

## Voter Power Index

### Statistical basis of the Index

UK national government elections back from 1954 to 2005<sup>1</sup> have been analysed to establish a model of the likelihood of any constituency seat changing hands between political parties. Seats were categorised by the size of the margin between the first and second placed candidates for every election and then the number that changed hands in the next election was observed. Table 1 shows the proportion of seats that changing hands split by different categories of marginality.

<b>Table 1</b>	No. of seat changes	Total No. of Seats	Proportion changing hands
0-2%	136	329	0.413
2-4%	103	292	0.353
4-6%	105	326	0.322
6-8%	77	352	0.219
8-10%	59	332	0.178
10-15%	75	862	0.087
15-20%	55	787	0.070
20-25%	25	771	0.032
25-30%	13	617	0.021
30-40%	8	827	0.010
40%+	5	627	0.008
Total	661	6122	0.108

An exponential regression analysis was carried out with the resulting curve fitting the data very well (R-squared = 97.3%) – see figure 1. This analysis shows (unsurprisingly) that the more marginal the seat the higher probability of the seat changing hands at the subsequent election.

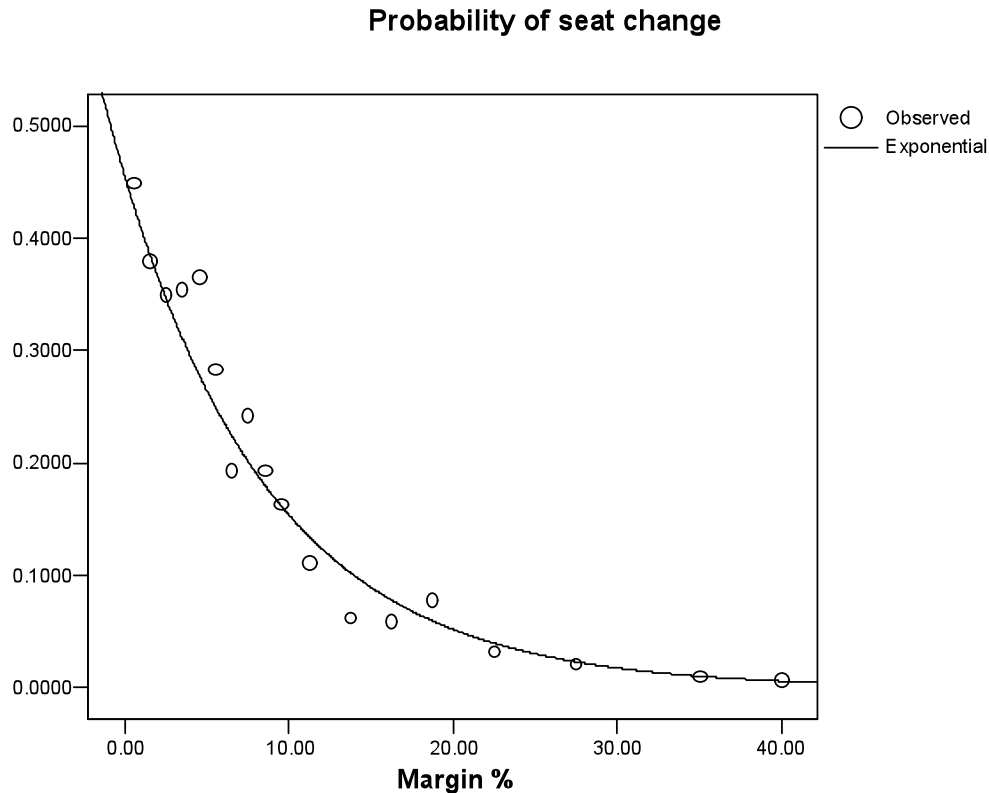
The regression curve enables an estimation of the probability of each seat changing hands – this is the ‘Probability to Swing Indicator’ (PSI) for each constituency. For the most marginal seats the PSI approaches 0.5, which means it becomes like tossing a coin (over many elections) as to which party (between the top two) would win the seat.

No estimations for second order effects are directly allowed for, though it is possible that a party can win a seat from third position. However this is always more unlikely than a party from second place winning the seat – constituencies are normally two-horse races. In the model these events have

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<sup>1</sup> 1970-4 and 1979-83 are excluded due to significant boundary changes, making direct comparisons impossible.

already been partially allowed for, as the proportion of seats that change hands, detailed in Table 1, does not distinguish between whether a seat changed hands to the party placed second or third (or indeed a new party or independent candidate).



**Figure 1: Plot of Marginality of seat to probability of a subsequent seat change.**

To estimate the power that an individual voter has to influence the outcome of a seat the IPS has to be adjusted by the relative size of the constituency. The average number of electors per seat was 68,845 in 2005, whereas the smallest seat (Na h-Eileanan an Iar in the Scottish Islands) has only 21,576 and the largest (Isle of Wight) has 109,046. An adjustment for constituency size (Adj) is calculated by dividing average number of electors per seat (68,845) by the number of electors in a particular constituency.

The potential for a voters living in each constituency in the UK to influence a change in the structure of government – the voter power index (VPI) is then estimated by multiplying the ‘Probability to Swing’ by two (as potential is defined as full, equalling one, when the seat is totally marginal, theoretically just one vote between the first two parties, and the PSI ≈ 0.5) and then weighting it with the adjustment factor:

$$VPI = (PSI * 2) * Adj$$

The VPI is therefore the same for every elector living in the same constituency, and has been calculated for all seats in England, Scotland and Wales.

### **Estimated Euro-VPI**

In order to create a comparison to the VPI for the UK national elections an estimation has been made for an equivalent Euro-VPI for the UK European elections which use a multi-member constituency system.

Within each of the eleven regions in England, Scotland and Wales, seats are allocated in rounds, with as many rounds as there are seats to be awarded. In the first round the party with the most votes is awarded a seat, and this 'costs' them half of their votes. In the next round the seat is allocated to the party with the most votes left – if a party wins a second seat on this basis they only lose a further third, another seat and it is a quarter, a fifth etc. In the final round of allocations the 'margin' between the party that wins the final seat and the party that comes second in this round can be calculated. This defines the marginality of the region in that it would only take this swing for a different allocation to have taken place, and hence an ability to influence the outcome of the election.

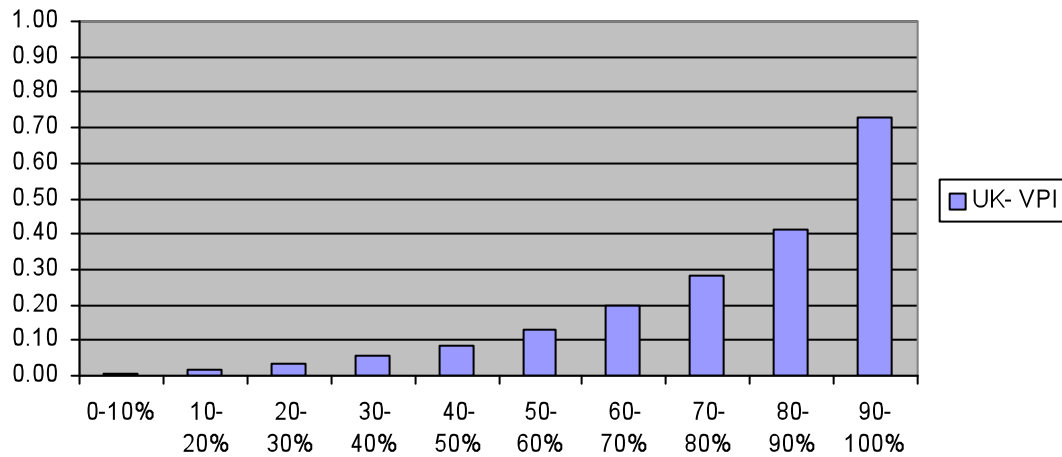
As European elections are multi-member constituencies, an estimation is made of second order effects (they are never just two-horse races) and a change in seats allocated is likely to come from any direction. However no third order effects (a party winning from fourth place) are included.

The European elections started in 1979 but only became multi-member seats in 1999, so it is not feasible to create a detailed probabilistic model such as for the UK parliamentary elections. So instead the regression model from UK elections is used to estimate the probabilities of swings occurring in the European elections – this does not seem unreasonable as they occur within a similar political context and if anything will underestimate the volatility of the European elections (eg UKIP's strong performance). A similar adjustment for constituency (region) size is made though this is not nearly such an important factor for European elections.

**Euro-VPI = Probability of swinging (to 2<sup>nd</sup> or 3<sup>rd</sup> party) \* 2 \* Adj**

## Some Results – Draft (need to be checked but very close to be right)

Distribution of Voter Power Index - UK Elections 2001/5



Decile Group	VPI average
0-10%	0.0047
10-20%	0.0155
20-30%	0.0327
30-40%	0.0549
40-50%	0.0875
50-60%	0.1283
60-70%	0.1964
70-80%	0.2839
80-90%	0.4102
90-100%	0.7299

This represents the following uneven ratios:

Top 10%: Bottom 10% = 155:1

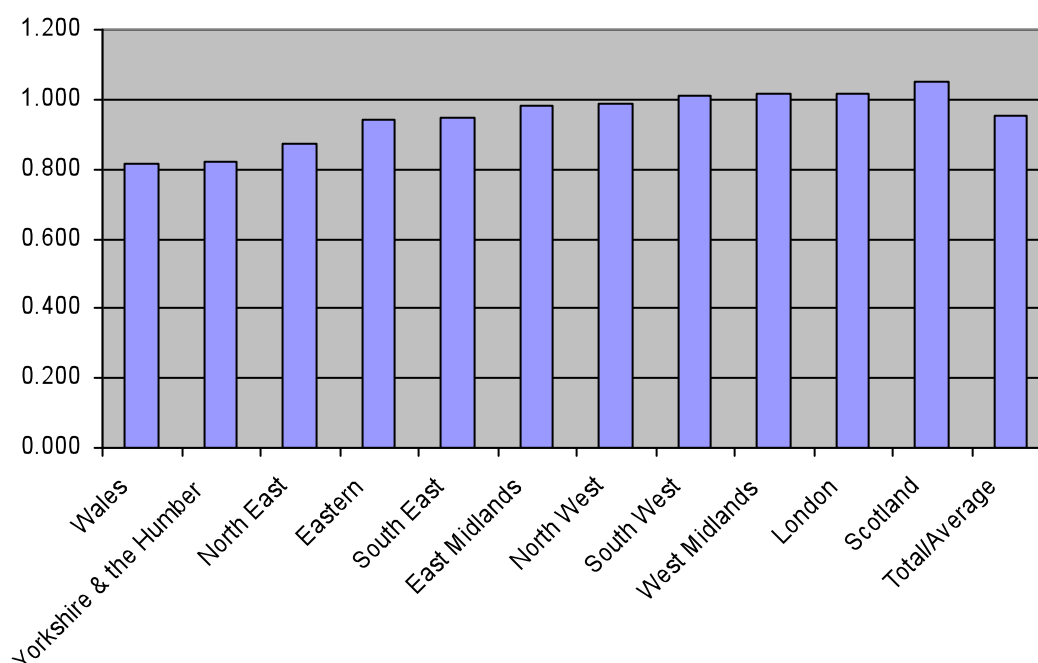
Top 20%: Bottom 20% = 56:1 (gross income equivalent 15:1, redistributed income 4:1)

Top 50%: Bottom 50% = 9:1

The average VPI is equal to 0.196 – this can be considered an efficiency measure – so the system is only working at 19.6% efficiency. Pure PR (as in Israel) would operate at 100% efficiency – every vote would count and it would count equally (no distribution effects).

The estimated Euro-VPI is shown below.

UK European Elections - Voter Power Index Estimations - 2004



The system is operating at 96.2% efficiency and there are small distribution effects due to a combination of constituency size and 'lumpy' voting patterns – but it is hugely more procedurally just.

### Structural inertia to change.

The VPI can also be allocated to political parties. In that the party's spread of seats has different average VPIs.

Winner of seat 2005	Average VPI	Party in 2nd place 2005	Average VPI
Con	0.297	Con 2nd	0.178
Lab	0.106	Lab 2nd	0.353
LDem	0.322	LibDem 2nd	0.116
PC	0.375	PC 2nd	0.203
SNP	0.687	SNP	0.070
Other	0.023	Other 2nd	0.004
Total	0.194	Total	0.194

So the higher the VPI the more likely you can influence a change of seat. So Labour are not only most secure in their seats but also best placed to come from second place and pick up seats.

