The Voter Power Index

The effects of the Alternative Vote on the
distribution of electoral power in the UK

Contents

Executive Summary

This report examines the distribution of electoral power amongst voters in the UK and the possible impact of a change in the electoral system. It compares the distribution under the current First Past the Post system (FPtP) with the Alternative Vote system (AV) which will be put before voters in the May 2011 referendum. Our aim is to help voters consider the impact of the choice on offer in the referendum.

Our analysis shows that moving from FPtP to AV will mitigate some of the distortions of the current system, but that inequalities and inefficiencies in the distribution of voter power would remain.

Our research builds on **nef**'s 2005 report *Spoiled Ballot* which developed the first Voter Power Index (VPI).[1] The VPI measures the power of voters to change the outcome of the election. Voter power is measured for each constituency and is determined by the chance of it changing hands and the number of voters. The more marginal and smaller the constituency, the higher the VPI score.

The key findings of our analysis are that moving from FPtP to AV would produce:

- An increase in the average power of UK voters from 0.285 of a vote to 0.352 of a vote (where a score of 1 is a fair vote).
- An increase in the number of very marginal seats from 81 to 125, an increase of 44 seats.
- A reduction in the number of very-safe seats from 331 to 271, a reduction of 60 seats.
- A small reduction of inequality in the power of votes with the most powerful fifth of electors going from having 21 times the power of the least powerful fifth down to 18 times.

While these improvements are significant, moving to AV will go only some way towards mitigating the unequal power of votes and the wasted votes within the British electoral system. Voter power is unevenly distributed under both systems and the fact that the average VPI score for each system is well below the ideal score of 1 suggests that neither system is very good at translating votes into electoral power.

The inequality and inefficiency are caused by the use of single-member constituencies. This produces large numbers of very safe seats where votes for one party pile up into large majorities, while votes for other parties are effectively discarded. To fundamentally address these issues would require moving to larger constituencies which elect more than one member of parliament. This is not currently being considered by the Government and is not an option in the forthcoming referendum. VPI is one measure

among several factors to be considered when comparing different electoral systems.

Voter Power under First Past the Post

Our findings make two important points about voter power in the UK. First, they show that voter power is highly uneven across the country, or rather between constituencies. Under the current system of First Past the Post (FPtP), the most powerful 20 per cent of voters have 21 times as much power as the least powerful. This is the statistical reflection of a well-understood fact: it is the voters in marginal constituencies who determine the outcome of an election.

Both voters and parties are well aware that some constituencies are more important than others. In election campaigns, parties spend more than twice as much in the most powerful seats as in the least. Turnout in marginals is up to 6 per cent higher than in the safest seats. At the last general election as many as a million people may have been deterred from voting because they live in safe seats.

Our second finding is that the current system is inefficient in turning votes into seats. The average voter power score is only 0.285 compared to an ideal score of 1 which represents every vote counting equally towards the outcome of a general election. In the FPtP system many votes are effectively wasted because they form part of large majorities or are cast for candidates who do not win.

The effect of moving to the Alternative Vote

Our analysis demonstrates that switching to AV would mitigate both of these issues somewhat. Our modelling suggests that AV would increase the number of constituencies which change hands at each election: from 13 per cent to 16 per cent. This leads to a significant increase in the number of strongly contested very marginal seats: 125, up from 81.

Because of this, average voter power under AV would be 0.352, compared to 0.285 under FPtP. The increase in power is proportionately greatest in the least powerful constituencies. Under AV the most powerful constituencies have 18 times the power of the least powerful – down slightly from 21 times under FPtP.

Moving to AV mitigates, rather than eliminates the inequality and inefficiency of FPtP. Because AV retains the current system of small, single MP constituencies, its overall effects on the distribution of voter power are limited.

By contrast, the system of large, multi-member constituencies used in the Euro-elections offers significantly higher and more even distributed voter power. British voters in the 2009 European Parliament elections had an average VPI score of 0.962.[2] While the system used in the European elections is not ideal – it uses an allocation system which favours large parties and uses closed rather than open lists – this score does highlight the potential of multi-member constituency systems to significantly impact on the distribution of voter power.

The VPI website

In our efforts to inform the public of their voter power, **nef** has lent its research to web-designer Martin Petts again to develop it into a website. The website www.voterpower.org.uk provides an easy to use tool for people to see their voter power score under both FPtP and AV, assisting them to make an informed decision on the issue.

1. The AV Referendum in context

Across the world, free and fair elections are synonymous with democracy. They are the mechanism by which citizens select their representatives and the threat of electoral defeat is the key instrument by which citizens can control their government.

The last fundamental reform of the electoral system in the UK was in 1918 when the Representation of the People Act gave women the vote. This year, for the first time, there will be a UK-wide referendum on whether there should be a change to the electoral system. On May 5 2011, UK voters will be faced with the question:

> *At present, the UK uses the "first past the post" system to elect MPs to the House of Commons. Should the "alternative vote" system be used instead?*

The result will be decided by a simple majority, with every vote cast in England, Northern Ireland, Scotland and Wales counting equally. UK-wide referenda are very rare. The last one was the 1975 referendum on the UK's membership of the European Community.

This short report aims to help voters consider the alternatives available to them on May 5. It presents a statistical analysis of the power that the two systems on offer in the referendum would give voters have across the UK. The report builds on **nef**'s 2005 report *Spoiled Ballot* which highlighted the uneven distribution of voter power between electors in the UK. The report introduced the Voter Power Index (VPI), which is a measure of the power of an individual vote to influence the composition of parliament. For this report the VPI has been recalculated and a new comparable AV-VPI (Alternative Vote Voter Power Index) has been created to estimate the power that voters would have if the Alternative Vote (AV) system was adopted. VPI is one measure among several factors to be considered when comparing different electoral systems.

The referendum options

The referendum offers voters only two options – to retain the current First Past the Post (FPtP) system or to switch to a new system, the Alternative Vote (AV)..FPtP and AV differ in the way votes are cast and counted but both would retain the current constituency boundaries.

There are approximately 44 million registered electors in the UK divided into 650 constituencies. Each constituency elects its one member of parliament (MP). Legislation that was passed at the same time as the Referendum Bill demands a re-drawing of the boundaries to move to 600 single-member constituencies but this is not the subject of this referendum or our analysis.

Under the current electoral system the candidate with the most votes in each constituency is elected to the House of Commons at Westminster to represent all the voters within the constituency. The current system is commonly referred to as 'First Past the Post' as the winning candidate simply has to get more votes than any other candidate.

Under the AV system voters are given the opportunity to rank the candidates in order of their preferences. They rank them 1, 2, 3 … until they are indifferent between them, and can if they want just vote for one candidate.

In order to win, a candidate needs to receive more than 50 per cent of the votes cast. If no candidate receives more than 50 per cent of first preferences, the candidate with the lowest number of votes is eliminated and their votes are redistributed to the voters' second preferences. This process is repeated until one candidate has more than 50 per cent of votes cast.

First Past the Post in the 2010 General Election
In a multi-party political system like the UK, FPtP means that MPs tend to get elected with only a minority of the votes cast in their constituency. In the 2010 general election 66.4 per cent of MPs did not receive more than 50 per cent of the votes cast in their constituency.

The candidate who won with the smallest proportion of votes was Simon Wright, the Liberal Democrat MP for Norwich South, who gained just 29.4 per cent of the votes cast. Norwich South was a three-way marginal between the Liberal Democrats, Labour (28.7 per cent) and the Conservatives (22.9 per cent) with the Greens also polling very strongly (14.9 per cent).

Given the geographically polarised nature of support for the main political parties, FPtP's single member constituencies produces a large number of very safe seats where support for one party is overwhelming. The vast majority of seats never, or almost never, change hands. Even in the 2010 general election, which was seen a major defeat for the Labour Party, 82 per cent of seats did not change hands.

In 2010, the safest seat was Liverpool Walton where the winning candidate, Labour's Stephen Rotheram MP, won a majority of 57.7 per cent. He received 72 per cent of the votes cast compared to the second place Liberal Democrat's 14.2 per cent.

At the other end of the scale, there are a limited number of marginal seats which have a very high chance of changing hands. The smallest majority was just 0.1 per cent in Hampstead and Kilburn constituency with Labour MP Glenda Jackson (32.8 per cent) just holding on to her seat by less than 50 votes from the Conservative candidate (32.7 per cent). The Liberal Democrat (31.2 per cent) also polled just 900 votes short of Ms Jackson.

The effects of marginal and safe seats
The variation between the safest and most marginal seats has a significant effect on UK election campaigns. Both parties and voters are more active in marginal seats and less active in safe seats.

Evidence suggests that as many as a million voters are not voting because they do not live in the strongly contested marginal seats. In the 2010 General Election average turnout across the UK was 65.2 per cent. However, turnout in the safest constituencies was only 61.2 per cent but in the most marginal it was 67.5 per cent, shown in Figure 1. If turnout across the country had been at the same level as the most contested marginal

Figure 1. Voter turnout by marginality of constituency – 2010 election

Turnout of voters (as % of electors) vs **Marginality of constituency**

Marginality	Turnout (%)
Ultra safe	~61
Very safe	~65.5
Fairly safe	~67
Marginal	~67
Very marginal	~67.5
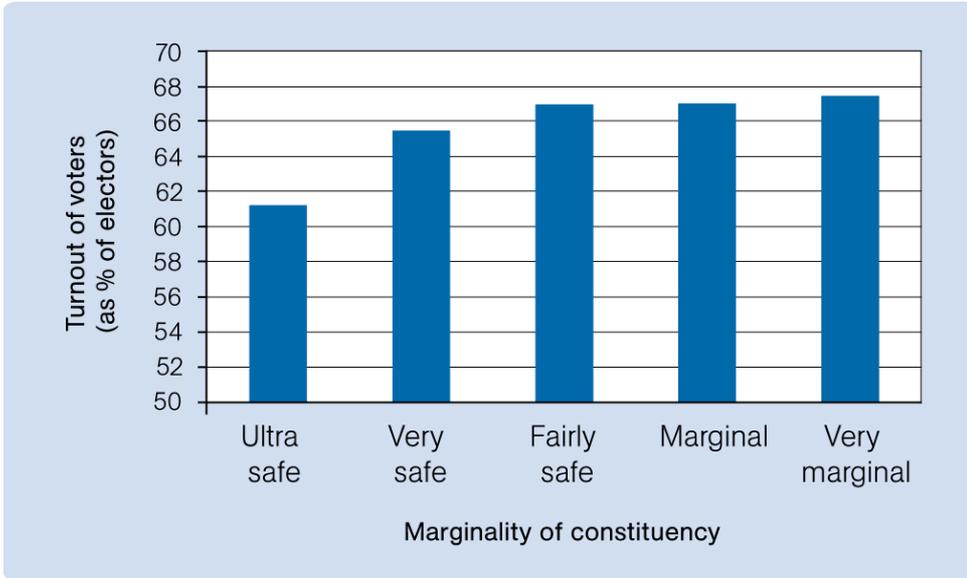
seats then nationally about a million more votes would have been cast.

The amount that parties spend in an election campaign is tightly monitored by the Electoral Commission. Our analysis of their published data on party spending clearly demonstrates that parties concentrate their efforts in the most marginal constituencies and pay much less attention to the safest. In the 2010 General Election, parties spent more than twice as much in the most marginal seats as in the safest, shown in Figure 2.

The evidence clearly demonstrates that the huge variation in marginality is concentrating attention on a small number of marginal seats. The UK's high degree of variation in marginality is closely linked to our use of single-member constituencies – something which will not be affected by the outcome of this referendum. However, there is also the potential for different voting mechanisms to affect the safeness or marginality of seats. In the next section of this paper we will explore how moving from FPtP to AV might affect the number of seats that would be actively contestable and hence influence the power of voters.

Figure 2. Average party spending and marginality of the constituency[3]

Spending by top two parties contesting the constituency as a % of the maximum spend allowed by the Electoral Commission vs **Marginality of the constituency**

Marginality	Spending (%)
Ultra safe	~20
Very safe	~31
Fairly safe	~45
Marginal	~56
Very marginal	~54.5
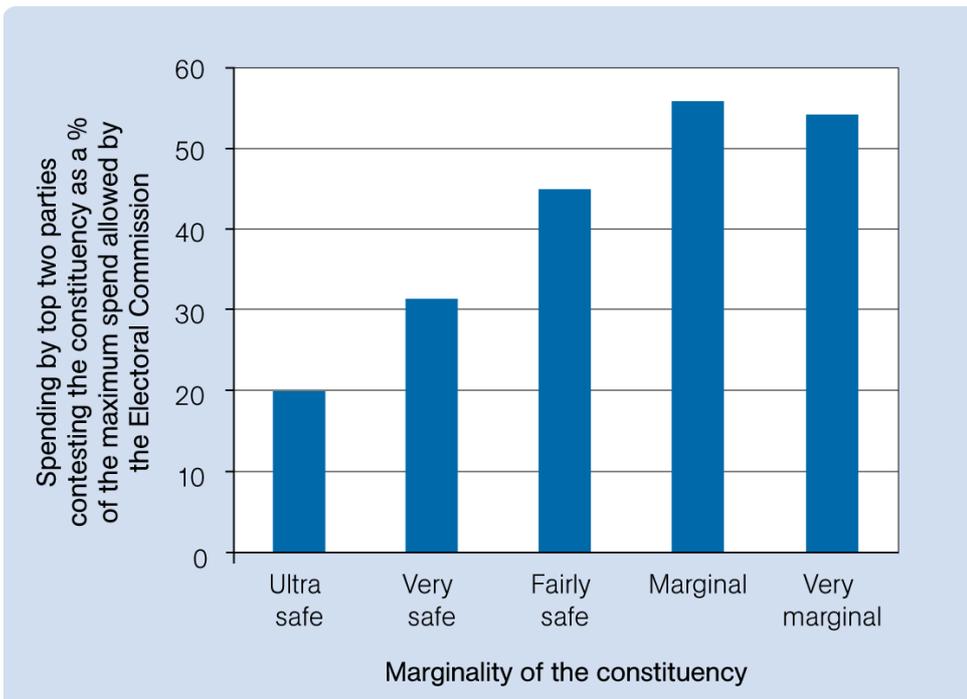
2. The Voter Power Index

The Voter Power Index is a measure of the power of voters in the constituencies of the UK. It assesses to what degree voters have the power to influence the make-up of parliament – and therefore which party, or parties, get to form a government. The key determinant of voters' power within a particular constituency is the likelihood that the seat will change hands. The more likely it is to change hands, the more contested it will be and hence the more influence voters will have.

For this report we have calculated a VPI score for every constituency across the UK. The score represents the amount of power voters had in the 2010 General Election as it happened. We have also calculated an AV-VPI score which is an estimate of the amount of power that voters would have had if the 2010 election had been run under AV. This enables us to compare the two systems.

Our analysis suggests that switching from FPtP to AV would have the following effects:

- An increase in the average power of UK voters from 0.285 of a vote to 0.352 of a vote (where a score of 1 is a fair vote).
- An increase in the number of very marginal seats from 81 to 125, an increase of 44 seats.
- A reduction in the number of very-safe seats from 331 to 271, a reduction of 60 seats.
- A small reduction of inequality in the power of votes with the most powerful fifth of electors going from having 21 times the power of the least powerful fifth, down to 18 times.

In short, a move to AV would mitigate some of the issues with the UK's electoral system. However, it would by no means eliminate them. Many of the problems are a result of the UK's use of single-member constituencies and addressing them would require a more fundamental change.

How the Voter Power Index is calculated

The VPI is a measure of voters' power, where power is understood as the ability to influence the outcome of the election. The power of an individual voter is calculated according the chance that their constituency will change hands and the number of voters in the constituency.

To estimate the potential of seats to change hands under FPtP we looked at six elections in the period 1983-2010.[4] Based on observing how often seats actually did change hands over this period we constructed a statistical model which estimates the probability that a seat might change hands in the next election depending on the size of the majority. The details of the model can be found in Appendix 2 but it is important to note that the model does not use polling predictions of the likely swing to or from a

particular party. Instead it estimates the likelihood of a seat changing irrespective of the incumbent's party affiliation. To calculate the VPI score, the probability of changing hands is adjusted to account for variation in the number of registered electors in different constituencies. The average number of electors per seat in the 2010 elections was 68,433. The smallest seat was Na-h-Eileanan an Iar in the Scottish Islands which had only 21,575 electors and the largest was the Isle of Wight with 109,042 electors. Clearly each Isle of Wight elector has less influence on the result of the election than each elector in Na-h-Eileanan an Iar.

In order to understand how voter power would be distributed under AV it was necessary to construct a new statistical model of the probability of seats changing hands. The model that we developed draws on the work of David Saunders and colleagues from the University of Essex[5] who simulated outcomes of the 2010 election under AV.

In order to create a methodology that would allow for direct comparisons between the two systems we adapted the Essex simulation so as to be able to apply it consistently to past elections. The adapted simulation was run for the same six elections between 1983 and 2010 that formed the basis of the FPtP model. This simulation suggested that at every level of 'marginality' (the majority the incumbent has over the second candidate) a greater proportion of seats are likely to change hands under an AV system than under FPtP system (see Table 3 in Appendix 2). Based on this simulation a second probability model was constructed which calculated the chance of seats changing hands for a given size of majority under AV. This model was used to create a new index of the power of votes in the 2010 General Election if it had been run using AV rather than FPtP – the AV-VPI. This was then adjusted by the size of the constituency in the same way as before.

It's worth noting that both indices apply to the 2010 General Election, and are derived from the majorities in each constituency going in to the election campaign. Constituency boundaries across the UK are due to be changed before the next general election to create more uniformly sized constituencies. This will create a slightly more equal distribution of voter power irrespective of which voting system is used. However, our analysis suggests that constituency size is responsible for only an extra 2 per cent of the variation in voter power, so even completely equal constituency sizes would leave most of the inequality in place.

Voter Power under FPtP and AV
Average voter power under AV would be 0.352, compared to 0.285 under FPtP. This represents a significant increase in the ability of the average voter to influence the make-up of parliament. However, average VPI for both the FPtP and AV systems is well below a score of 1, which would represent every vote counting fully and equally towards the overall outcome of a general election. This suggests that neither system is very efficient in translating votes into electoral power.

Figure 3 shows the uneven distribution of voter power under both the FPtP and the AV systems. It splits the UK electorate into five equal groups – 'quintiles' – of 8.9 million electors each. The quintile on the left have the lowest VPI scores and those with the highest are to the right. If every vote counted fully and equally towards the results of the election, then all electors' VPI scores would be equal to 1. The variation between the quintiles represents unequal distribution of voter power.

Figure 3. Comparison of the levels and distribution of voter power under PFtP and AV systems
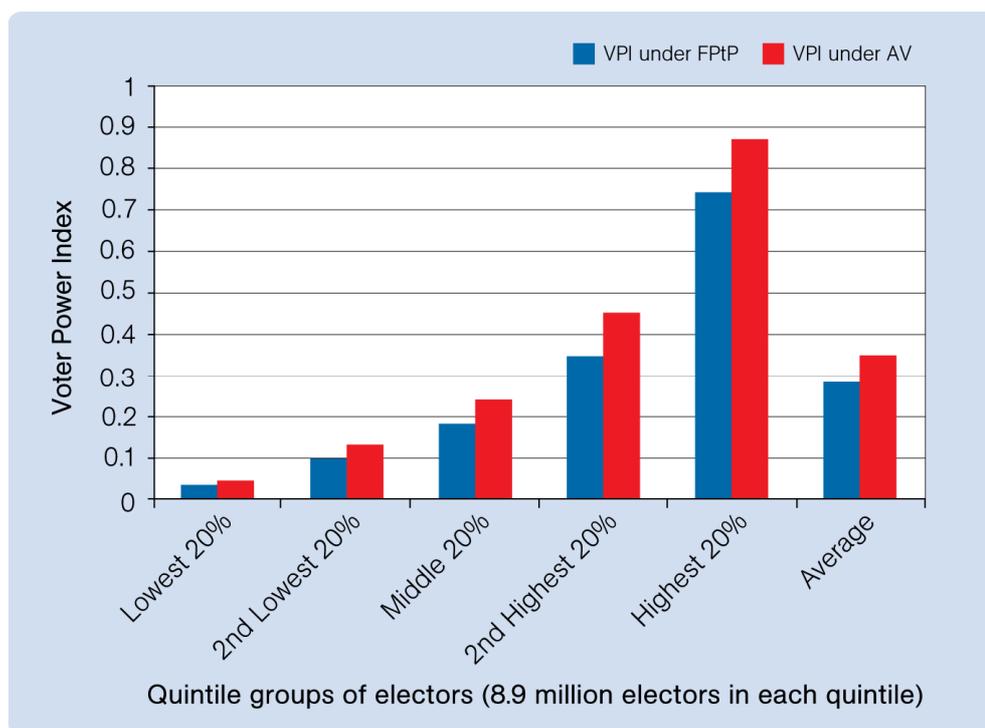
While all voters gain power under AV, the proportionate gain is greater for the lowest quintile, leading to a somewhat more equal distribution of voter power. The ratio of the most powerful quintile to the least is 18 to 1 under AV compared to 21 to 1 under FPtP. However, this still represents a highly uneven distribution of power.

Numbers of marginal and safe constituencies

Switching from FPtP to AV would increase the number of contested very marginal constituencies from 81 to 125. It would also reduce the number of very safe and ultra safe seats from 331 to 271.

Usually, marginal seats are defined by the size of the majority of the sitting MP. But for the purposes of the VPI we have translated these majority sizes into a 'probability of changing hands'. For example seats are often categorised as being 'very marginal', 'marginal', 'fairly safe', 'very safe' and 'ultra safe' based on the size of the majority alone. However, under AV the relationship between majority size and how likely a seat is to change hands will be altered. We have therefore converted these majority sizes into the equivalent probabilities in order to enable like-for-like comparison between FPtP and AV.

Table 1 shows how each category of marginality is defined in terms of its chance of changing hands. A 1-in-3 chance effectively means that the seat is likely to change hands about every third election – or about once every 12–15 years (as elections normally occur every 4–5 years). As the chances become less likely the time a party is likely to dominate a seat increases considerably so a 1-in-10 chance is a change on average once every 40 years and a 1-in-25 only once every century (nearly a quarter of seats are in this category). The columns to the right indicate what size majorities fall into this category. As described above, our modelling shows that a seat with a given majority is more likely to change hands under AV than FPtP. Therefore, a seat with a 5.0 per cent majority would be categorised as 'marginal' under the FPtP system but 'very marginal' under AV as under AV it is more likely to change hands. Similarly, a seat with a 10 per cent majority would be 'fairly safe' under FPtP but 'marginal' under AV.

Table 1. Categories of marginality and their meanings under FPtP and AV

Categorisation	Definition	Equivalent majority size under FPtP (%)	Majority under AV (%)
Ultra safe	Less than 1 in 25 chance of changing hands	Over 26.9	Over 29.7
Very safe	Between 1 in 25 and 1 in 10 chance of changing hands	17.1– 26.8	20.0 – 29.7
Fairly safe	Between 1 in 10 and 1 in 5 chance of changing hands	9.7 – 17.0	12.6 – 19.9
Marginal	Between 1 in 5 and 1 in 3 chance of changing hands	4.2 – 9.6	7.1– 12.5
Very marginal	More than 1 in 3 chance of changing hands	0.0 – 4.1	0.0 – 7.0

The number of seats in each category is illustrated in Figure 4.

As Figure 4 shows, under AV there would be more seats that could be considered very marginal or marginal. In contrast there would be less ultra safe and very safe seats. Effectively 190 seats are 'bumped' up a category, though this reflects a continuum of changes with all seats having a greater probability of changing hands. However, even under AV, 43 per cent of seats remain very safe or ultra safe (down from 52 per cent under FPtP) with changes likely to occur less frequently than every 40 years.

Figure 4. Comparison of the number of safe and marginal constituencies under FPtP and AV systems
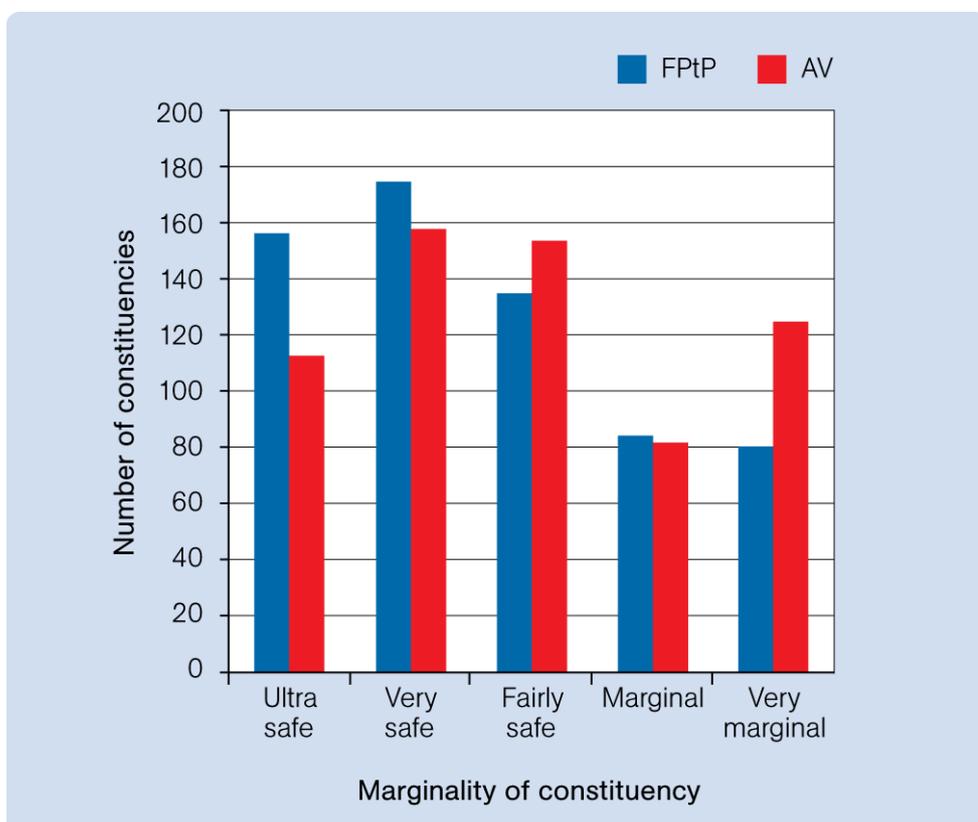
Beyond the referendum

As mentioned above, the current referendum does not include an option for a system which includes multi-member constituencies. Many of the issues identified by the VPI analysis are closely linked with the way that the single-member constituency system functions in a multi-party political environment.

nef's 2005 report *Spoiled Ballot* also calculated voter power for the European Parliament. The Euro-elections use a form of proportional representation – the party list system – with multi-member constituencies. The Euro-VPI score was estimated at 0.962, suggesting that such a system would be much more efficient in expressing the views of voters. While the system used in the Euro elections is not without its issues, not least in the bias towards large parties caused by its use of the D'hondt system for attributing seats and the closed nature of its party lists, this result points to the potential of multi-member constituencies to increase and equalise voting power.[6]

Conclusion

The Voter Power Index analysis shows that there are some advantages to moving to the Alternative Vote. It would considerably increase the number of marginal seats, slightly reduce the inequality in the value of people's votes and make the system more efficient at translating votes into MPs.

The VPI does not cover all the issues: it does not examine the pressure for tactical voting, the ease with which extremist parties can achieve representation or the simplicity of the system. But it does measure one of the most fundamental tests of free and fair elections: that each voter should have equal power to influence the outcome. This is a test on which AV does better but which neither of the referendum options can honestly be said to pass.

While AV does offer some improvements, our findings demonstrate that it cannot be the final answer to Britain's electoral issues. To achieve meaningful equality for all voters, we require a more far-reaching reform of the UK's electoral system.

The process by which the AV referendum was arrived at – a backroom compromise between politicians with profound vested interests – was hugely undemocratic. A more fundamental process of democratic reform must place citizens at its heart.

When Ontario was considering electoral reform, it brought together an assembly of 100 of its citizens, selected by lot, to consider the issue. Those citizens, impartial and at first inexpert, heard the evidence, considered the issues and selected a referendum question to be put to the public vote. Perhaps the British public should be given a similar chance to look at all the options for electoral reform.

Appendix 1. Summary of electoral systems

The forthcoming referendum offers voters a choice between two electoral systems: the Alternative Vote and First Past the Post. In this section, we will describe the key features of these two systems. For comparative purposes, we also look at other systems in use in the UK, and elsewhere, which use multi-member constituencies: the Party List system, the Single Transferable Vote system, the Additional Member system and Alternative Vote Plus.[7]

Method	Description	Example of current UK usage	What would it mean for Westminster?
First Past the Post	Each constituency elects one candidate. Each party nominates one candidate for the seat. Voters select one candidate. The candidate with the highest number of votes is elected.	UK parliamentary elections	See the body of the report for a full discussion of the impact of FPtP.
Alternative Vote	Each constituency elects one candidate. Each party nominates one candidate for the seat. Voters rank candidates in order of preference. At the count, if no one candidate has over 50 per cent of the votes, the last place candidate is eliminated and their votes are redistributed to the second preference candidate. Redistribution continues until a candidate has 50 per cent of the votes.	London Mayoral election	See the body of the report for a full discussion of the impact of AV.
Closed Party List	Large, multi-member constituencies are used. Parties put up a list of candidates in priority order. Voters select one party. Parties are allocated seats according to the number of votes they receive.	European Parliamentary elections in the UK	This system would create significantly higher and more equal voter power than either FPtP or AV. At the Euro-elections in 1996, the average VPI score was 0.962, so almost a full vote for each elector. It would create a parliament whose party make-up is generally proportional to that of voters and lead to coalition

| | | | governments.

Representatives are jointly responsible for a larger area which would weaken the geographical link.

Voters vote for parties and cannot express their views on individual candidates. |
|---|---|---|---|
| Single Transferable Vote | This system is similar to AV but uses multi-member constituencies.

Each constituency elects between, say, three and six MPs.

Voters rank candidates in order of preference. Candidates are eliminated and votes redistributed in the same way as under AV, but candidates are elected with a smaller percentage of votes. If a constituency elects three candidates, for example, each candidate needs only a quarter of the vote. | Local elections in Scotland | We have not yet run a voter power analysis for STV but we estimate that it would raise and equalise VPI in a similar way to the closed party list system.

STV would produce more proportional outcomes and lead to more coalition governments.

STV offers voters the opportunity to select between candidates from the same party, which could increase accountability.

STV provides a weaker MP-constituency link than our current system, but stronger than that under Party List. However, the increased accountability of individual MPs may increase their incentives to undertake constituency work. |
| Additional Member System | Some MPs are elected using single member constituencies, generally FPtP, while others are elected from regional lists so that the overall result is more proportional.

Voters have two votes, one for a single constituency member and a second for a party list 'top-up'.

Second votes determine the share of 'top-up' seats allocated to each party, sometimes constituency representatives or votes are included when calculating the 'top-up' representatives. 'Top-up' seats are filled from central party lists. | Used for Scottish Parliament, Welsh Assembly and London Assembly elections | Electing representatives from closed party lists for the 'top-up' members gives a lot of power to party leaders. How representative results are of votes cast depends on the split between constituency and 'top-up' seats and exactly how the 'top-ups' are determined.

Voters would retain a link to their constituency MP. Smaller parties would be likely to do better. But if half of all MPs are elected from the lists, the overall outcome would be similar to that of the regional system. |

Appendix 2. The Voter Power Index: the statistical basis

The Voter Power Index is an assessment of voters' power in different constituencies. It understands power as the ability to influence the outcome of the election by causing a seat to change hands.

The primary determinant of power is the marginality of the constituency. Because a vote in a very marginal seat has more potential to cause the seat to change hands than a vote in a very safe seat, the index is primarily derived from the marginality of each constituency. Marginality is derived from the size of the majority won by the sitting MP at the previous election

As well as marginality, the index also incorporates a secondary factor which is how many registered electors there are within a constituency. The index brings these two factors together into a single number by using the formula below:

Voter Power = (Potential to change hands) * (size adjustment coefficient)

The same formula is used to calculate voter power for both FPtP and AV. However, the way that the potential to change hands is calculated differs between the two systems. The way that this was calculated for each system is discussed below.

The size adjustment coefficient is very straightforward to calculate. It is simply the national average number of electors per constituency divided by the specific number of electors in the constituency – to reflect the fact that a voter in a constituency with fewer than average registered electors has greater power than one with more than the national average.

Calculating the VPI for First Past the Post
For FPtP, the potential to change hands is determined via a statistical model which predicts the probability based on the size of the sitting MP's majority.

The model was developed based on the methodology used in the 2005 **nef** report *Spoiled Ballot*. To create the model we looked at six recent elections – 1983, 1987, 1997, 2001, 2005 and 2010 (1992 was excluded due to the large number of boundary changes). It is important to do this over many elections as the specific 'swing' between parties differs from election to election and an overall average is needed.

Across the 3,600 constituency results that made up the elections, we charted the relationship between the size of majorities and which seats actually changed hands. An exponential regression analysis was used to create a best-fit curve which allowed us to precisely calculate the chance that any given seat would change hands according the size of its majority.

The VPI score was then calculated by multiplying the estimated probability of changing hands by the size adjustment coefficient. The result is presented as a number normally between 0 and 1, where 1 represents a vote in a very marginal constituency of average size – in other words a fully powerful vote. It is possible, and does occur that the VPI score is above 1, this is when the constituency is very marginal and has few electors. For example, the Welsh seat of Arfon is both very marginal and, in 2010, had 42,000 electors compared to the UK average of 68,000. Its VPI score was 1.325, representing that voters in Arfon actually had more than their fair share of influence at the election.

The VPI data presented in this report is for voter power at the 2010 general election. It is therefore calculated based on the majorities that resulted from the 2005 general election, using a model which is drawn from all six elections.

Calculating the VPI for the Alternative Vote

To enable the creation of an AV-VPI (Alternative Vote VPI) it was necessary to statistically model the probability that seats would change hands under the AV system. To do so we drew on the work of a team from Essex University.

In January 2011 David Saunders and colleagues from Essex University published a paper called *Simulating the Effects of the Alternative Vote in the 2010 UK General Election.*[8] In the paper they outline, in some detail, how they created a simulation to estimate how the outcome of the 2010 election may have played out under AV. Their methodology made use of the British Election Survey which asked respondents immediately after the election to fill out a mocked-up AV ballot paper. From this survey they simulated all the constituency results as if the AV system had been used. Their simulation suggested that there would have been 43 different constituencies where the results under AV would have been different to those which actually occurred.

For our purposes we needed to simulate AV results for the same six elections between 1983 and 2010. A simplified version of the Essex simulation was created which made these assumptions:

- Only four major parties were included: Conservatives, Labour, Liberal Democrats and 'Others'. Others in Scotland were the SNP, in Wales Plaid Cymru and in England a mix between UKIP, BNP and the Greens. All other 'minor' candidates were ignored.
- Second preferences were allocated as per the Essex model, excepting for the four-party simplification.
- No third preferences were taken into account.

These simplifications allowed for a simple process of first re-allocating the second preferences of the party coming fourth and then secondly re-allocating the second preferences of the (potentially new) third placed party. In this way only two rounds of reallocations were needed to identify the AV winner.

Our simplified simulation was first run against the 2010 election results and then compared to the more detailed Essex simulation. The results, shown below in Table 2, were very similar to the **nef** simulation predicting 41 changes of outcomes as compared to the Essex simulation's 43 (changes shown in bold italics in the table). Whilst the Essex simulation should be considered more accurate, the VPI simplified simulation performs comparably.

Table 2. Showing comparison between the VPI model of simulating the AV outcome of the 2010 election with the Essex simulation model

		'Winner' of AV simulated results								
		Essex Model				VPI model				
		Cons	Lab	L-D	Other	Cons	Lab	L-D	Other	Total
Actual Winner 2010 Election	Conservatives	282	*10*	*13*	0	285	*8*	*12*	0	305
	Labour	*1*	238	*19*	0	*1*	237	*18*	*2*	258
	Liberal Democrats	0	0	57	0	0	0	57	0	57
	Others	0	0	0	10	0	0	0	10	10
	Total	283	248	89	10	286	245	87	12	630

Having developed and tested a simplified simulation, the next stage in the calculation of the AV-VPI was to run the simulation on previous elections. We ran the **nef** simulation on the same six elections which the FPtP-VPI model was based on.

Table 3 summarises the actual results of the elections under FPtP and the simulated results under AV, though for the actual analysis more fine grained categories of marginality were used for better accuracy. As can be seen, for all sizes of majority the simulation model predicts a greater number of seats would change hands.

In a similar fashion to the FPtP analysis an exponential regression analysis was used to create a best-fit curve so that probabilities that a seat would change hands under an AV system could be calculated precisely for each constituency.[9] The AV-VPI could then be scored by making the additional adjustment for the size of the constituency. The net result is that across all sizes of majority, the VPI score is higher, with the greatest proportional increase in VPI coming in the lowest scoring constituencies.

There is one caveat to these results, which is that each time we were comparing the simulated AV results to the FPtP results of the previous election. In order to test the sensitivity to this assumption we also compared the simulated AV results to previous elections' simulated AV results. In all cases the VPI model still predicted greater changes of seats than FPtP

Table 3.

Margin between top two candidates (before election) (%)	No. of seats analysed	FPtP (actual)		AV (simulated)	
		No. seats changed hands	% of seats changed hands	Predicted No. seats changed hands	Predicted % of seats changed hands
0 – 5	403	173	43	187	46
5 – 10	434	128	29	138	32
10 – 15	486	67	14	89	18
15 – 20	502	50	10	71	14
20 – 25	490	26	5	44	9
25 – 30	439	13	3	29	7
30 – 40	537	8	1	12	2
40 plus	321	2	1	3	1
Total	3,612	467	13	573	16

though the number of extra changes (due to AV) was reduced by up to a third, with overall 15 per cent of seats estimated to change hands. It is important to recognise that this test was using three layers of estimates so there is a further loss of accuracy.

Endnotes

[1] Marks, N. (2005). *Spoiled Ballot.* London: **nef**. In the original report the index was called the Index of Democratic Power.

[2] See Figure 2 in Marks (2005) *op cit.*

[3] Electoral Commission expenses data (downloaded in February 2011). Further details available from Electoral Commission website:
http://www.electoralcommission.org.uk/party-finance/party-finance-analysis/campaign-expenditure/uk-parliamentary-general-election-campaign-expenditure3

[4] 1992 was excluded due to extensive boundary changes, as were many Scottish seats in the 2001 election. Northern Ireland was excluded from the whole analysis.

[5] Sanders, D., Clarke, H. D., Stewart, M. C., & Whitely, P. (2011). *Simulating the Effects of the Alternative Vote on the 2010 UK Election.* Parliamentary Affairs. January 2011. London.

[6] For more information on a range of electoral systems in use in the UK, and their potential impact on Westminster Elections see Appendix 1.

[7] For a very comprehensive review of the features of electoral systems, see Hix, S., Johnston, R. & McLean, I. (2010). Choosing an Electoral System. London: British Academy.

[8] Sanders, D. et al. (2011). *Op cit.*

[9] The fitted regression model for AV broke down for very marginal seats (under 2 per cent) it predicted probabilities of changing hands of greater than 0.5 which does not in reality make sense. To ensure that this did occur the curve was smoothed so that only when marginality equalled 0 per cent did the predicted probability equal 0.5. This has the effect of lowering the AV-VPI scores for these very marginal seats and so can be considered conservative. It is quite possible that this effect is due to the second order effects of three-way marginal and an exponential model based on two variables, margin between first and second place and also marginal between second and third place, would fit the data better. This was beyond the scope of this project though.

This report is aligned with **nef**'s charitable objectives "*to advance the education of the general public in economic and social studies*".