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Forecasting the 2015 British General Election:

The Seats-Votes Model

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Highlights

We utilise a modified Cube Rule to forecast seat shares for the parties in the House of Commons in 2015 based on data from 1945 to 2010

The model predicted a hung Parliament with no party having an overall majority of seats, a predictive failure.

We show that part of the predictive failure was due to the fact that the poll data did not capture the vote intentions of those who actually participated in the election.

We also show that the Coalition government represented a 'regime shift' in the time series and adjustments for this using an ARIMA model were not sufficient to capture Liberal Democrat seat share.

Abstract

This paper applies the Seats-Votes Model to the task of forecasting the outcome of the 2015 election in Britain in terms of the seats won by the three major parties. The model derives originally from the 'Law of Cubic Proportions' the first formal statistical election forecasting model to be developed in Britain. It is an aggregate model which utilises the seats won by the major parties in the previous general election together with vote intentions six months prior to the general election to forecast seats. The model was reasonably successful in forecasting the 2005 and 2010 general elections, but has to be modified to take into account the 'regime shift' which occurred when the Liberal Democrats went into coalition with the Conservatives in 2010.

Forecasting the 2015 General Election: The Seats-Votes Model

This paper utilises the Seats-Votes model to forecast the outcome of the General Election in Britain in May 2015. This model has been used with some success in the past to forecast both the 2005 and 2010 general elections (Whiteley, 2005, 2008; Whiteley et al. 2011; Gibson and Lewis-Beck, 2011). It is derived from the so-called 'Law of Cubic Proportions' formalised by the statisticians Kendall and Stuart (1950) in an article which represents the starting point of contemporary election forecasting modelling in Britain.

The literature on election forecasting in Britain has grown tremendously in recent years and a variety of approaches have been used to predict electoral outcomes (Whiteley, 1979; Mughan, 1987; Norpoth, 2004; Sanders, 1991, 2005; Belanger, Lewis-Beck and Nadeau, 2005; Nadeau, Lewis-Beck and Belanger, 2009; Lewis-Beck and Stegmaier, 2011; Murr, 2011; Fisher et al. 2011; Lebo and Norpoth, 2011). These models utilise different methodological approaches and can be classified in a variety of different ways, but two important types recur in the literature. There are popularity functions, which utilise time series analyses of monthly or quarterly poll data to capture the relationship between voting intentions, the economy and other variables, for the purpose of forecasting. This approach was introduced by Goodhart and Bhansali, (1970) in a seminal paper on economic voting. Secondly, there are vote function models which utilise data on election results, an approach pioneered by Kendall and Stuart (1950). These models use aggregate data measured over time or alternatively at the constituency level to derive the forecasts (Johnston et al. 2006).

Each method has its advantages and disadvantages. Popularity functions are based on relatively large numbers of observations, particularly in the contemporary era with the presence of many opinion polls, and this increases the precision of model estimates (Duch and Stevenson, 2008). On the other hand this approach faces the problem of translating vote forecasts into seats, since winning a general election in Britain does not mean winning most votes, but rather the most seats in the House of Commons. This is not a trivial distinction either since in the twentieth century the party winning most votes did not win most seats on three different occasions. This happened in 1929, 1951 and again in the February 1974, so there is a clear advantage in modelling the number of seats at the outset rather than analysing voting intentions which subsequently have to be translated into seats.

The Seats-Votes model uses aggregate analysis combining seat shares from all eighteen general elections since the Second World War with poll data to forecast seats in the Commons. It does not face the same problem as popularity function models, but the sample size is small making it essential to conduct extensive diagnostic testing to ensure that the models are well-behaved. It also requires the analysis to focus on political parties that have been in existence since 1945, and so has little to say about the rise of new parties such as the Scottish National Party or UKIP. These considerations aside, it is a relatively simple model with a respectable track record, although as the discussion below shows it has to be modified to deal with the era of Coalition politics.

The Seats-Votes Model

The seats-votes model adapts 'Law of Cubic Proportions' or the 'Cube Rule' to forecast seats shares over time. According to the Kendall and Stuart the Cube Rule:

> *'.. states that the proportion of seats won by the victorious party varies as the cube of the proportion of votes cast for that party over the country as a whole.'* (Kendall and Stuart, 1950: 183).

Using their example of the 'White' and 'Black' parties then:

$$(1) \qquad \frac{W}{B} \Rightarrow \frac{P_0^3}{Q_0^3}$$

where:

W is the 'White' party and B is the 'Black' party seat shares

P_0 is the White party vote share and Q_0 is the Black party vote share, with $P_0 = 1- Q_0$, so that:

(2) $$W \Rightarrow B.(P_0)^3.(Q_0)^{-3}$$

When they applied this model to the task of forecasting seat shares in the 1950 general election in Britain using poll data collected three days before the election the results were extremely accurate. The forecasting errors were one seat for Labour, five seats for the Conservatives and four seats for other parties, with the Liberal forecast being spot on (Kendall and Stuart ,1950: 194).

The key weakness of the model, fully acknowledged by the authors, was that it really only works in a dominant two party system in which it is safe to ignore minor parties. This was certainly true in 1950 when the Conservatives and Labour together took 90 per cent of the vote and 98 per cent of the seats. But as the British party system evolved towards the multi-party system of today the forecasts got progressively less accurate. In the early 1970s Edward Tufte (1973) suggested that a '2.5 rule' should be used as an alternative and Laakso (1979) showed that this appeared to work quite well at that time. But as we enter a new context of a fragmented multi-party system this is no longer the case.

Accordingly, we make three modifications to the Cube Rule to adapt it for forecasting seats in the 2015 election. The first change is to estimate the exponents rather than assuming that they are 3.0, thereby removing one source of error. Secondly, we utilise seat shares won by each party in the last parliament rather than the seat shares won contemporaneously by the rival party, as in equation (2). This is designed to capture the incumbency effect, which is partly a matter of existing MPs having a personal vote (Cain, Ferejohn and Fiorina, 1987), but also the fact that parties represented at Westminster generally have much better coverage in the media than their non-parliamentary rivals and therefore are much better known to the general public. Incumbency bestows several advantages on the existing parties which need to be taken into account in the modelling.

The third change is that we utilise poll shares six months rather than three days prior to the election in order to make the forecast. The six month lag has been identified as the most efficient compromise between having the longest lead time for the forecast with the highest goodness of fit of the model (Whiteley et al. 2011). It is clearly advantageous to have as long a lead time for the forecast as possible without this degrading its accuracy and the six months lag achieves this goal.

The theoretical forecasting model is given by the following expression:

$$S_{it} = \alpha(S_{it-1})^{\gamma i} . \prod_{i=1}^{k} (P_{it-m})^{\beta i} . \varepsilon_i$$

where

S_{it} is the seat share of party i at the election at time t

P_{it-m} is the vote share for party i out of k parties, in the polls m months prior to the election

α, β^j, γ^i are parameters to be estimated

ε_i is an error term where $E(\varepsilon_i)=0$, $var(\varepsilon_i) = \sigma^2$

The theoretical model includes all rival parties but in practice this cannot be estimated since it would be perfectly collinear, so the empirical model estimates future seats for a party from its past seats and also from poll data for the party and its main rival.

For example, the Labour seat model in log-linear form is:

$$\ln(LabS_t) = \ln \alpha + \beta_1 \ln(LabS_{t-1}) + \beta_2 \ln(LabP_{t-m}) + \beta_3 \ln(ConP_{t-m}) + \ln.\varepsilon$$

where:

$LabS_t$ is the number of Labour seats won at election t

$LabP_{t-m}$ is the Labour vote share in the polls m months prior to the election

$ConP_{t-m}$ is the Conservative vote share in the polls m months prior to the election

The Conservative seat share model has the same specification as the Labour model but with lagged Conservative seat shares as a predictor. In previous versions the Liberal Democrat model utilised lagged Liberal Democrat seat share along with Liberal Democrat and Conservative vote shares in the polls (Whiteley et al. 2011). However, soon after the Liberal Democrats entered the Coalition government in 2010 a major change occurred to their support.

(Figure 1 about here)

Figure 1 shows vote intentions for the Liberal Democrats using monthly data from the Continuous Monitoring Survey from the date of the general election of 2010 election up to February 2015[1]. After the party obtained 23 per cent of the vote in the 2010 general election, Liberal Democrat voting intentions dropped dramatically in the months immediately after the election and have stayed at a low level since (Clarke et al. 2011; Whiteley et al. 2013). This change cannot be captured by the Seats-Votes model, since there are no seat data available after 2010. This sea-change in Liberal Democrat support is what econometricians call a 'regime switch' or a fundamental shift in the behaviour of a time series caused by an outside shock to the system, and this needs to be taken into account in the modelling (Carnot, Koen and Tissot, 2005). We return to this issue below.

The empirical models for the two major parties contain a dummy variable designed to capture the split in the Labour party in 1981 when the Social Democratic Party was formed. This huge shock to the party system arose from Labour's defeat in 1979 and had a very strong impact on the party's poor performance in the subsequent 1983 election. So the

[1] The Continuous Monitoring Survey of the BES ended in December 2012, and so the series is continued up to February 2015 using the same voting intention question in the Essex Continuous Monitoring Survey.

variable scores one in 1979 and 1983 and zero otherwise, to capture these divisions in the party which occurred after it lost power to Mrs Thatcher in 1979.

(Table 1 about here)

The results of the modelling for the two major parties appear in Table 1 where all variables apart from the split dummy are expressed in logarithms. It can be seen that the effects are highly significant for both the Labour and Conservatives. The coefficient of the seats lagged variable which measures the inertia in the system is similar for both parties, and as expected Labour voting intentions six months prior to the election have a strong positive impact on Labour seat shares and Conservative vote intentions have a significant negative effect. The reverse is true for the Conservative seats model with Conservative vote intentions boosting and Labour vote intentions reducing Conservative seat shares. Finally, the Labour split variable has significant negative impact on Labour seats and weakly significant positive impact on Conservative seat shares.

Various diagnostic tests (Table 1) show that the models are free of residual autocorrelation and heteroscedasticity in the estimates and the model residuals approximate a Normal distribution, indicating that there are no significant outliers that influence the results (Kennedy, 2013). The Ramsey test for the adequacy of a linear functional form test is not significant for Labour although it is significant for the Conservatives[2]. Overall, these diagnostic tests indicate that the models are quite well behaved and so are likely to produce reliable results when applied to the task of forecasting seats in May 2015.

[2] Note that if the Conservative model is estimated in linear rather than logarithmic form the Ramsey test is non-significant. This implies that the positive effect for the Conservatives is not a serious problem that will unduly distort the results.

The Liberal Democrat Model

Given the recent regime switch for the Liberal Democrats we use an alternative approach to estimating the forecast for that party. We estimate the Liberal Democrat vote share in the 2015 election before translating this into seat shares utilising the long-term relationship between seats and votes for the party found in all the elections since the Second World War. This exercise involves estimating a popularity function and since we are not concerned with modelling the effects of the economy or other variables on the Liberal Democrat vote, the simplest and most parsimonious type of popularity function is a univariate Autoregressive-Moving Average model (ARIMA). This class of model was introduced by Box and Jenkins (1970) and it has been used to forecast vote shares in British general elections in the past (Whiteley, 1979). It is designed to extract the maximum amount of information from the data in order to forecast it efficiently while controlling for the random noise in the series.

The starting point of the Box-Jenkins modelling strategy is to determine if the series is stationary, that is, if it fluctuates around a constant mean and has a finite variance in the limit. Figure 1 appears to suggest that Liberal Democrat voting intentions is non-stationary since it declines throughout the period from 2010 to 2015. But a Phillips and Perron (1988) test for a unit root demonstrates that the series is in fact stationary[3], which can be attributed to the fact that Liberal Democrat vote intentions collapsed very rapidly in late 2010 and the series has changed very little since then. This means that the Liberal Democrat ARIMA model is one where the 'I' term is 0, indicating that the Liberal Democrat voting intentions do not need to be differenced to obtain mean stationarity before estimating AR or MA terms.

(Table 2 about here)

[3] The critical value for Z(t) in the Phillips-Perron test of the Liberal Democrat vote intentions series is -4.48 which is significant at the 0.01 level. Since the null hypothesis is that the series is nonstationary, rejecting the null implies that the series is stationary.

Table 2 shows two versions of the ARIMA model, the first is a purely autoregressive model and the second an autoregressive-moving average model. The autoregressive coefficients are highly significant in both versions, and the moving average coefficient is significant in the second. The Ljung-Box portmanteau test indicates if there is any systematic information left in the residuals which has not been captured by the model (Ljung and Box, 1978). These tests are non-significant for both models indicating that the model residuals are white noise and therefore do not contain any useful additional information. The Akaike and Bayesian Information Criteria test if the second model is an improvement on the first in terms of the goodness-of-fit (see Burnham and Anderson, 2002). These coefficients confirm that the second model is indeed and improvement on the first, and so we utilise the autoregressive-moving average model in order to forecast the Liberal Democrat (LD) vote share in the 2015 election.

The ARIMA model predicts that the Liberal Democrats will receive 8.4 per cent of the vote in the election and this can be used to forecast the party's seat share. If we use the historic relationship between seat shares and vote shares for the party which has operated since 1945 then it is predicted to win 11 seats in 2015. But, as the earlier discussion indicates, this ignores the impact of seats won in the 2010 general election. If the latter are incorporated into the forecasting equation then the party is predicted to win 34 seats in 2015[4]. Figure 2 summarizes the forecasts for all parties in the general election.

(Figure 2 about here)

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[4] The estimates are:

$$LDS_t = \underset{(0.5)}{-0.20} + \underset{(4.8)}{0.68}LDS_{t-1} + \underset{(3.0)}{0.46}LDF_t \quad \text{Adjusted } R^2 = 0.84\text{, Durbin's H} = 0.99$$

where: LDS = logged Liberal Democrat Seats, LDF = logged Liberal Democrat Vote Forecast (t statistics in parenthesis)

Conclusion: Deadlock 2015

The Seats-Votes model is a relatively parsimonious aggregate level forecasting tool which derives from the Cube Rule which successfully forecast seat shares in the era of two-party politics in the 1950s and 1960s. We have adapted it to the task of forecasting seat shares in an election which looks very different from those which occurred sixty years ago. The model had a reasonably good track record in forecasting seats in the 2005 and 2010 general elections. But it requires additional modification to deal with the advent of coalition politics in Britain in 2010. The 2010 general election produced a hung parliament and the model suggests that the parliament that elected in 2015 will be even more divided, making it very difficult, perhaps impossible, to form a stable coalition government. It would not be surprising if another general election occurred well before 2020 in these circumstances.

Post-Election Postscript: Learning from Experience

As is well known all the forecasting models got it wrong with the exception of the exit poll conducted on the day of the election. In the case of the Seats-Votes model two factors help to explain the failure of the modelling. One was the effect of the regime shift on the Liberal Democrat seat share, and the second was the inaccuracy of the polls six months out which were used to predict the seats won by Labour and the Conservatives.

Regarding the first factor, in our paper we argued that the Liberal Democrats had experienced a 'regime shift' and therefore modelling their support required a different approach than that used for the Conservatives and Labour. With hindsight it appears that the regime shift was more fundamental than we thought. The paper showed that if Liberal Democrat seats in 2010 had no effect at all on seats in 2015, implying no incumbency effect, then the forecast would give the party 11 seats. In fact it won 8 seats, so on this assumption the forecast was 3 seats out. The Lib Dem regime shift was clearly more profound than we originally envisaged.

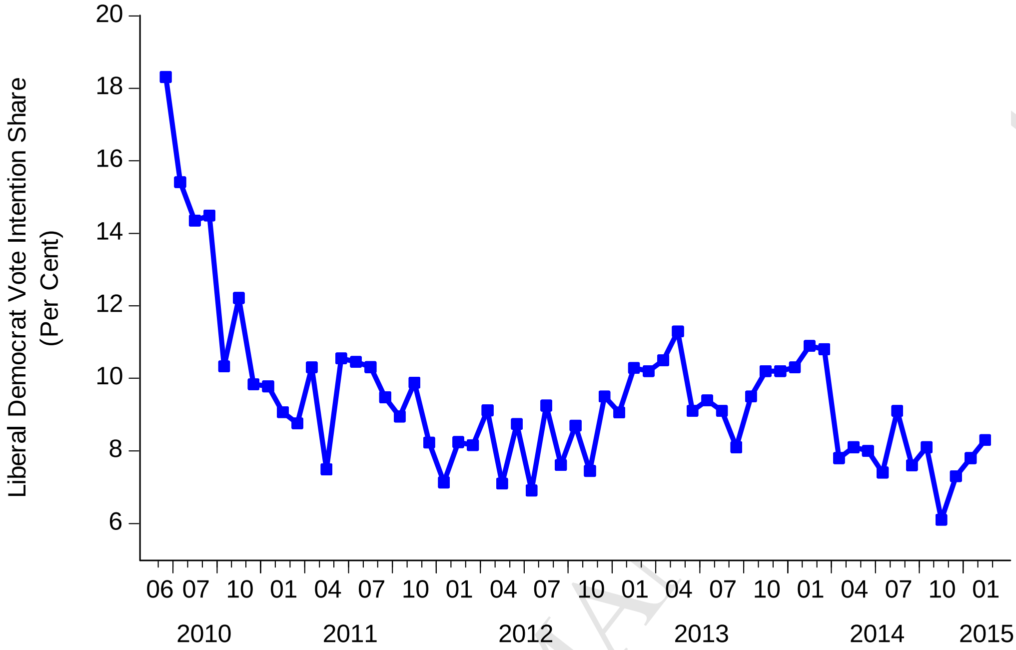
The second factor concerns the fact that the voting intentions data gathered six months prior to the election were inaccurate guides to the vote shares the Conservatives and Labour actually obtained. This discrepancy negatively affected the seats forecasts for these two parties. The point can be demonstrated by recomputing our forecast, using actual vote shares obtained in the 2015 election, rather than vote shares in the polls six months out. In the event, the Conservatives obtained 36.9 per cent of the vote share and Labour 30.4 per cent in the election. When these numbers are used in our forecasting model it predicts that the Conservatives would win 333 seats and Labour 245 seats. Since the Conservatives seat total was 331 and Labour 232 seats, the forecasting errors under this assumption are quite modest. This raises the possibility that the vote intentions data could have been adjusted to make them more accurate.

We believe that there are two such adjustments. First, given a turnout of 66 per cent in 2015, it is evident that employing a 'likely voter' filter to polling data may be very important for improving the accuracy of parties' vote share estimates. Second, recognizing the possibility of campaign effects suggests that, in general, surveys conducted several months before an election risk being less reliable guides than surveys carried out closer to the contest.

These ideas can be illustrated by employing a 'likely voter' filter to data gathered in the April 2015 Essex Continuous Monitoring Survey (ECMS). For respondents eligible to vote in the 2010 or earlier general elections, the filter uses two criteria: (a) a score of 10 on a 0-10 'likely to vote' scale and (b) reporting voting in 2010. For young people first eligible to vote in 2015, (b) is replaced by agreement with a statement regarding voting as a civic duty—a strong predictor of turnout (see, e.g., Clarke et al. 2004). Figure 3 displays the resulting survey vote shares, together with the parties' actual vote percentages in Great Britain. (Northern Ireland was not included in the survey). As the figure shows, discrepancies between the two sets of figures tend to be quite small—1.1 per cent on average. Taking sampling error into account, the only statistically significant difference ($p < .05$) involves the Conservatives where the miss is 2.6 per cent, just outside the boundaries of a 95 per cent confidence interval.

A final point—when using polling data as input to an election forecasting model, it is important to recognize and respect the reality of sampling error. Sampling error is not merely a 'get out of jail free' card for embarrassed pollsters whose data miss the mark. Rather, it is an intrinsic feature of the survey research enterprise. Acting in conjunction with the sensitivity of a first-past-the-post system to changes in vote shares in situations where there is a sizable number of marginal seats, sampling error entails a continuing possibility of getting an election outcome wrong. With more and better survey data and improved models, we can reduce the probability of incorrect forecasts, but we cannot eliminate it entirely. That said, being right on most occasions is a worthy goal.

Figure 1. Trend in Liberal Democrat Voting Intentions,
June 2010 to February 2015



Source: BES CMS and ECMS monthly surveys

Figure 2. Forecasts for the 2015 General Election from the Seats-Votes Model

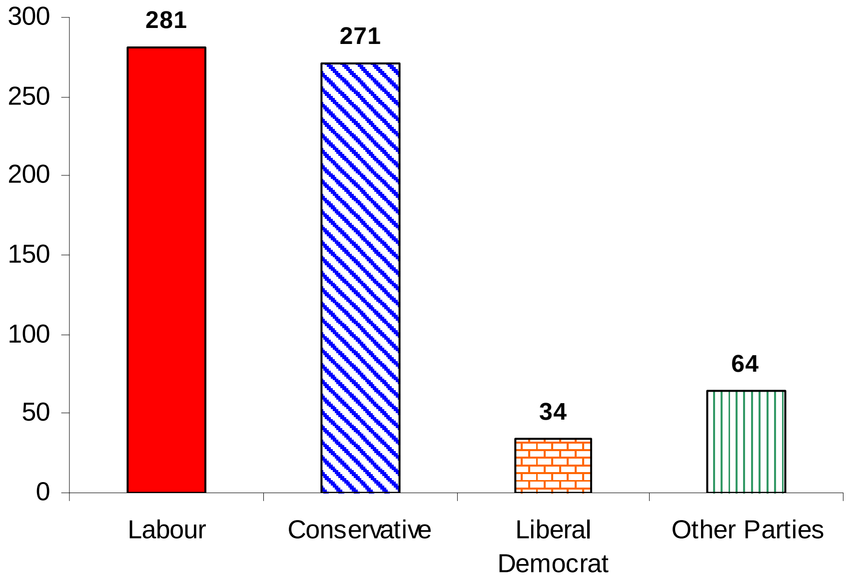


Figure 3. ECMS April 2015 Pre-Election Survey Vote Intention Shares Among Likely Voters and 2010 Election Result in Great Britain

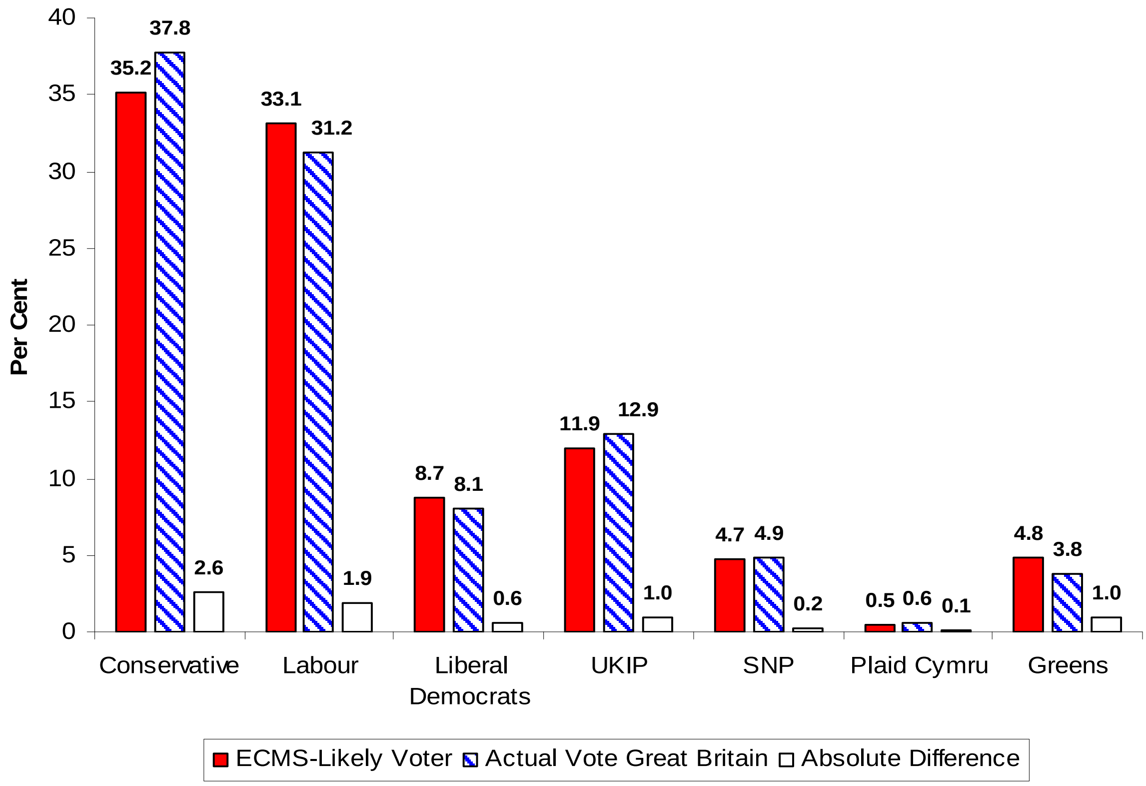


Table 1. Labour and Conservative Seats-Votes Forecasting Models

Predictors	**Labour Seats**	**Conservative Seats**
Number of Seats Lagged one Election	0.54***	0.59***
Labour Poll Share six months out	0.46***	-0.47***
Conservative Poll Share six months out	-0.37***	0.72***
Labour Split Dummy Variable	-0.19***	0.14*
Adjusted R^2	0.86	0.86
Serial Correlation Chi-Square Test	1.1	0.84
Ramsey Functional Form Test	0.48	4.95**
Residual Normality Test	0.70	0.91
Heteroscedasticity Test	0.00	0.11

N = 18

Table 2. ARIMA Models of Liberal Democrat Vote Intentions,
June 2010 to February 2015

	AR(1) Model	**AR(1) MA(1) Model**
Constant	11.12***	12.04***
Autoregressive Parameter	0.88***	0.97***
Moving Average Parameter	---	-0.33**
Ljung-Box Q	33.26	20.86
Model Selection Statistics:		
AIC	219.24	214.02
BIC	225.37	222.19

*** - $p \leq .001$; ** - $p \leq .01$
N = 56
Note: --- - parameter not included in model.

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