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# Predictable and Unpredictable Changes in Party Support: A Method for Long-Range Daily Election Forecasting from Opinion Polls

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**ABSTRACT** *This paper outlines several methods for forecasting the next British general election on a daily basis from 20 months prior using opinion polls. It discusses their performance for previous electoral cycles and shows that the two models with the best historical record lead to substantially different predictions for 2015, but they can be averaged. The historical relationship between the polls and the vote suggests that government support rises substantially in the run up to elections, that Conservatives outperform but Labour underperform relative to the polls, and parties generally recover from low points or decline from high ones. Approximate prediction intervals and probabilities for key events are also generated. Despite the Conservatives trailing in the polls by 7 points in early October 2013, the models suggest a substantial Conservative lead at the 2015 election with a 64% chance of being the largest party and 42% chance of an overall majority. The estimated probability of a hung parliament (40%) is instructive for understanding the operation of the electoral system.*

## Introduction

There is considerable public interest in the likely outcome of elections even well in advance. If, as Harold Wilson famously claimed, a week is a long time in politics, then it would seem like a hopeless task to try to say what might happen in an election more than a year away. But we know that in Britain, opinion polls are informative of future election results quite some time in advance of the election (Wlezien et al., 2013). Not least this may be because most voters are relatively stable in their party preference, the parties do not change much within electoral cycles and they are unlikely to change their leaders or policies within the last couple of years before the election. So some of the key factors that affect election outcomes are in place well before polling day. Thus, it is reasonable to consider what the opinion polls tell us about the likely outcome of an election even over a year in advance.

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This paper develops a methodology for forecasting election outcomes from opinion polls on a day-to-day basis up to 20 months<sup>1</sup> in advance of an election. This paper first considers the case for long-range forecasting from polls relative to previous election forecasting technologies and then the general lessons from looking at how polls 20 months out corresponded with election results in previous cycles. I then describe three main types of votes-on-polls regressions that can be used as bases for forecasts. Out-of-sample prediction properties identify two formulations as being better at predicting previous elections: a votes-on-polls-and-government-status model and a relative change since the last election model. Although these two models have typically been very close to the final result or wrong in the same direction in previous cycles, there are important substantial differences between them for a 20-months out forecast of the 2015 election, especially with respect to the Liberal Democrat share. So, an average of the two models is considered.

This paper also discusses the problem of day-to-day forecasting and the need to smooth forecasts so that if public opinion in the polls is stable, the forecast does not change direction as the election approaches. I propose a method of ironing out daily and longer term variation to get linear trends in forecasts and prediction intervals if public opinion is static. Given forecasts for the shares of the vote, predicting parliamentary seat total outcomes is done with the Curtice and Firth (2008) probabilistic seat prediction method. Holding the Liberal Democrats at their point estimate for the share of the vote, an approximate prediction interval for seats focusing on variation in Conservative and Labour performance is generated from the prediction intervals for shares. In turn, this is used to define an approximate uncertainty distribution over seat outcomes from which approximate probabilities of key events can be calculated, including probabilities of overall majorities for the Conservatives and for Labour, the probability of a hung parliament outcome and the probability that the Conservatives will be the largest party instead of Labour.

Of all these aspects, the main contributions of this paper to the literatures on forecasting and British elections are the patterns identified in British electoral cycles, the specification of new forms of votes-on-polls regressions with government status and cycle effects, identification and discussion of issues with prediction for the current cycle, smoothing/ironing of forecasts and prediction intervals, and the method of constructing approximate probabilities for key events.

### **Why Forecast from Polls?**

A variety of different methods based on different kinds of data were used to forecast the last British general election. These include approval of the prime minister, local election results, citizen forecasting as well as forecasts from vote intention opinion polls (for a summary introduction to a special symposium, see Gibson and Lewis-Beck, 2011). Of these, forecasting from properly adjusted vote intention polls was the most successful even though the final polls suffered some serious industry bias,<sup>2</sup> especially with respect to the Liberal Democrats (Pickup et al., 2011).

In addition to reasonable accuracy, vote intention polls also have the virtue of ubiquity. With the advent of internet polling, they are now daily in Britain and this raises the prospect of a continually updated forecast some way before the election. There are few alternatives to vote intention polls for forecasting from more than a year before the election, especially if frequent updates are desired. Economic indicators more than a year before the election are probably premature for classic forecasting from “fundamentals”. This “historical” approach to prediction is usually conducted with data “three to six months before the election, sometimes a full year” (Bélanger and Soroka, 2012). There are other opinion poll questions that are available well before the election, such as prime-ministerial approval but these are only available on a monthly basis for previous cycles (Lebo and Norpoth, 2011).

While it is interesting to consider “nowcasting” to tell us what election outcomes might be if they were held now or in a few months’ time (Lewis-Beck et al., 2011), there is also a virtue in long-range forecasting. It is especially important for political commentators to understand not just what the likely outcome would be if the election were held today or in three months’ time, but when it will actually or most likely be held. Furthermore, regularly updated forecasts, while creating problems of over supply for post-mortem comparisons, can be useful as a means of evaluating pre-election party performance. They enable commentators to reflect on how recent events and party performance affect the chances of future election outcomes rather than just current polls. Finally, the development and comparison of forecasting technology, while not focused on building causal models, helps improve our understanding of the dynamics of public opinion and electoral behaviour.

## **Data**

Data on opinion polls are those used in Wlezien et al. (2013), which include an estimate of the average vote intention share for each of the three main parties for every day of each election cycle, starting with the first opinion poll after 1945. Figures are averages of headline published shares, indexed by the midpoint of their fieldwork period. Where pollsters have published daily “tracking” three-day moving average polls, these are used only every three days to avoid double counting of respondents. Linear interpolation is used to estimate voting intention for days without any polls. For further details of the data and discussion of their properties, see Wlezien et al. (2013).<sup>3</sup>

## **Experience of Previous Election Cycles**

Table 1 shows three sets of differences between polls and election results. The left-hand side gives the changes from the previous election to the polls 20 months before the next election, the middle set shows change from the polls 20 months prior to the next election, and the right-hand side shows change from the average of the final week polls to the election result. The final column shows which party was in

**Table 1.** Differences between polls 20 months before the election and both previous and eventual elections, and between polls 1 week out and the election

Election	Ave. poll share in 20th month before election – %Vote in previous election			%Vote – Ave. poll share in 20th month before election			%Vote – Ave. poll share in week before election			Prior gov.
	Con	Lab	Lib	Con	Lab	Lib	Con	Lab	Lib	
1950	8.6	–9.0	–0.2	–5.0	7.0	0.3	–1.6	2.2	–1	Lab
1951	1.2	–2.6	0.5	3.7	5.2	–7.2	–2	3.3	–1.1	Lab
1955	–2.8	–1.9	4.4	4.2	–0.1	–4.2	–1.5	0.1	0.9	Con
1959	–12.8	–2.5	14.9	12.4	–0.3	–11.7	0.6	–1.6	0.9	Con
1964	–15.3	5.2	9.8	9.4	–5.0	–4.4	–1.4	–1.6	2.6	Con
1966							1.1	–2.8	1.0	Lab
1970	7.5	–9.4	–0.6	–4.2	8.4	–3.2	1.9	–3.9	1.0	Lab
Feb-74	–6.8	5.2	1.8	–0.8	–11.0	10.4	0.5	2.1	–3.3	Con
Oct-74							2.6	–3.0	–0.2	Lab
1979	8.9	4.7	–13.6	–2.6	–5.0	7.9	1.2	–2.8	1.1	Lab
1983	–16.4	–6.6	24.0	15.0	–2.8	–12.1	–2.1	2.2	–0.2	Con
1987	–8.9	7.6	1.5	8.6	–4.4	–4.4	0.3	–2.6	1.6	Con
1992	–6.8	16.7	–14.6	6.4	–13.0	9.8	5.5	–3.6	–1.9	Con
1997	–15.1	16.6	–2.2	3.8	–7.5	1.1	0.7	–3.1	1.9	Con
2001	–1.1	6.1	–3.8	2.3	–8.4	5.4	2.0	–3.6	1.4	Lab
2005	–1.4	–6.5	7.4	1.9	0.6	–3.6	1.2	–1.6	0.2	Lab
2010	9.5	–6.3	–6.2	–5.8	–0.1	7.2	1.7	2.2	–3.9	Lab
Mean	–3.4	1.2	1.5	3.3	–2.4	–0.6	0.6	–1.1	0.1	
S.D.	8.9	8.2	9.6	6.1	6.1	7.1	1.9	2.4	1.7	
Mean abs. ch.	7.2	6.3	6.2	5.7	5.2	6.2	1.6	2.5	1.4	
Max abs. ch.	16.4	16.7	24.0	15.0	13.0	12.1	5.5	3.9	3.9	
Con gov mean	–10.6*	5.0	5.0	7.4*	–5.5*	–1.9	0.4	–1.0	0.3	
Lab gov mean	4.7*	–3.3	–2.4	–1.4	1.1	1.0	0.9	–1.1	–0.2	
Gov diff	15.3*	–8.3 <sup>a</sup>	–7.3	8.7*	–6.6*	2.9	–0.5	–0.1	0.1	
N	15	15	15	15	15	15	17	17	17	

*Note:* Figures are differences in the GB share of the vote (actual election share of the vote – mean share in the published polls). *Con gov mean* is mean for years when Con was in government prior to election. *Gov diff* is *Con gov mean* – *Lab gov mean*.

\* $p < 0.05$ .

<sup>a</sup> $p = 0.053$  so only marginally insignificant.

government before the election. Various patterns can be discerned that constitute important tendencies in the operation of electoral cycles in Britain that might be repeated in the future.

First, governments tend to lose support up to the twentieth month prior to the next election, while the main opposition party tends to gain over the same period. The

middle set of columns shows us that more often than not the losses are partly recouped and the gains are partly undone in the final 20 months. By 20 months before the next election, Tory government support dropped by 10.6 points on average, but 7.4 points were recovered on average. Heath was the only Tory prime minister to have gone down in the polls in the last 20 months.<sup>4</sup> Similarly, Labour oppositions have in the final 20 months on average lost ground that was gained earlier in the cycle. The “Gov diff” row gives the difference between a party’s performance according to the colour of the government. This difference-in-difference estimator is a measure of the strength of the electoral cycle effect. Despite the sample number of cases, the figures are statistically and substantively significant for the two main parties for both the first and second parts. If previous experience of different government and opposition electoral cycles is a reasonable guide to the current election cycle, then we can expect some Conservative gains and Labour set back before 2015 relative to the polls in October 2013.

Second, the tendencies for governments to fall then rise but oppositions to rise then fall over the cycle is part of a more general tendency for initial changes in party support to be reversed. In particular, for the Liberals, along with the two main parties, mid-term gains or losses tend to be reversed by the time of the election, with big gains/losses only partly held/recovered. If repeated for the 2015 election, the Liberals should recover somewhat but most likely not fully.

Third, the consistency and strength of the cycle effect are greater for the Conservatives. One reason why the large average Conservative government mid-term losses then recovery are not matched by equally large Labour poll gains and then reversion is that on average Liberals have also benefited from Conservative mid-term slumps. The reverse has happened for the Liberals since 2010, so perhaps as a consequence of the Liberals in government, we should expect a stronger Labour opposition cycle effect than previously.

The fourth and final main pattern to note from [Table 1](#) focuses just on the end of the cycle. The Conservatives have on average over performed in elections relative to the polls 20 months prior, and correspondingly Labour under performed on average. This is true of all but two of the elections since 1974 and true both overall and specifically under Conservative governments. Some of this asymmetry seems to be due to discrepancies between the final week polls and the eventual election-day result shown in the right-hand side of [Table 1](#). Either there is a regular late swing from Labour to the Conservatives, or the polls have had a tendency to overestimate Labour at a cost to the Tories. Again this is true of all but two of the elections since 1974, and it is true on average for Conservative and Labour governments. Although 2010 was one of the exceptions, in itself this is not sufficient evidence that the tendency has gone away. A more important caveat to note is that the figures are small and statistically insignificantly different from zero. Still, they are potentially important substantively and so these observations suggest that the Conservatives may do a little bit better at the election, and Labour a bit worse, relative to the polls because of either late swing or polling-industry bias.

### Votes-on-Polls Regression Methodology

The aim of this paper is to develop a methodology that can be used to forecast the GB share of the vote for the three main parties at the next general election from current vote intention polls, up to 20 months ahead, together with prediction intervals. In particular to have a methodology which will allow for daily forecasts that can be published in a consistent manner, for which fluctuations in the forecast will be driven either by fluctuations in the polls or otherwise easily explicable.

First, it is necessary to specify the future election date. Under the Fixed-term Parliaments Act 2011, the time of the next general election is no longer simply the prerogative of the prime minister but scheduled for 7 May 2015, and so this paper proceeds as though that date is fixed.<sup>5</sup> There were just under 600 days to the election at the start of the time of writing and so I consider forecasting over this period.

For a given number of days before the next election, call this  $t$ , it is possible to consider how, across previous election cycles, the opinion polls  $t$  days before the election corresponded with the eventual election outcome. This can be done by considering votes-on-polls regressions (e.g. see Erikson and Wlezien (1996) and Brown and Chappell (1999) for applications in the USA, Selb and Munzert (2013) for Germany, and Fisher et al. (2011) and Wlezien et al. (2013) for Britain).

I extend this approach to consider three related models which each fit the British data better than the basic votes-on-polls regressions: vote shares regressed on poll shares and a government status dummy variable; vote shares regressed on poll shares and the share of the vote at the previous election (a lagged dependent variable or LDV); and the change in vote share since the last election regressed on the difference poll shares and the last election result. These are described in turn in this section and evaluated according to out-of-sample prediction quality in the next.

#### *Votes-on-Polls-and-Government-Status*

These regressions have the following form:

$$\text{VOTE}_{pi} = \alpha_{pt} + \beta_{pt}\text{POLL\_SHARE}_{pti} + \gamma_{pt}\text{GOV\_STATUS}_{pi} + \varepsilon_{pti} \quad (1)$$

for each party  $p$ , where  $t$  is the number of days before the election and  $i$  is an election cycle indicator. The VOTE is the share of the vote for the party at the election. POLL\_SHARE is the average of the polls for a given day as described above. GOV\_STATUS is a dummy variable for being in government prior to the election. Essentially, Equation 1 describes, for each party, a series of 600 separate ordinary least squares (OLS) regressions, one for each day  $t$  before the election. Each regression has as many observations as there are election cycles since 1945 that were at least  $t$  days long. In effect, they tell us how public opinion changed in the last  $t$  days of the election cycle, taking into account government status.

These regressions can be used to forecast the 2015 election outcome with estimates of public opinion from  $t$  days before the election for each party. Despite the Liberal Democrats now being in coalition, they are coded zero for GOV\_STATUS and so the regressions for this party effectively omit that variable.<sup>6</sup>

Wlezien et al. (2013) showed that regressions of this form, but without government status, are informative and increasingly so approaching the election. Fisher et al. (2011) showed how they can be used to forecast the share of the vote a month before the election.<sup>7</sup> Such regressions allow for “reversion-to-the-mean” when parties are performing usually well or badly in mid-term compared to their historical average. They also average over historic polling-industry bias, which has tended to be pro-Labour and adjust for that.

#### *Votes-on-Polls and Prior Election (LDV)*

Similar regressions but with a LDV are possible and sensible. One such model has the following form:

$$\text{VOTE}_{pt} = \alpha_{pt} + \beta_{pt} \text{POLL\_SHARE}_{pti} + \gamma_{pt} \text{PREV\_VOTE}_{pt} + \varepsilon_{pti} \quad (2)$$

again for each party  $p$ , where  $t$  is the number of days before the election and  $i$  is an election cycle indicator. The difference between Equations 1 and 2 is that GOV\_STATUS is replaced by the share of the vote for the party at the previous election PREV\_VOTE. Models of this form essentially say that the expected election result is a weighted sum of the previous result and the current polls for a party. Naturally enough different estimates of this model for different days in the cycle show that current polls become increasingly important and the partial predictive power of the previous election weakens as the election approaches. But the previous election does not become close to being irrelevant until the final week. So, a tendency for some reversal of fortunes remains till near the election.

It is possible to add a government status dummy variable to this model, but it proved to have a consistently small and statistically insignificant coefficient. This does not tell us that government status does not matter, only that with a small number of electoral cycles, it is hard to identify a government status effect above and beyond the electoral cycle effect that this model picks up. Government status is highly correlated with whether polls are higher or lower than the previous election result. This model effectively tells us that knowing by how much a party has gone up or down relative to the last election matters more for understanding performance in the remainder of the cycle than knowing who was in government.

#### *Change in Votes on Change in Polls Since the Last Election*

A more parsimonious way to allow the previous election to influence expectations for the next election is to measure both votes and polls relative to the previous election.



Thus, a relative-change model would have the form:

$$\text{VOTE} - \text{PREV\_VOTE}_{pt} = \alpha_{pt} + \beta_{pt}\text{POLL\_SHARE} - \text{PREV\_VOTE}_{pt} + \varepsilon_{pt}. \quad (3)$$

Whereas in Equations 1 and 2 what is being predicted is the absolute share of the vote for a party, here the change since the last election is a function of change in the polls relative to the previous election. Beta coefficients from models of this kind are typically close to 0.5 between 20 months to a year before the election. This tells us that parties are expected to lose roughly half their gains (or recoup half their losses) in the polls since the last election. As the election approaches, the coefficient approaches one, but remains somewhat below one until the final week. Again this tells us that some of the reversal of fortunes is likely to occur late in the cycle.<sup>8</sup>

Model (3) is actually a special case of model (2). If  $\text{PREV\_VOTE}$  is subtracted from both sides then the right-hand side of Equation 3 becomes  $\beta_{pt}\text{POLL\_SHARE} + (1 - \beta_{pt})\text{PREV\_VOTE}$ , which is the same form as for model (2) but with a constraint that the coefficients of  $\text{POLL\_SHARE}$  and  $\text{PREV\_VOTE}$  sum to one. So, in practice, the LDV and relative-change models are rather similar to each other for forecasting purposes and both have important differences from the first model with government status. As with the LDV model, adding a government status dummy variable would not improve the model because government status is extremely strongly correlated with whether parties are polling more or less than at the last election.

This model is also formally equivalent to a regression of change in the final  $t$  days of the cycle  $\text{VOTE} - \text{POLL\_SHARE}_{pt}$  on the change from the previous election up to  $t$  days out  $\text{POLL\_SHARE} - \text{PREV\_VOTE}_{pt}$ . So model (3) can be thought of as the most direct model of the electoral cycle effect whereby change in the remainder of the electoral cycle is modelled and forecast as a function of change in the first part of the cycle.

Forecasting from regressions always involves a regression (or reversion) to the mean effect (hence the name). In the votes-on-polls model (1), the mean to which a party reverts is essentially the historical post-1945 average for that party (Con 41, Lab 40, and Lib 14). In the relative-change model (3), reversion is to the mean changes since the previous election (Con  $-0.14$ , Lab  $-1.12$ , and Lib  $0.85$ ). Since these are all quite close to zero, the relative model predicts that parties will move back towards their 2010 result at the 2015 election. The LDV model is between the two but very close to the relative model in this respect because the previous election is such a powerful predictor of the next election. The practical implications of this are discussed further later in this paper. First, it is important to consider which would have been the best for forecasting previous elections.

### Out-of-Sample Forecasting

While it is the case that polls are informative and there is evidence of a government recovery effect, it is necessary to consider the extent to which votes-on-polls

regressions actually improve prediction over simple projection of current polling and which model would have worked best in the past at predicting elections. This section considers out-of-sample prediction, i.e. running regressions of the forms in Equations 1–3 excluding each election cycle in turn and producing forecasts for the share of the vote for the omitted election. This is done separately for polls 20 months, 12 months, and 6 months prior to the election, with the mean overall errors from out-of-sample forecasts for each shown in Table 2. For any given election, the overall error is half the sum of the absolute differences between the prediction and the actual share of the vote for all three main parties and other parties as a group.<sup>9</sup> This can be thought of as the proportion of voters who would need to be reallocated to correct the prediction of the four-party share of the vote. The averaging is over all available cycles since and including 1974 on the basis that there are enough of these elections to judge performance, they are the most relevant ones and critically, they allow sensible comparability with models based on just 1974 onwards data. Essentially then, Table 2 shows us how good each model would have been at forecasting elections since 1974 at different time points beforehand, with smaller numbers indicating better performance.

The first two rows provide baseline comparisons. The first row (1a) shows the mean overall error from using the straight polling average as a prediction of the election result. Row (1b) shows the mean overall errors from forecasts from basic votes-on-polls regressions. The latter is clearly an improvement on the former, but both are clearly less good than the three kinds of models outlined above which incorporate government status or cycle effects.

The remainder of the table is organized first by model type, and then by whether the sample was restricted to elections since 1974 or not, and finally according to whether the data were weighted or not.

Restriction to elections since 1974 is considered because of the decisive move from a two to a three-party system in 1974. The Liberals were a tiny party in the 1950–1970 elections only once winning more than 10% of the GB vote and usually contesting around half or fewer seats. Since their breakthrough in February 1974 (with 19.8%), the Liberals have consistently contested the large majority of seats and only once secured less than 17%. Moreover, polls in the pre-1974 period were much fewer and further between, creating more uncertainty about trends in public opinion. In light of these considerations, it is worth testing whether forecasting for elections since 1974 is best done with information from this period only.

Weighting, where applied, is a linear function of time so that more recent elections are weighted more highly. This partly has the effect of making the weighted regressions on the full sample of cycles more like those based on post 1970 cycles only.

There are substantial differences between the best and worst prediction models, with one case of no improvement over the polls at all (12 months out row 2) and one case of error reduction by more than a half (6 months out row 11). The votes-on-polls-with-government-status models are clearly better done with elections only from 1974 (rows 4 and 5, better than 2 and 3), whereas the LDV and relative-change models are not so sensitive to the baseline set of cycles. In general, weighting

**Table 2.** Mean overall forecast errors for elections since 1974 from out-of-sample predictions

		Time prior to the election:		
		20th month	12th month	6th month
(1a)	Mean overall error in polls	9.6	6.8	6.8
(1b)	Votes-on-polls regressions (unweighted full sample)	8.4	7.6	6.1
	<i>N</i> (cycles for averaging)	9	9	10
	Votes-on-polls-with-government-status			
	<i>Forecasts with regressions from 1950 to 2010</i>			
(2)	Unweighted	7.5	7.2	6.1
(3)	Weighted	5.8	5.2	4.2
	<i>N</i> (cycles for regressions)	14	15	16
	<i>Forecasts with regressions from 1974 to 2010</i>			
(4)	Unweighted	5.7	4.6	4.0
(5)	Weighted	6.2	4.5	4.0
	<i>N</i> (cycles for regressions)	8	8	9
	Votes-on-polls and prior election (LDV)			
	<i>Forecasts with regressions from 1950 to 2010</i>			
(6)	Unweighted	5.9	6.2	4.2
(7)	Weighted	5.8	5.7	3.5
	<i>N</i> (cycles for regressions)	14	15	16
	<i>Forecasts with regressions from 1974 to 2010</i>			
(8)	Unweighted	6.0	5.6	3.9
(9)	Weighted	6.4	5.8	3.9
	<i>N</i> (cycles for regressions)	8	8	9
	Change in votes on change in polls since last election (relative change)			
	<i>Forecasts with regressions from 1950 to 2010</i>			
(10)	Unweighted	5.4	5.2	3.7
(11)	Weighted	5.2	4.9	3.2
	<i>N</i> (cycles for regressions)	14	15	16
	<i>Forecasts with regressions from 1974 to 2010</i>			
(12)	Unweighted	5.8	5.1	3.4
(13)	Weighted	5.9	5.2	3.9
	<i>N</i> (cycles for regressions)	8	8	9
(14)	Average of row (4) and (11) forecasts	5.3	4.5	3.2

*Notes:* See text for explanation. Ns for regressions reflect the exclusion of a single election for out-of-sample prediction.

makes little difference when regressions are based on the 1974 onwards set, but it matters for the full sample models.

Looking across the whole table, there are two rows that stand out as having the lowest prediction error. Votes-on-polls-with-government-status models based on 1974 onwards unweighted data (4), and the relative-change model based on a weighted full sample (11). The latter has the best on average over the three

columns, but the former was marginally better for the six months out data. For this reason, both these models are given particular attention for the remainder of this paper.

Although models in rows (4) and (11) produce similar predictions for past elections, either being close to the outcome or wrong in the same direction, as shown later in this paper they produce rather different point estimates for 2015, especially for the Liberal Democrats. So given their similar levels of success for past elections, it is reasonable to consider the average of the forecasts from row (4) and row (11) models, as shown in row (14). This average is only very little if at all better than the component forecasts and so it is not definitely to be strongly preferred to those from either component models. Without a strong preference for either the votes-on-polls-and-government-status or the relative-change models, the average of the two is a useful compromise.

Before moving on to applications note that [Table 2](#) suggests that the best models can reduce prediction error by about a third to a half of that from treating current polls as a forecast. It is also worth noting that in addition to reducing absolute prediction error, the regression approach almost entirely eliminates the expected bias in the prediction for out-of-sample prediction. This is to say that the out-of-sample predictions averaged out to 0.0 plus or minus 1.0 and no party systematically over or under performed in the out-of-sample regression-based predictions.

### **Issues with Applying the Models to the 2010–2015 Cycle**

In addition to understanding how well the forecasting methods perform for past elections, it is also important to consider whether there are factors that might affect the performance for this election. One such issue is the rise of the UK Independence Party (UKIP) for which there is insufficient historical electoral or polling data to be able to forecast shares for the party with this kind of technology specifically. But their current poll standing will have an impact on the poll shares for other minor parties collectively and for the three main parties also, which in turn will affect predictions. Any differential effect that the party has on the poll share of another party at the national level will also therefore be reflected, as any change in the level of party support would do.

More important for three-party share forecasting is the advent of the coalition government, after which support for the Liberal Democrats in the polls dropped dramatically in the second half of 2010, most likely as a result of more left-wing former Liberal Democrats switching support to Labour (Curtice, 2013). Since the start of 2011, the Liberal Democrats have been consistently polling close to 10%, less than half of their 2010 vote. So while the Conservatives and Labour have been polling within their interquartile range for polls between 1974 and 2010, the Liberals are currently standing near the bottom of their distribution for this period. As with all regression-based forecasting, it is more imprecise and difficult the further the main explanatory variables are from the average of past values (Greene, 1991: 167). So

there is a particular statistical problem with forecasting the Liberal Democrat share for 2015.

Incorporation of pre-1974 cycles into the Liberal forecasting regressions removes this problem when using Equation 1 because it increases the range of Liberal polls and election results making current polling levels closer to the historical average. For this reason, I believe it is better to use all prior cycles from 1950 onwards for forecasting the Liberal Democrat share of the vote in 2015 from Equation 1, even though the Conservative and Labour forecasts from Equation 1 are best done based on regressions with 1974–2010 cycles. This is the basis on which the votes-on-polls-and-government-status model is applied in the rest of this paper. This is also a problem for the relative-change model in Equation 3 since the Liberals have rarely deviated so much in the polls from their previous general election result as they have currently done, but it is not clear whether there are any consistent strategies for dealing with this problem within the relative-change model.

### **Smoothing for Day-to-Day Forecasts and Prediction Intervals**

A significant problem with daily forecasting from any of these models is that predictions have considerable temporal variation even for stable public opinion as measured by the polls. For example, consider what would happen if the Liberal Democrats continue to flat line in the polls close to 10% as they have been doing. There would be lots of day-to-day variation in the forecast, with random fluctuations up sometimes as much as three percentage points. It is possible to smooth over day-to-day variation easily enough with moving averages or other approaches, but there would also be waves with weekly/monthly and even longer term wave spans. These are much more problematic for both presentation and substantive reasons. It is hard to explain to a public (or any) audience why a forecast should change direction if public opinion does not change. It is possible to argue that a party should be expected to over or under perform its current poll share but not both at different times with the same share of the vote. If the Liberal Democrats stay on 10%, the forecast will drop from above 10 to below 10 over the first nine months and then rise above 10 again in the final 11 months. The question would be why does the forecaster think the Liberal Democrats will do better than the polls 20 months before the election but worse than the polls a year out from the election. There is no good social scientific or other explanation for this or similar waves. They are idiosyncratic and accordingly the patterns vary from party to party and somewhat according to the level of support. Thus, such waves need to be smoothed out because there is no basis on which to think they are informative about what will happen in this or future election cycles.

Exploratory work for this paper considered quadratic and other approaches to smoothing but did not identify a method that would ensure a curvilinear smooth monotone function beyond a simple linear trend. It also revealed that for a reasonable range of possible levels of support for each party, a linear trend was a decent approximation most of the time especially when the trend was forced to go through the final forecast one day before the election.

Formally, the regressions are of the following form where  $\text{RAW\_FORECAST}_{pxt}$  are the forecasts from votes-on-polls regressions from any of the models in Equations 1–3 for party  $p$ , with poll share  $x$  at time  $t$  days before the election.

$$\text{RAW\_FORECAST}_{pxt} - \text{RAW\_FORECAST}_{px1} = b_{px} * t + \varepsilon_{pxt}. \quad (4)$$

This linear regression forces the forecast to progress steadily approaching the election. Since this process forces the sequence of forecasts onto a straight line, it is more like ironing than smoothing. So the fitted values will be referred to as the ironed forecasts, which for party  $p$  on share  $x$  at  $t$  days before the election are given by

$$\text{IRONED\_FORECAST}_{pxt} = b_{px} * t + \text{RAW\_FORECAST}_{px1}. \quad (5)$$

While often the no-constant regression is very similar to regular OLS, the differences can be massive. In such cases, the no-constant regression typically attenuates any reversion-to-the-mean effect from the votes-on-polls regressions late in the cycle and brings the smoothed forecasts closer to the polls. This is probably a good thing and so an added benefit from ironing.

Prediction/forecast standard errors from each votes-on-polls regression (Equations 1–3) can be generated for given levels of party support straightforwardly (Greene, 1991: 166–168). The inexplicable variation in these can then be ironed out using the same process described above for ironing the trajectory of the point estimates. Prediction intervals using ironed forecast standard errors naturally narrow in a linear fashion as the election approaches. This is important for both presentation and substantive reasons as for the point estimates. People expect to become more and more confident in the forecast the closer the election. While it would be fair to say that the rate of narrowing might not be linear, most of the time a linear trend is a good approximation.<sup>10</sup> Most importantly for the nature of the forecast, there is much more uncertainty than you would expect just from sampling error in the polls. This is true even the day before the election because of the varying nature of polling-industry bias and idiosyncratic error over time.

### Predicted Seat Totals and Approximate Prediction Intervals

Predictions for seat totals for each party can be generated using the method outlined in Fisher et al. (2011) which involves applying a uniform change in the share of the vote implied by the predicted share on to each constituency and then using the formula below developed by Curtice and Firth (2008) estimating probabilities of each party winning each seat. Here, the probability for party  $j$  to win in constituency

$i$  from the predicted shares of the vote  $s_{ij}$  as  $r_{ij}/\sum_j r_{ij}$ , where

$$r_{ij} = \exp \left[ - \left( \frac{\max_j \{s_{ij}\} - s_{ij}}{\sigma} \right)^\lambda \right], \quad (6)$$

where  $\sigma$  and  $\lambda$  are tuning constants. For the purposes of election-night prediction in 2005, the values were  $\sigma = 4$  and  $\lambda = 1.5$ . These were picked using experimentation on 2001 results and they produced well-calibrated probabilities for 2005 (Curtice and Firth, 2008) and 2010 (Curtice, Fisher, and Kuha 2011) and so these values have been used again here. The predicted seat total for a party is then just the sum of the predicted probabilities for the party across constituencies.

This method can straightforwardly be applied to the point estimates for the shares of the vote with some assumptions about the nationalist and minor parties and special seats.<sup>11</sup>

The idea of prediction intervals for seats for each party is complicated conceptually. To estimate seats, predicted shares for all three parties are needed. But since the prediction intervals for each party share were generated independently, it is unclear where to set the performance of the other two parties when considering one of the bounds for another party. For example, it makes no sense to ask what the seats would be if all three parties were at their upper bounds. Instead, I consider the range of outcomes for the Conservatives and Labour, fixing the Liberal Democrat and Other shares at their point estimates. Thus, I construct a prediction interval for the Conservative lead over Labour assuming a constant sum for the two-party vote by pooling the forecast variances for the Conservative and Labour prediction intervals discussed above. The upper and lower bounds of this prediction interval imply two distinct scenarios:

- A: Conservative forecast share close to its upper bound, Labour close to its lower bound and Liberal Democrats and Others at their point estimates;
- B: Labour forecast share close to its upper bound, Labour close to its lower bound and Liberal Democrats and Others at their point estimates.

These scenarios are the most politically interesting since seat totals for the two main parties are the most important for government formation and they depend primarily on their performances and are relatively insensitive to the performance of the Liberal Democrats. So there is less need to consider possible variation in the Liberal Democrat share than in that for the two main parties.

Scenario A provides a best possible outcome for the Conservatives given the current polls and historical relationship between the polls and the vote, and similarly scenario B is the best possible outcome for Labour. Having identified the forecast shares of the vote for the three main parties in scenarios A and B, seat totals for all parties under these scenarios can be estimated with the formula above. The predicted seats for scenarios A and B provide approximate prediction intervals for seats.

### **Predicted Probabilities of Overall Majorities, Hung Parliaments and Largest Party**

To estimate the probabilities of a Conservative or Labour majority or a hung parliament, some estimate of the uncertainty distribution over seat totals is needed. This is a multidimensional problem if all parties are to be taken fully into consideration, but given only the top two parties have any prospect of gaining an overall majority and their seat totals are relatively insensitive to variation in the levels of support for the Liberal Democrats and others, it is reasonable to take an approximation approach as with the prediction interval for seats. Moreover, there are benefits for communication in providing probabilities of key events that are consistent with the seats prediction intervals.

The approach I take here is to assume that the approximate prediction intervals for seats are in effect 95% confidence intervals from normal distributions describing the probabilities of different seat totals for each party. For each party, the centre of the distribution is the best point estimate for seats as described above and a quarter of the width of the prediction interval provides an estimate for the standard deviation for the number of seats for a party. To enable consistency with the probability of being the largest party calculations, these party-specific standard deviations are averaged to provide a single standard deviation to reflect uncertainty in predicted seats total for both parties.<sup>12</sup> Given the normal distributions for both parties thus defined, the probability of an overall majority for the Conservatives or Labour can be inferred from the normal distribution function at the predicted minus threshold (326) number of seats. The probability of a hung parliament is then given by

$$\Pr(\text{Hung parliament}) = 1 - \Pr(\text{Conservative majority}) - \Pr(\text{Labour majority}). \quad (7)$$

The approximate probability that the Conservatives will be the largest party in parliament is estimated as the probability that the predicted number of Conservative seats exceeds the average of the point estimates for Conservative and Labour seats. Thus,

$$\Pr(\text{Con seats} - \text{Lab seats} > 0) \approx \Pr\left(\text{Con seats} - \frac{(E(\text{Con seats}) + E(\text{Lab seats}))}{2} > 0\right), \quad (8)$$

where  $E()$  is the expectation function and so refers to the point estimates for seat totals. Again this is calculated using the pooled standard deviation for seats and the cumulative normal distribution. The corresponding approximate probability that Labour will be the largest party is the symmetrical opposite and so by design is equal to one minus the approximate probability that the Conservatives have the most seats.



### Example Forecasts with Discussion

Table 3 shows three sample forecasts calculated with the above methodology for a 7 May 2015 election from 8 October 2013, at which point the average poll shares from the [www.ukpollingreport.co.uk](http://www.ukpollingreport.co.uk) polling average were Conservative 32%, Labour 39%, Liberal Democrats 10%, Others 19%.<sup>13</sup> The first forecast is based on votes-on-polls-and-government-status regressions and the second forecast comes from on weighted relative-change votes-on-polls regressions. Column (c) forecasts are based on the average of the daily forecasts and prediction intervals from the first two, after the application of the methodology for ironing, seats predictions, and probabilities. So while close, the figures in the third column are not the straight average of those in the first two. They deviate because of the ironing process and then the implications of that for later calculations.

Both basic forecasting models (columns (a) and (b)) suggest a Conservative lead in the share of the vote over Labour despite the inputted polling average of a seven-point Labour lead: an almost perfect switch in relative standing.

The most striking difference between the two basic models is the gap in the forecast Liberal Democrat vote share, which has a point estimate of 11.0 from the votes-on-polls-and-government-status models but 20.3 from the relative-change model. This is because the Liberal polls have historically been fairly weak predictors of the eventual Liberal vote this far away from an election. So both models have very strong regression to the mean effects driving their forecasts, but with regression to different means: to the historical average (14%) with votes-on-polls-and-government-status models but to the last election (24%) for the relative-change model.

This difference has a big impact on the implied share of the vote for Others, which is expected to fall by just two points from current polls in the first column but by six points in column (b). Given that nearly all the variations in the Other share since the last election has been due to the rise of UKIP, these forecasts could effectively be read as suggesting that the UKIP vote will fall by about these amounts before the next election. So the relative-change model is suggesting that UKIP will lose about half their current support in the polls. But note that neither model is suggesting that UKIP will win any seats even though the calculation assumes that all of the predicted rise in the combined other share of the vote will go to the largest minor party<sup>14</sup> from each constituency in 2010.

The predicted seat totals depend mostly on the predicted shares for the three main parties. The higher Liberal Democrat vote share estimate and the lower predicted Tory lead from the relative-change model both contribute to a prediction of a hung parliament with Conservatives the largest party, instead of a small Conservative majority from the votes-on-polls-and-government-status models.

This is certainly a big political difference between the two models but notice that the prediction intervals for shares of the vote for all three parties are very broad mostly overlap. At first glance, the combined prediction intervals may seem to encompass all foreseeable outcomes and more. For the Liberal Democrats, the interval for the average forecast from nothing (a hard boundary that had to be invoked) to

**Table 3.** Example forecasts from 8 October 2013, 576 days till the election

	(a) Votes-on-polls- and-government- status	(b) Weighted relative-change model	(c) Forecast from average of a and b models
<i>Inputted current average poll shares</i>			
Con	32	32	32
Lab	39	39	39
LD	10	10	10
Others	19	19	19
<i>Forecast election day shares with 95% prediction intervals</i>			
Con (36.9 in 2010)	$39.9 \pm 12.0$ i.e. between 28 and 52	$35.9 \pm 7.3$ i.e. between 29 and 43	$37.9 \pm 9.7$ i.e. between 28 and 48
Lab (29.7 in 2010)	$32.2 \pm 6.6$ i.e. between 26 and 39	$30.7 \pm 7.8$ i.e. between 23 and 39	$31.5 \pm 7.2$ i.e. between 24 and 39
LD (23.6 in 2010)	$10.9 \pm 15.7$ i.e. between 0 and 27	$20.3 \pm 9.2$ i.e. between 11 and 30	$15.6 \pm 12.5$ i.e. between 3 and 28
Implied point estimate for Others combined:	17.0	13.1	15.0
<i>Forecast election day seats</i>			
Con (307 in 2010)	333	295	315
Lab (258 in 2010)	270	276	275
LD (57 in 2010)	19	51	33
	Con majority of 16	Con largest party, but short of a majority by 31	Con largest party, but short of a majority by 11
<i>Forecast election day seats with approximate 95% prediction intervals</i>			
Con	216–468	203–402	211–436
Lab	143–381	176–364	162–372
LD	13–28	44–58	25–42
<i>Approximate probabilities of key outcomes (%)</i>			
Pr(Con majority)	54	27	42
Pr(Lab majority)	19	16	18
Pr(Hung parliament)	27	58	40
Pr(Con largest party)	69	58	64
Pr(Lab largest party)	31	42	36

*Notes:* Seats intervals assuming LD and Other shares fixed at point estimates while Con and Lab vary as per prediction intervals above.

28 seems ridiculously large. While these may seem hilarious at first sight, remember that not all points within the intervals are equally likely to occur. Also as 95% forecast confidence intervals, they reflect the historical variation in the votes for these parties and there should be only a 5% chance of a result outside the interval, conditional on the model being appropriate. So they are bound to be very broad to be credible. Even so, the lower bound for the Conservative forecast, at 28%, tells us that it is very unlikely the Conservatives will do much worse than they currently stand in the polls,

which is informative. Similarly, the Labour prediction intervals suggest that it is extremely unlikely that Ed Miliband could do as well as Tony Blair in 1997 or 2001, but there appears to be a fair chance he could do worse than Gordon Brown or Michael Foot.

The forecast election-day seat totals are as you would expect them given the forecast shares (Johnston et al. 2012). A classic uniform change prediction would produce slightly different figures but not by much, especially given the large prediction intervals for seats that follow from the large prediction intervals for votes. A future elaboration of the methodology here would reassess this assumption since uniform change is less likely to hold when there are very large changes in overall shares of the vote. UKIP are likely to rise more in some places than others, while the Liberal Democrats will have to fall more where they started stronger because of the floor effect where they were weakest in 2010.

The estimated probabilities for key outcomes are perhaps the most helpful feature of the forecast so far from an election. These show that the Tories have either a 69% or 57% chance of being the largest party but only 54% or 26% chance of an overall majority, respectively, from the two primary models. At this stage in the cycle part of the reason why these probabilities are not more one sided is because there is plenty of scope for change in party support before the election. But even immediately before the election, there is considerable uncertainty given the historic record of the polls as shown in Table 1.

Having some estimate for the probability of a hung parliament is particularly helpful given that it is otherwise hard to get a sense of this. Traditionally, there has been a tendency for commentators to underestimate the chances of a hung parliament (Gibson and Lewis-Beck, 2011).<sup>15</sup> The two different models help to show just how, even so far out from an election, the probability of a hung parliament is very sensitive to the scale of the Liberal Democrat recovery. With the relative-change model, a hung parliament is the most likely outcome with a probability of 59%, but note that this assumes that the Liberal Democrats will definitely be on 20.3% of the vote.

## Methodological Discussion

Had just the post 74 cycles been used the Liberal Democrat forecast in column (a) of Table 3 would have been lifted from 11% to 18%, close to the 20% in column (b). While important for the Liberal Democrats, current point estimates for the Conservatives and Labour are fairly insensitive to the base set of cycles for the votes-on-polls-and-government-status regressions.<sup>16</sup> Based solely on the statistical reasoning that forecasting from regression models is best done close to the centre of the distribution of past experience, the full historical set seems appropriate. In effect, this is a hedge on bets over whether the Liberal Democrats will continue their post-74 success or return to pre-74 levels of performance.

The choice between absolute change approach in column (a) and relative-change models in column (b) could also be characterized in this way for the Liberal Democrats. For both choices, it is also possible to consider side information and argue that

since Liberal Democrat losses are primarily to Labour because of the coalition (e.g. Curtice, 2013) they are less likely to be undone. Since employing such information would effectively imply guessing the degree of permanence of the Liberal to Labour switching I have refrained from taking this approach. But such considerations do provide reasons why some readers might prefer the Liberal Democrat forecast from column (a) to that in column (b).

It might be thought that there is a danger that some election cycles are driving the results here more than others. Exploratory data analysis suggests not. Even dramatic cycles like 1983 with the advent of the Social Democratic Party (SDP) and the Falklands war are not clear outliers in the votes-on-polls regressions. The famous failure of the polls in predicting the Conservative victory in 1992 means that that cycle is the furthest from the regression line for the Conservative share, but it is not clearly more influential than others.

Political, social, and economic phenomena also have played a part in determining when prime ministers have chosen to call elections in the past and so the previous electoral cycles have been of different lengths for different reasons which are linked to the success or failure of the electoral cycle. Traditionally, governments that are likely to secure re-election call them after four years but those more likely to lose go the full five years. Maybe this strengthens the measured electoral cycle effect and maybe then we should expect it to be weaker in the current cycle than in the past. If so the outcome should be closer to current opinion polls than any of the models. Without a government recovery and opposition setback effects in the model the forecast would be for the two main parties to be neck-and-neck.

Further elaboration and different formulations of the votes-on-polls and similar regression models is possible. One could incorporate a cost of governing effect (Paldam, 1986) or similarly an electoral pendulum effect (Lebo and Norpoth, 2007). Especially closer to the election, it may be worth adding leading economic indicators (Erikson and Wlezien, 2012) or considering whether PM approval data add value (Lebo and Norpoth, 2007). But with just 17 prior electoral cycles, there is a danger of over fitting the data.

There is nothing special about 20 months prior as a starting point, but forecasting much before 600 days would involve incorporation of much more unstable patterns of correspondence between polls and votes (Wlezien et al., 2013), so it is potentially problematic to apply this approach to even longer range forecasting. Conversely, the precision of the forecast improves only incrementally until quite close to the election, so there is relatively little gain from delaying the start of a forecasting exercise until closer to the election.

Related to this, narrowing the period over which ironing is done would make some but not considerable difference to the trajectories of point estimates. The implications for prediction intervals are more dramatic since, in practice, they tend to narrow more dramatically in the last few weeks than on a steady basis. There might be some junctures at which it makes sense to switch to a new basis for ironing (e.g. the start of the campaign). Another possible strategy worthy of further investigation would be using either

or both the daily variance in the polls<sup>17</sup> and the correlations in the errors of the forecast regressions between parties to provide better and probably narrower prediction intervals.

## **Conclusion**

The development of a method for long-range forecasting of the next British general election from opinion polls has been useful for illustrating a number of important points about the historical relationship between opinion polls and election results and about the operation of the electoral system. These include the following observations. The polls are informative about the likely outcome even a long time beforehand. Governments are likely to rise then fall in the polls over the course of the electoral cycle, and vice versa for the principle opposition party. More generally, parties' gains or losses in the polls over the first half or so of the electoral cycle are likely to be undone somewhat by the next election. Even accounting for these features, historical experience suggests that the Conservatives are likely to do better at elections than they do in the polls 20 months prior, and vice versa for Labour. This is true, but to a diminishing extent, right up to the final week. A very small amount of this looks like either very late swing or polling-industry bias.

In addition to suggesting systematic changes between now and the election, the historical data also show that substantial unpredictable changes have happened over the final 20 months before an election. But really big changes are relatively rare. This helps to explain how forecast confidence intervals are very broad without becoming uninformative. While the Conservatives, in October 2013, were clearly expected to be the largest party at the election, there is still a 36% chance that Labour would be according to the average of the two best models identified in this paper.

Of course, history may not be such a good guide this time, and there are major features of the current political landscape to support such a view, not least the coalition and the rise of UKIP. While the methodology allows these developments to be somewhat reflected in the forecasts, there simply is no evidence base for proper modelling – potentially jeopardizing the predictive power of the historical cycles approach. Substantial though recent changes to the party system are, there were also exceptional events and developments in many of the other election cycles. Major party performance dynamics will only really be different this time if the outcome falls outside the prediction intervals, which we will not know till after the election.

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ranging comments on Twitter and elsewhere online in response to previous drafts. The paper has been revised substantially in part thanks to them.

## Notes

1. This only reflects the time this work was started relative to the 2015 election.
2. This is a technical term is used just to refer to the difference between the average poll and the election result. It is not necessarily the product of any methodological or other choice by pollsters and may not be possible to predict, control or correct for and certainly there is not any accusation here of politically motivated interference.
3. I have added 96 polls that were missing from the Wlezien et al. (2013) data set, all of them from the final three months of election cycles up to February 1974. Also note that allocations of fieldwork mid-points involved rounding down not rounding up as was mistakenly reported in Wlezien et al. (2013).
4. Government recoveries can be engineered by a change of leadership as when John Major replaced Margaret Thatcher 15 months before the 1992 election. Douglas-Home replaced Macmillan a year before the 1964 election, primarily because of illness but arguably also because of unpopularity. But the only other two changes, from Wilson to Callaghan and from Blair to Brown, were more than 20 months prior to the election and did not improve their party's standing.
5. The 2015 general election is expected regardless of the outcome of the referendum on Scottish independence.
6. Since this is the first time the Liberals have been in government since the war, there is no evidence as to how this affects the likelihood of recovery before the election. One could look at the experience of the 1979 minority administration supported by the Liberals to argue that a recovery is likely, but this is too limited an evidence base to estimate the magnitude of the effect.
7. That paper provided two forecasts – one from just before the campaign and one from the final week of the campaign. The pre-campaign forecast was adjusted for the historical polls–vote relationship (stage 2 of the method) but the final forecast was not (given the nature of the regressions run being close to identity). Note that the pre-campaign polls–vote relationship was estimated using polls aggregated over a week before the campaign (or equivalent) for each cycle.
8. There are various mechanisms which might cause the pattern of increasing strength of the coefficients, such as vote intention increasingly based on party identification or leadership ratings, or just the diminishing time left for change to occur. See Wlezien et al. (2013) for graphs and discussion of the evolution of the coefficients from similar regressions.
9. That is,  $\sum \text{abs}(\text{predicted}_p - \text{actual}_p)/2$ , with summation over  $p = \text{Con, Lab, Lib, Oth}$ .
10. In truth, there is perhaps the possibility of developing a theory of when opinion-turning events are most likely to occur, e.g. at party conferences and Budget speeches, and which periods are likely to be disproportionately quiet, e.g. holidays. Developing this idea would require too much groundwork for this paper and various informal analyses suggest that there is limited systematic lasting legacy of budgets and conferences.
11. I assume no change in vote share for the Scottish National Party (SNP) and Plaid Cymru (PC). Otherwise, I assume that the largest minor party in the constituency in 2010 will get all the increase or decrease in the Other share of the vote. In many cases, this will be UKIP. I further assume that the Green's will hold their seat, that Wyre Forest will stay Conservative (after they narrowly defeated an independent incumbent in 2010) and that the speaker's seat will remain Conservative.
12. In practice, the prediction intervals for seats are slightly skewed and doubtless a full simulation exercise would not produce a density which was perfectly normal, but the approximation seems good enough for the purpose given that with a fixed estimate for the Liberal Democrat and Other party share the variation in seats is overwhelmingly between Conservative and Labour and the probability calculations are relatively insensitive to the estimate of the standard deviation within a reasonable range.
13. The technology can be used to generate forecasts for different scenarios so predictions from different poll averages can be compared.
14. Not including SNP or PC.

15. Approaching the last election, a hung parliament was more likely than not, but this was not reflected in the media debate. Things may be different now that there is hung parliament with a coalition, but it could still be seen as an aberration or people may become too inclined to think it will happen again.
16. Except that perversely the prediction intervals for Labour are much narrower as result of the smaller more appropriate post-74 sample.
17. See Wlezien et al. (2013) for information on the variation in the polls and how it differs between parties and both within and across cycles.

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