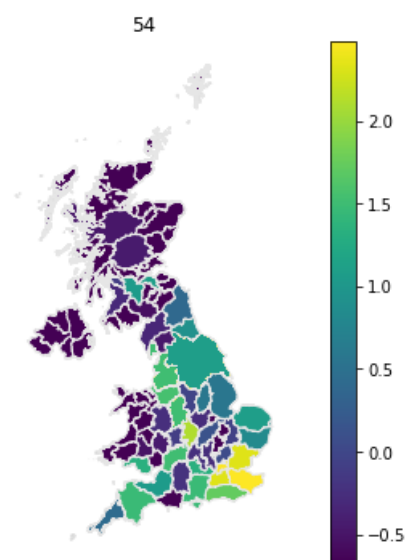
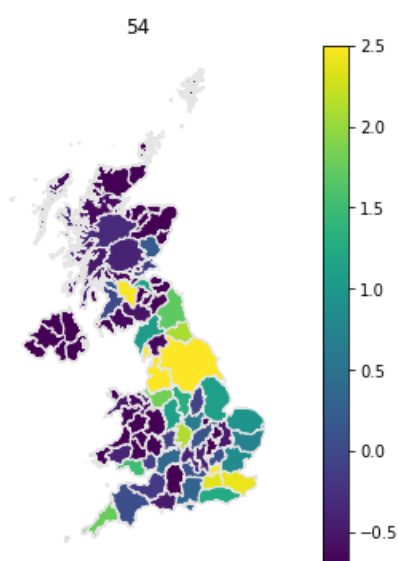


Figure 14: The power transformation of the number of MPs born per 1000 population in each county has been plotted for the Labour Party in 54<sup>th</sup> Parliament



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