Election Forecasting

GRAD-E1234

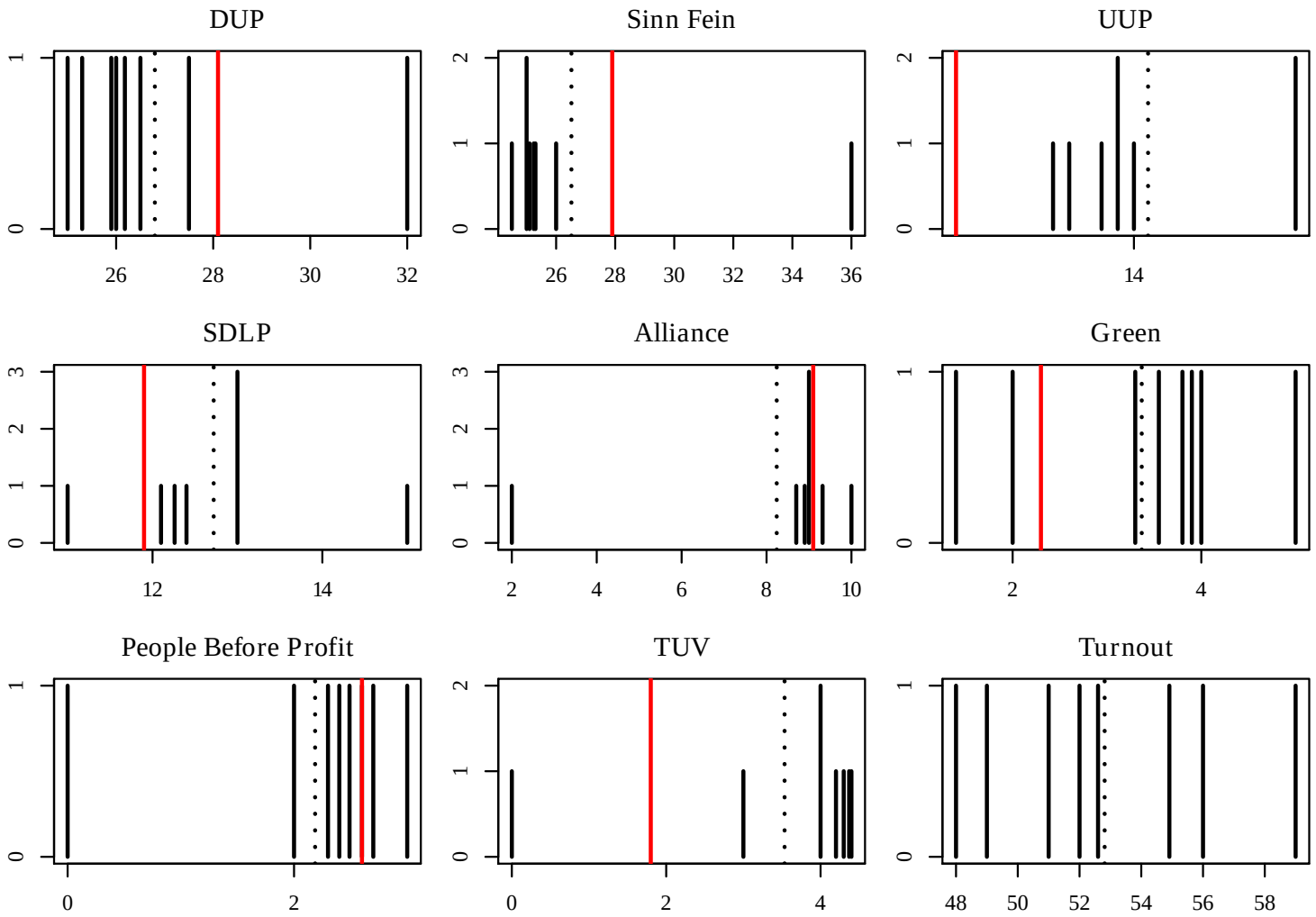
Survey-Based Models

Simon Munzert

Spring Semester 2017
Humboldt-University of Berlin

Session outline

Election forecast of last week



Election forecast of last week

rank	respondent	mae	rmse	time
1	Jeremie Bonnemort	1.91	2.61	30
2	Hendrik Frank	1.98	3.23	20
3	Christoph Abels	2.22	3.61	15
4	Alexander Sacharow	2.63	4.55	30
5	Rafael Goldzweig	2.75	4.44	30
6	Moritz Hemmerlein	2.82	5.72	20
7	Victoria Dykes	3.49	5.64	15
8	Michael Chaitow	4.53	6.12	20

Election forecast of the week

Dutch general election next Wednesday! → Google Form online

Survey-based models

Assets and drawbacks of poll-based forecasting

Pros

- most popular method
- polls as natural by-product of campaigns
- incorporation of effects of campaign events
- dynamic forecasts possible → horserace journalism
- high face validity; predictor and outcome closely related

Assets and drawbacks of poll-based forecasting

Pros

- most popular method
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Cons

- campaign noise (Gelman/King 1993) → are observed shifts substantive?
- what's the point of dynamic forecasts of a singular event?
- survey institutes as black boxes → polling failures
- specification of uncertainty?
- no substantive theoretical value; almost tautological models

Sources of survey error

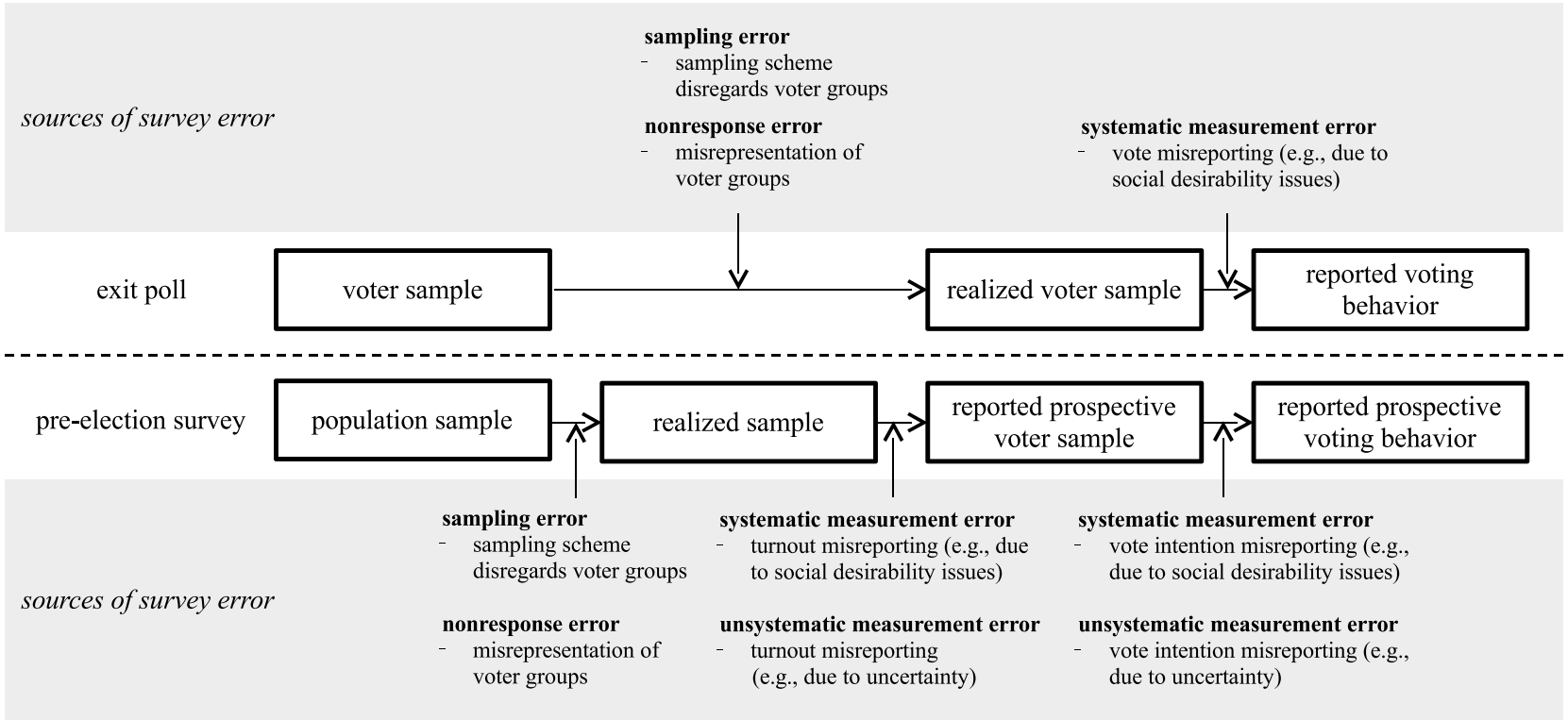


Fig. 1. Sources of survey error in exit polls and pre-election surveys.

Sources of survey error

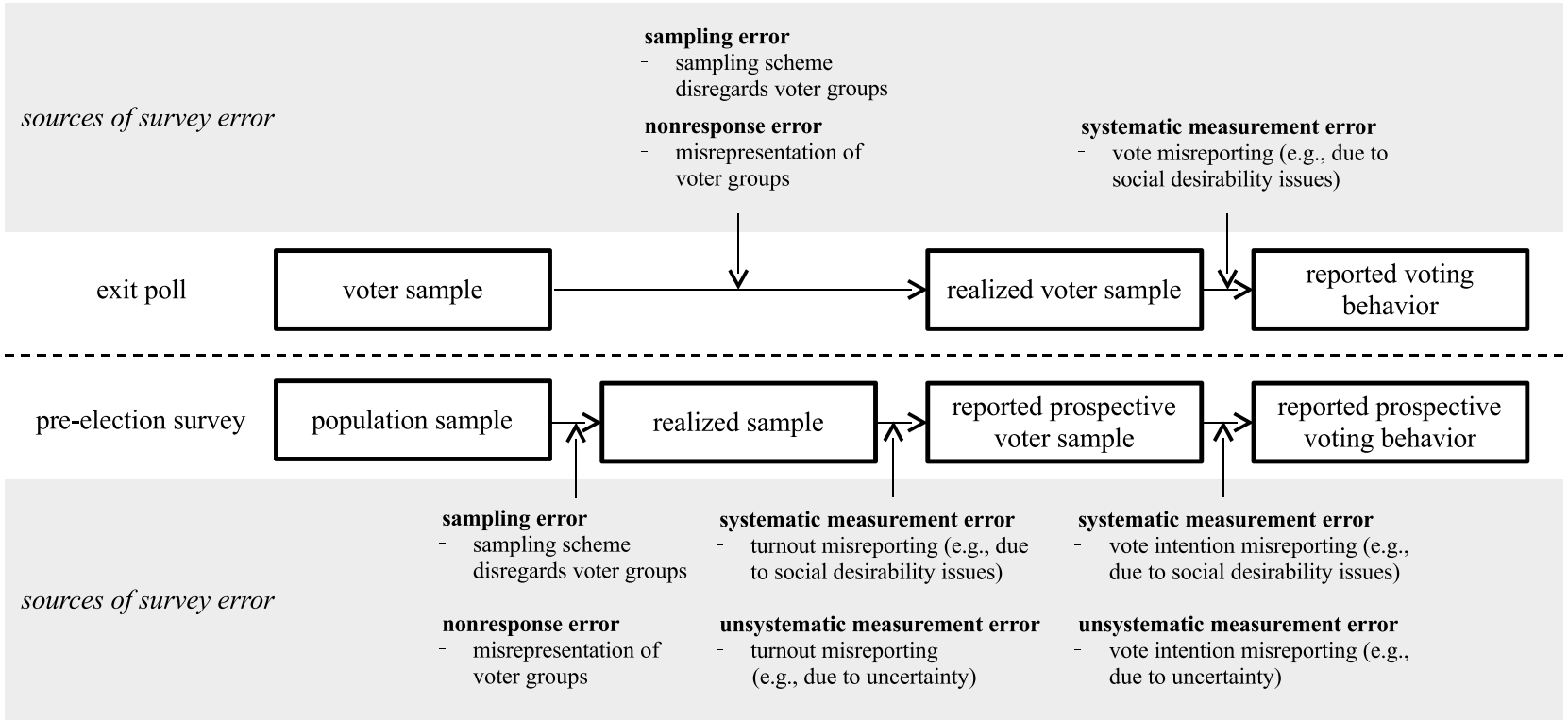
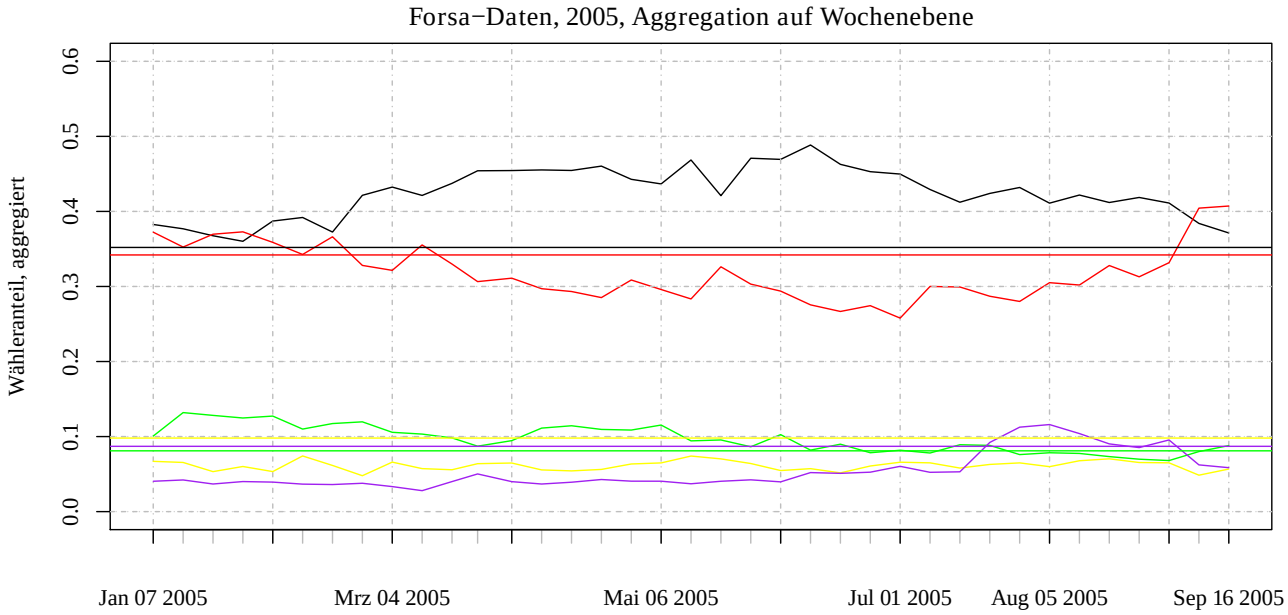
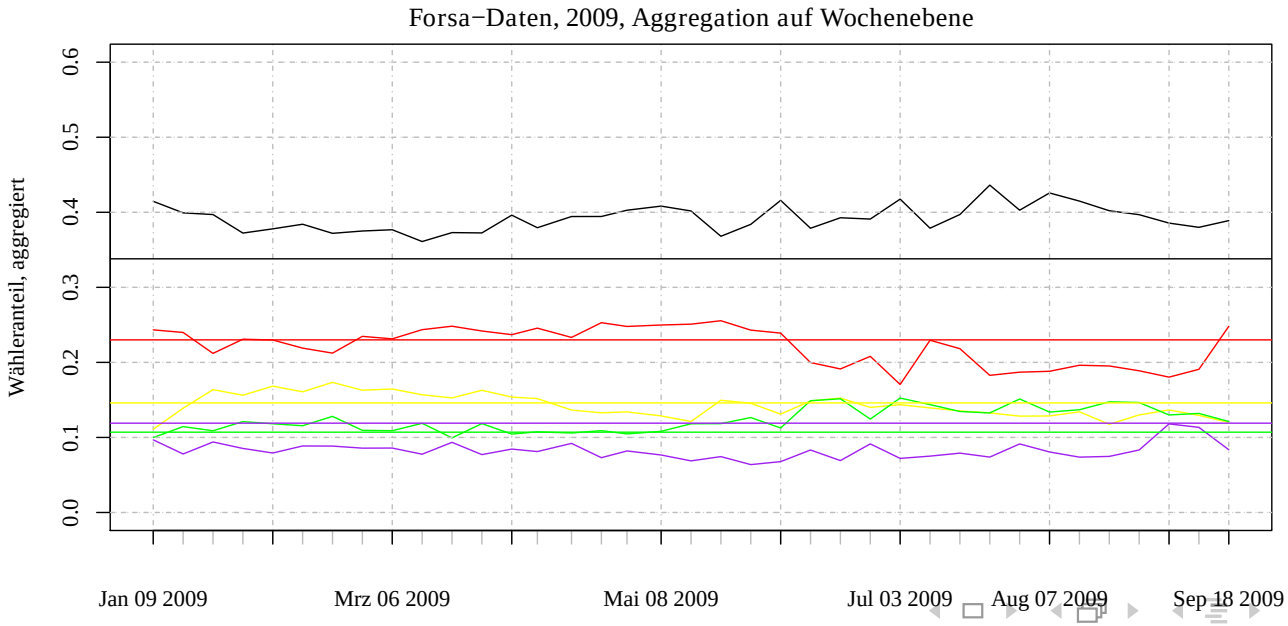


Fig. 1. Sources of survey error in exit polls and pre-election surveys.

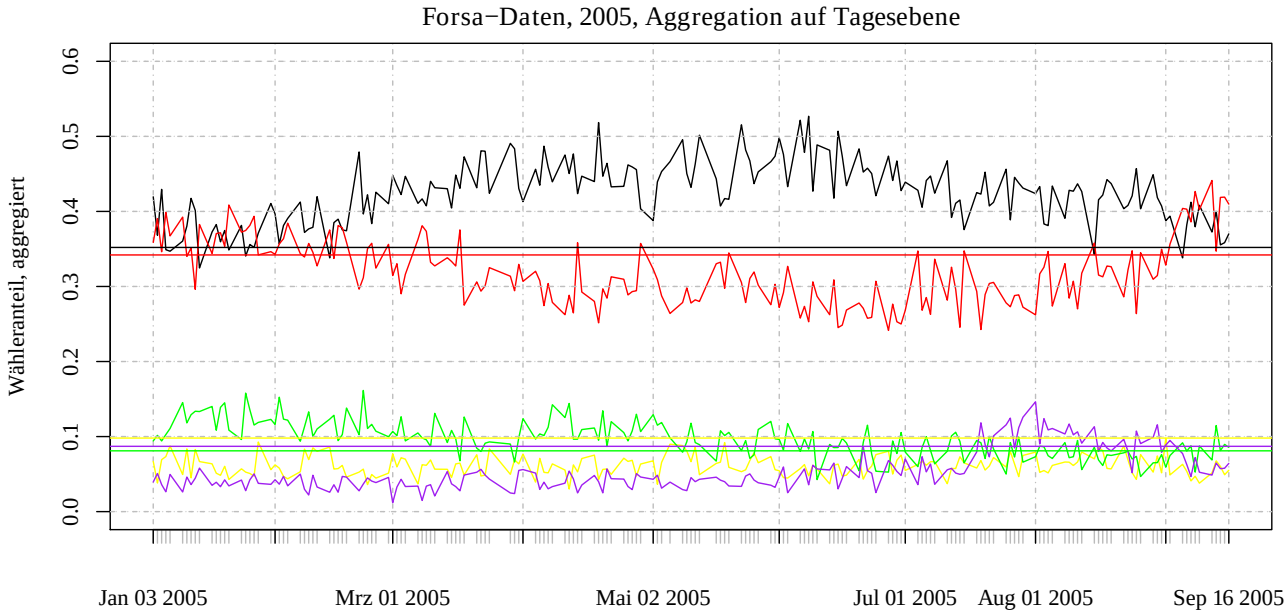
- even if none of these errors occurred (i.e., unbiased estimates can be obtained), we would still expect reported vote intentions to vary around the true value due to sampling variation
- astonishing that polls tell us something after all

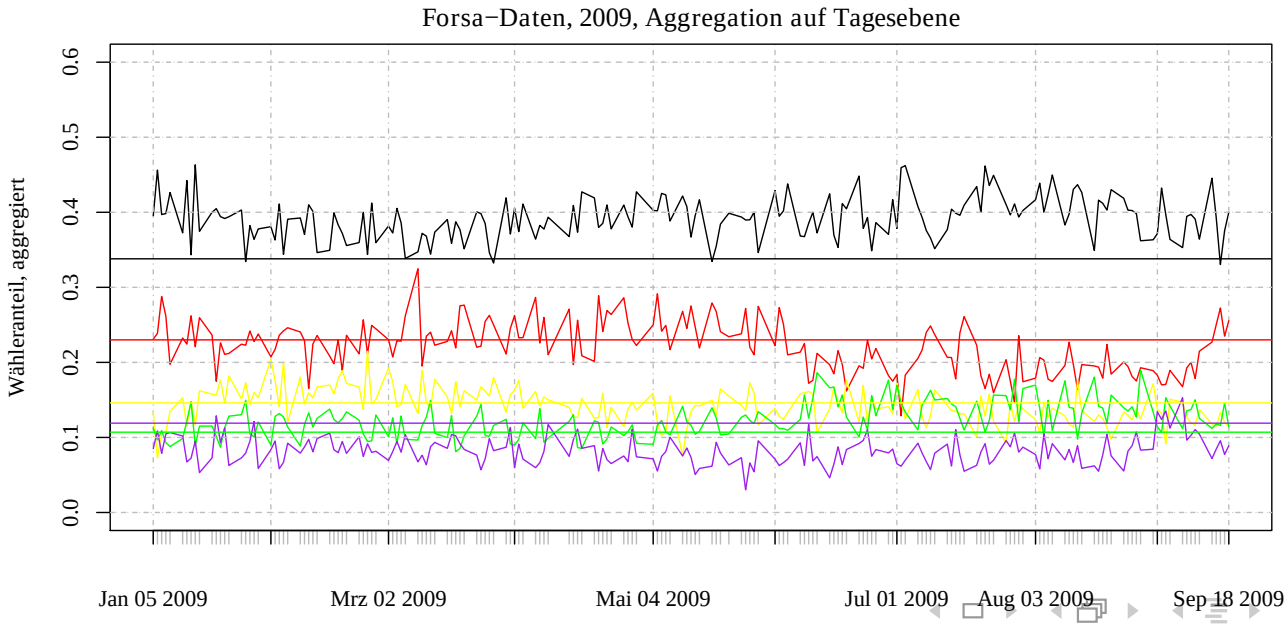
Measuring campaign dynamics or noise?





Measuring campaign dynamics or noise?





Poll uncertainty ("margin of error")

- commonly used margin of error for fractions:

$$\hat{v}_p \pm 1.96\sqrt{\frac{\hat{v}_p(1-\hat{v}_p)}{n}}$$

- example: $\hat{v}_p = .40$, $n = 1000 \rightarrow$ margin of error = [??;??]
- question: which parameters determine margin of error?
- no correction for design features of poll, or any other of the potential errors listed above

Poll uncertainty ("margin of error")

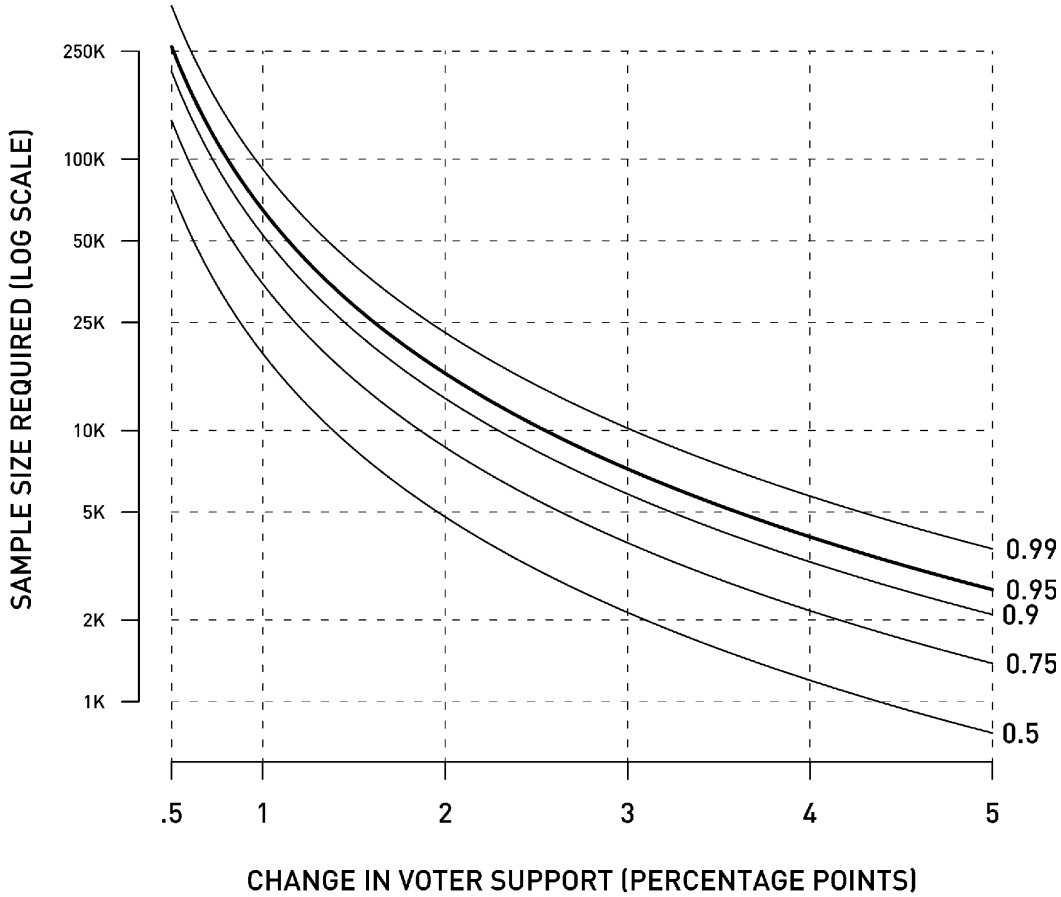


Figure 1. Sample size requirements. *Notes*: Each curve shows the sample size (vertical axis, log scale) required to detect the indicated change in support (horizontal axis, assuming a baseline level of 50%), with probability given by the label next to each line. In each instance it is assumed that the researcher's decision problem is whether to reject the null hypothesis of no change in favour of a two-sided, alternative hypothesis, using a 95% confidence level or better (ie a p-value of 0.05).

Pooling the polls

Considerations

- poll variation over time
- poll variation across polling organizations ("house effects")
- single polls hardly informative

Approach

1. pool polls (more data, more precision)
2. smooth over time (intentions less variable than poll variability suggests)
3. correct for house-specific bias

Pooling the polls

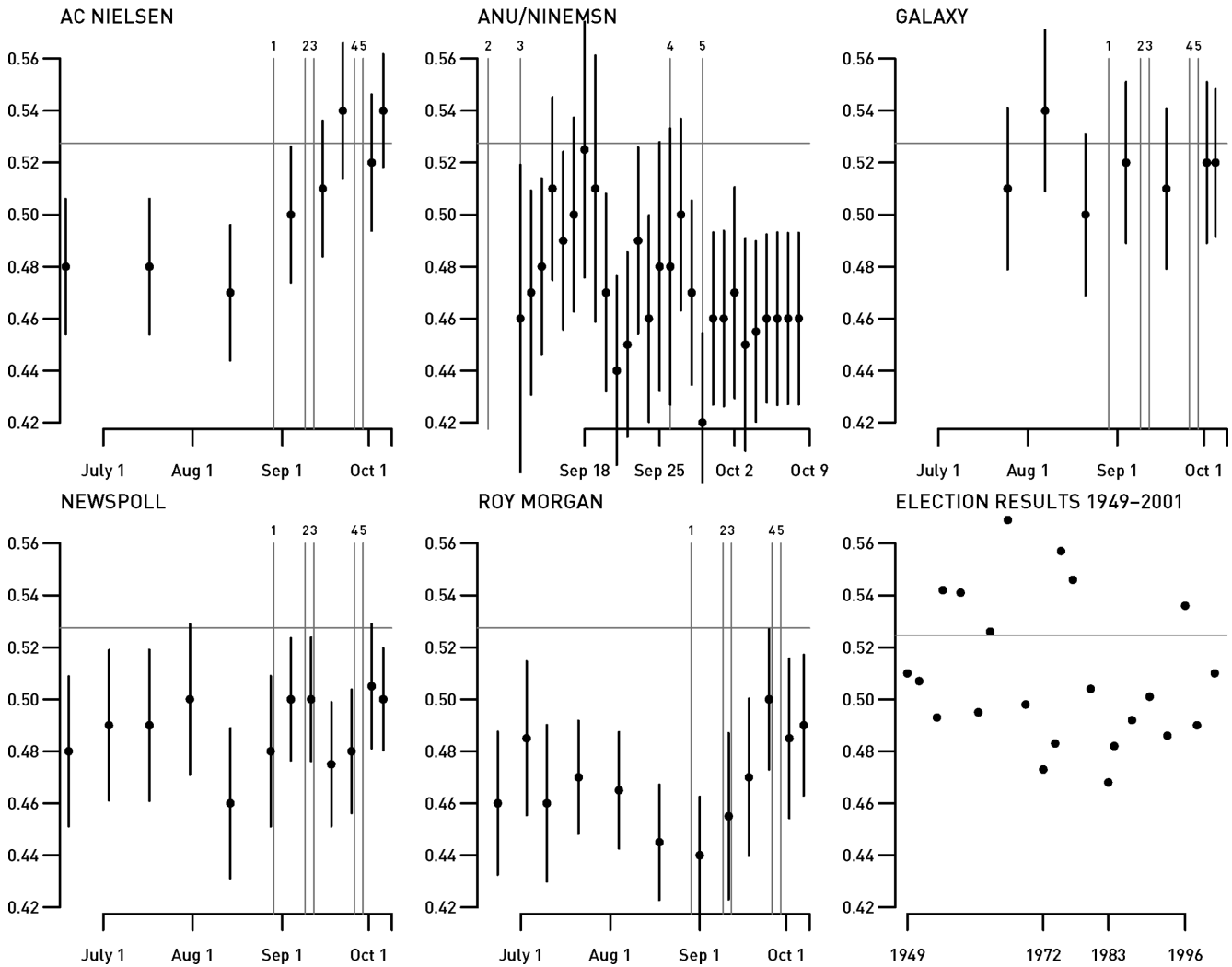


Figure 3. Polls in the 2004 campaign and historical election outcomes. *Notes*: Each poll is represented by a dot, with the vertical lines extending to cover a 95% confidence interval. The vertical axis is identically scaled in each panel; note that the ANU/ninemsn series of daily polls starts during the campaign. The vertical lines labelled 1 to 5 correspond to the following campaign events: (1) election announced, 29/8; (2) Jakarta Embassy bombing, 9/9; (3) Leader debate, 9/12; (4) Liberal Party campaign launch, 9/26; (5) ALP launch, 9/29.

Pooling the polls

to clarify matters. Let α_t be the Coalition 2PP intended vote share at time t, with t indexing days, where $t = 1$ on 18 June 2004 (corresponding to the field date of the first poll in my data set); below, I also consider the polls' estimates of the Coalition's share of first preference votes. Let $i = 1, \ldots, n$ index the polls available for analysis. Each poll result is assumed to be generated as follows:

$$y_i \sim N(\mu_i, \sigma_i^2), \tag{3}$$

where y_i is the result of poll i. Each of the n polls is generated by organisation j_i on field date t_i. σ_i is the standard error of the poll (a function of y_i and the poll's sample size; again, see equation (1)) and

$$\mu_i = \alpha_{t_i} + \delta_{j_i}, \tag{4}$$

where δ_j is the bias of polling organisation j, an unknown parameter to be estimated.

To model change in vote intentions, I use the following simple random-walk model:

$$\alpha_t \sim N(\alpha_{t-1}, \omega^2), t = 2, \ldots, T \tag{5}$$

with the distribution

$$\alpha_1 \sim \text{Uniform}(0.4, 0.6) \tag{6}$$

initialising the random walk (ie before we see any polling, I assume that Coalition support is anywhere between 40% and 60%, bracketing the historical range of election results reported above). In adopting this model I assume that vote shares are *locally constant*, ie on average, today's level of Coalition support is the same

Pooling the polls

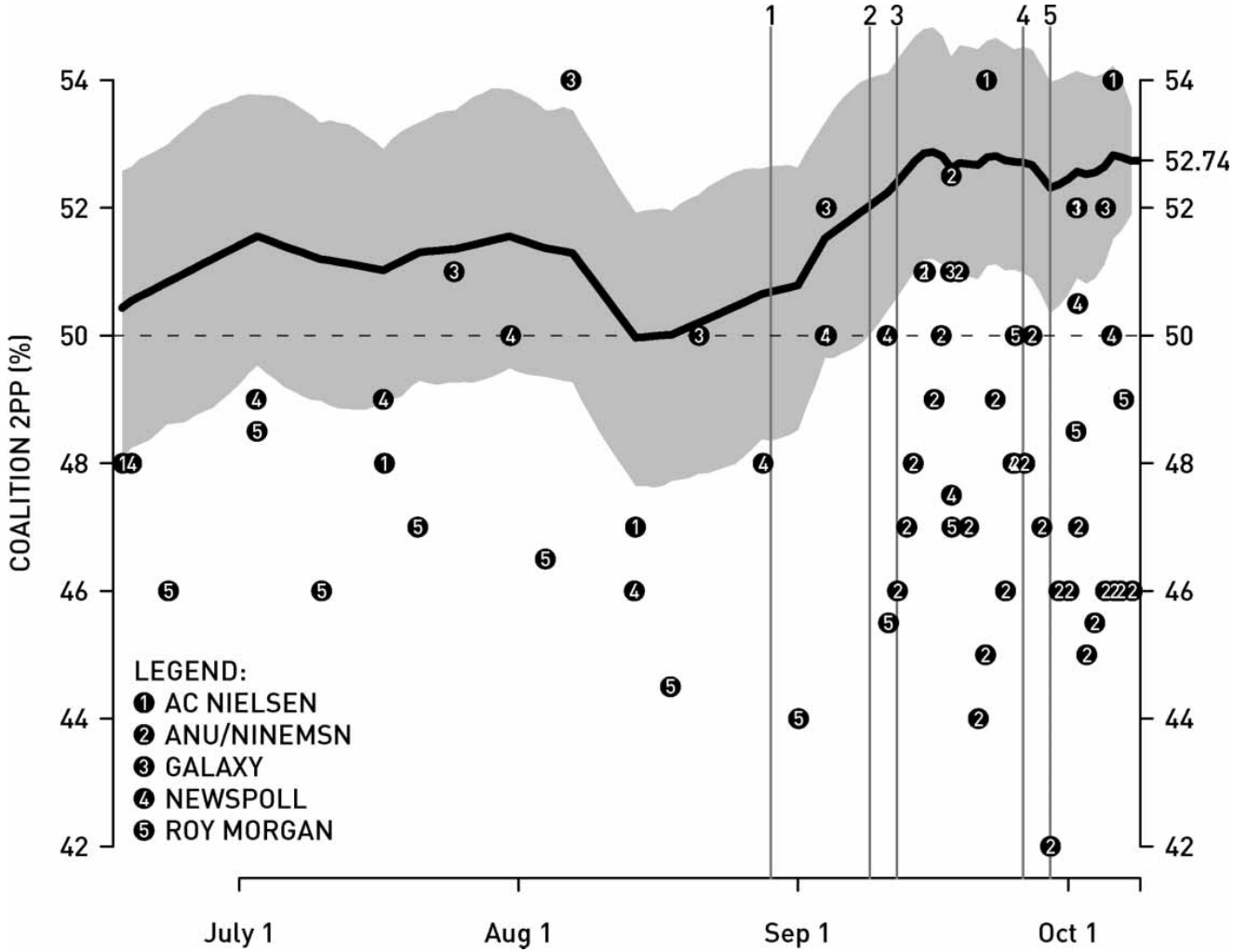


Figure 4. Estimated Coalition share of two-party preferred vote intentions, and pointwise 95% confidence intervals. *Notes*: The shaded area covers the 95% confidence intervals around the estimated levels of Coalition support, given the model and the polls. Individual polls are represented with a plotted point at their respective point estimates. See Figure 3 for campaign events.

Forecasting elections with non-representative polls

Considerations

- decreasing response rates
- realized samples are biased

Approach

1. realize (massive) non-representative poll
2. collect predictive demographic dimensions (sex, race, age, education, state, party ID, ideology, previous vote)
3. statistically adjust for bias using multilevel-regression with poststratification (MRP)

Forecasting with non-representative polls

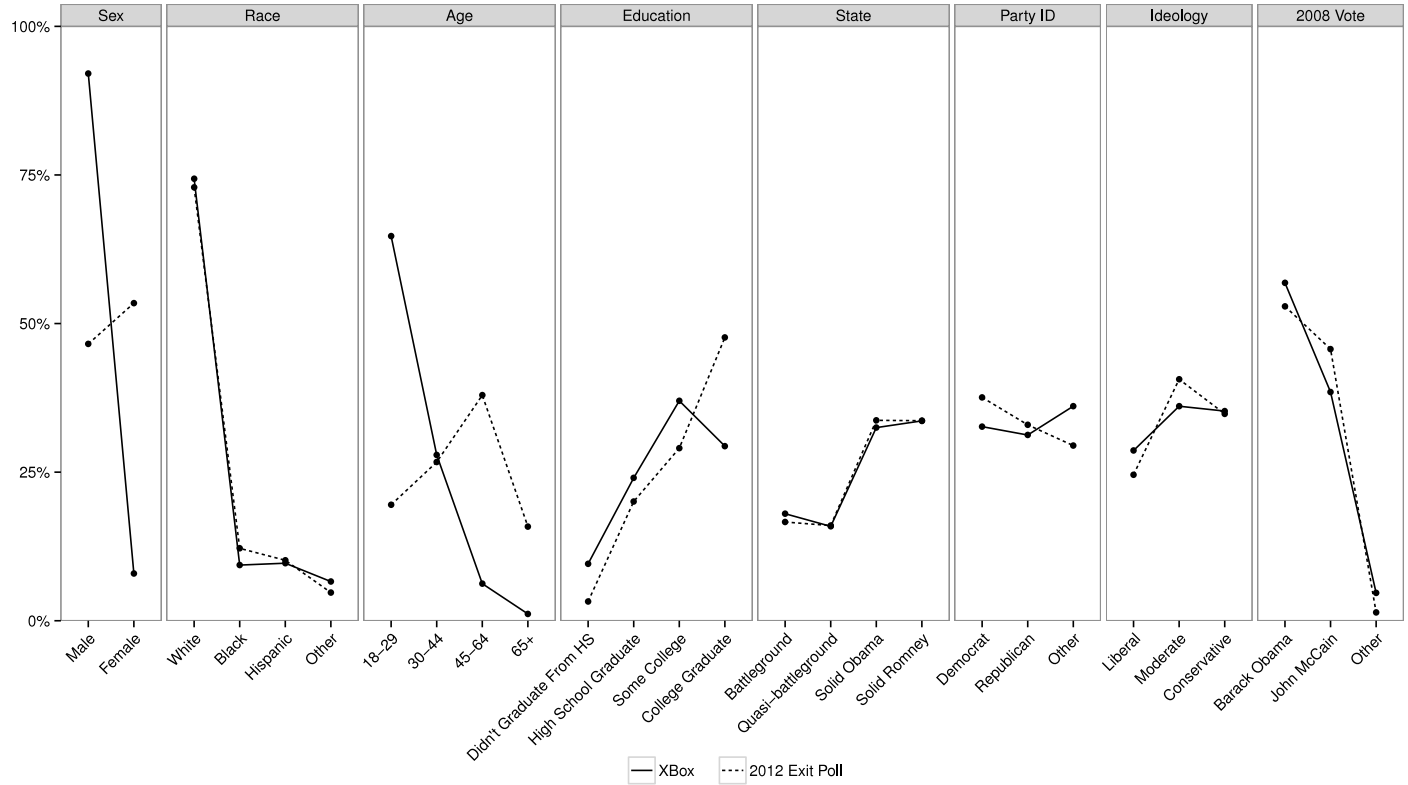


Fig. 1. A comparison of the demographic, partisan, and 2008 vote distributions in the Xbox dataset and the 2012 electorate (as measured by adjusted exit polls). As one might expect, the sex and age distributions exhibit considerable differences.

Forecasting with non-representative polls

Multilevel regression with poststratification

Step 1: Multilevel regression to obtain subgroup weights

$$\begin{aligned}
&\Pr(Y_i = \text{Obama} \mid Y_i \in \{\text{Obama, Romney}\}) \\
&= \text{logit}^{-1}\big(\beta_0 + \beta_1(\text{state last vote share}) \\
&\quad + b^{\text{state}}_{j[i]} + b^{\text{edu}}_{j[i]} + b^{\text{sex}}_{j[i]} + b^{\text{age}}_{j[i]} + b^{\text{race}}_{j[i]} + b^{\text{party ID}}_{j[i]} \\
&\quad + b^{\text{ideology}}_{j[i]} + b^{\text{last vote}}_{j[i]}\big) \qquad (2)
\end{aligned}$$

and

$$b^{\text{var}}_{j[i]} \sim N(0, \eta^2_{\text{var}}),$$
$$\eta^2_{\text{var}} \sim \text{inv-}\chi^2(\mu, \eta^2_0).$$

Step 3: Poststratification with population data

$$\hat{y}^{\text{PS}} = \frac{\sum_{j=1}^{J} N_j \hat{y}_j}{\sum_{j=1}^{J} N_j},$$

Forecasting with non-representative polls

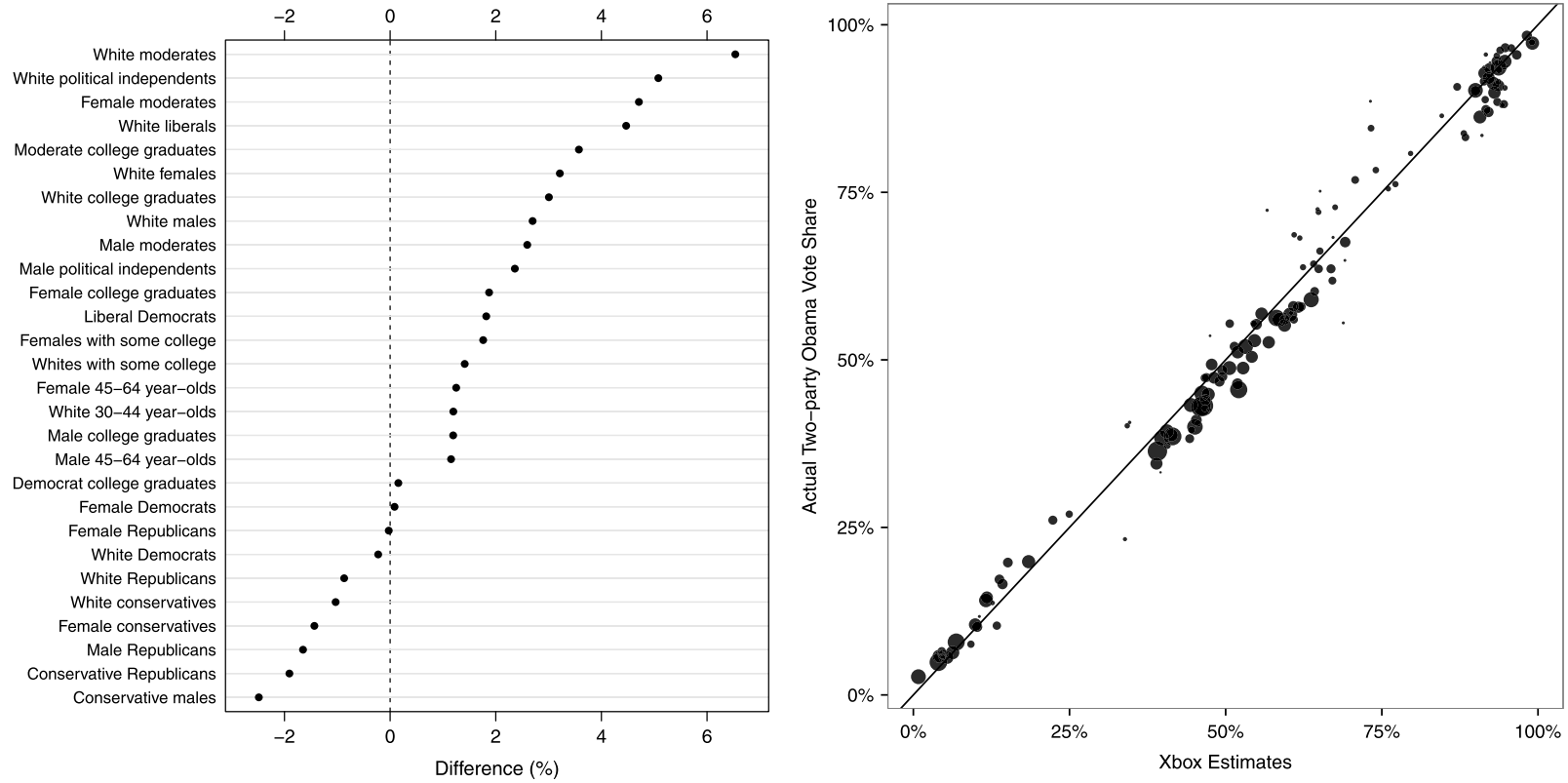


Fig. 6. Left panel: Differences between the Xbox MRP-adjusted estimates and the exit poll estimates for the 30 largest two-dimensional demographic subgroups, ordered by the differences. Positive values indicate that the Xbox estimate is larger than the corresponding exit poll estimate. Among these 30 subgroups, the median and mean absolute differences are 1.9 and 2.2 percentage points, respectively. Right panel: Two-party Obama support, as estimated from the 2012 national exit poll and from the Xbox data on the day before the election, for various two-way interaction demographic subgroups (e.g., 65+ year-old women). The sizes of the dots are proportional to the population sizes of the corresponding subgroups.

Forecasting runoff elections from first round exit polls

Scenario

- runoff elections: (usually) two rounds of voting
- French presidential election, Austrian presidential election, Baden-Württemberg mayoral elections
- large pool of candidates with little history
- strategic considerations in both rounds

Approach (Selb et al. 2013)

1. conduct exit polls among first round voters;
2. ask for evaluations of all candidates (instead of voting intentions in hypothetical runoff scenarios), as well as first round vote choices;
3. post-stratify sample distribution of reported voting behavior to actual first round election returns in order to account for potential selectivity; and
4. forecast the runoff by redistributing the votes for eliminated competitors according to their supporters' lower-order preferences among the viable candidates.

Forecasting runoff elections from first round exit polls

Was halten Sie von den einzelnen Kandidaten und Kandidatinnen?

Dr. Sabine Seeliger	gar nichts	☐	☐	☐	☐	☐	☐	☐	sehr viel	☐	weiß nicht
Sabine Reiser	gar nichts	☐	☐	☐	☐	☐	☐	☐	sehr viel	☐	weiß nicht
Thomas Linz	gar nichts	☐	☐	☐	☐	☐	☐	☐	sehr viel	☐	weiß nicht
Mykola Neumann	gar nichts	☐	☐	☐	☐	☐	☐	☐	sehr viel	☐	weiß nicht
Sylvia Grossmann	gar nichts	☐	☐	☐	☐	☐	☐	☐	sehr viel	☐	weiß nicht
Klaus Springer	gar nichts	☐	☐	☐	☐	☐	☐	☐	sehr viel	☐	weiß nicht
Martin Luithle	gar nichts	☐	☐	☐	☐	☐	☐	☐	sehr viel	☐	weiß nicht
Sven Zylla	gar nichts	☐	☐	☐	☐	☐	☐	☐	sehr viel	☐	weiß nicht
Henning Tartsch	gar nichts	☐	☐	☐	☐	☐	☐	☐	sehr viel	☐	weiß nicht
Uli Burchardt	gar nichts	☐	☐	☐	☐	☐	☐	☐	sehr viel	☐	weiß nicht
Roman Urban	gar nichts	☐	☐	☐	☐	☐	☐	☐	sehr viel	☐	weiß nicht
Andreas Kaltenbach	gar nichts	☐	☐	☐	☐	☐	☐	☐	sehr viel	☐	weiß nicht
Benno Buchczyk	gar nichts	☐	☐	☐	☐	☐	☐	☐	sehr viel	☐	weiß nicht

Für welchen Kandidaten (welche Kandidatin) haben Sie gestimmt?

☐ Dr. Sabine Seeliger	☐ Sabine Reiser	☐ Thomas Linz
☐ Mykola Neumann	☐ Sylvia Grossmann	☐ Klaus Springer
☐ Martin Luithle	☐ Sven Zylla	☐ Henning Tartsch
☐ Uli Burchardt	☐ Roman Urban	☐ Andreas Kaltenbach
☐ Benno Buchczyk		

In Deutschland neigen viele Leute längere Zeit einer bestimmten politischen Partei zu, obwohl sie auch ab und zu eine andere Partei wählen. Wie ist das bei Ihnen: Neigen Sie - ganz allgemein gesprochen - einer bestimmten Partei zu? Und wenn ja, welcher?

☐ CDU	☐ SPD	☐ FDP
☐ Bündnis 90/Die Grünen	☐ Die Linke	☐ Piratenpartei
☐ anderer Partei	☐ keiner Partei	

Forecasting runoff elections from first round exit polls

Table 1
First round vote shares by candidate at the 2012 mayoral elections: official results and sample distribution (percentages).

Candidate	Official result	Sample
Seeliger	20.1	21.8
Reiser	26.8	26.7
Linz	0.4	–
Neumann	1.0	0.9
Grossmann	0.5	0.3
Springer	0.1	0.2
Luithle	1.9	2.2
Zylla	14.3	17.3
Tartsch	4.6	2.5
Burchardt	25.9	24.9
Urban	0.5	0.5
Kaltenbach	2.3	1.1
Buchczyk	1.1	1.6
Others (write-in votes)	0.6	–

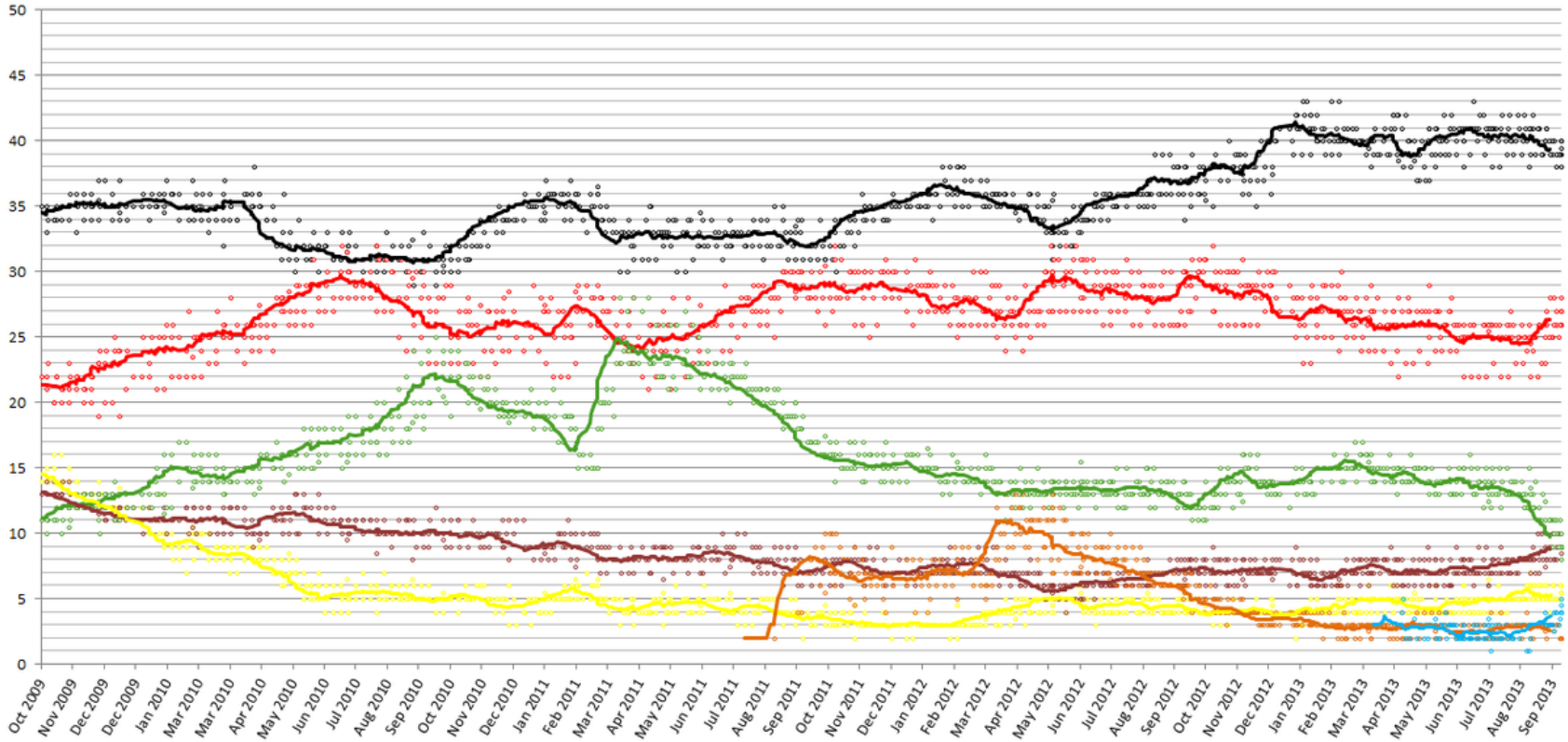
Forecasting runoff elections from first round exit polls

Table 2
Candidate vote shares in the runoff election: official result and forecasts.

Candidate	Official result	Scenario 1 forecast				Scenario 2 forecast			
		Sample raw	Abs. error	Sample poststratified	Abs. error	Sample raw	Abs. error	Sample poststratified	Abs. error
Burchardt	39.1	36.9	2.2	37.3	1.8	39.6	0.5	39.9	0.8
Reiser	31.9	28.2	3.7	29.9	2.0	30.2	1.7	31.1	0.8
Seeliger	27.6	27.7	0.1	26.6	1.0	30.2	2.6	28.9	1.3
Neumann	0.6	2.3	1.7	2.0	1.4	0.0	0.6	0.0	0.6
Urban	0.4	3.8	3.4	3.2	2.8	0.0	0.4	0.0	0.4
Springer	0.1	1.0	0.9	1.0	0.9	0.0	0.1	0.0	0.1
Mean abs. error			2.0		1.6		1.0		0.7
N			769		672		761		667

Forecasting the 2013 German General election using polls

Polls before the election



By Humongous125 - Created in Excel using the polling data from Opinion polling for the German federal election, 2013., CC BY-SA 3.0, https://en.wikipedia.org/w/index.php?curid=48044259

Polling forecast

Step 1: Assessing the Poll–Vote Link Using Historical Data

In step 1, we use historical data to predict election outcomes from polling results. To this end, we conceive of the vote share of party $j = 1, 2, \ldots, J$ as a linear function of a constant term α, the party's polling result in survey $i = 1, 2, \ldots, N$ conducted by institute $k = 1, 2, \ldots, K$, weighted by slope coefficient β, and a series of error terms that are specific to parties (ω) and an interaction of party and polling firm (ξ), plus an idiosyncratic residual (ψ), for all of which we impose the usual distributional assumptions:[11]

$$\text{vote}_j = \alpha + \beta \text{poll}_{ijk} + \omega_j + \xi_{jk} + \psi_{ijk}. \tag{1}$$

Step 3: Extrapolating to Current Elections

Equipped with these parameter estimates, we can now plug values of current polls into Equation (2) to arrive at poll-specific forecasts of party vote shares at the upcoming election that account for the types of biases described above:

$$\widehat{\text{vote}}_{ijk} = \hat{\alpha} + \hat{\beta}\,\text{poll}_{ijk} + \hat{\omega}_j + \hat{\xi}_{jk}. \tag{2}$$

Step 4: Combining Forecasts from Various Polls

For each party, we then combine the predicted vote shares from Equation (2), weighting by the reciprocal of the variance V of the individual quantities,

$$\widehat{\text{vote}}_{jm} = \frac{\sum_{i=1}^{N_m} \frac{1}{\hat{V}_{ijk}} \widehat{\text{vote}}_{ijk}}{\sum_{i=1}^{N_m} \frac{1}{\hat{V}_{ijk}}}, \tag{3}$$

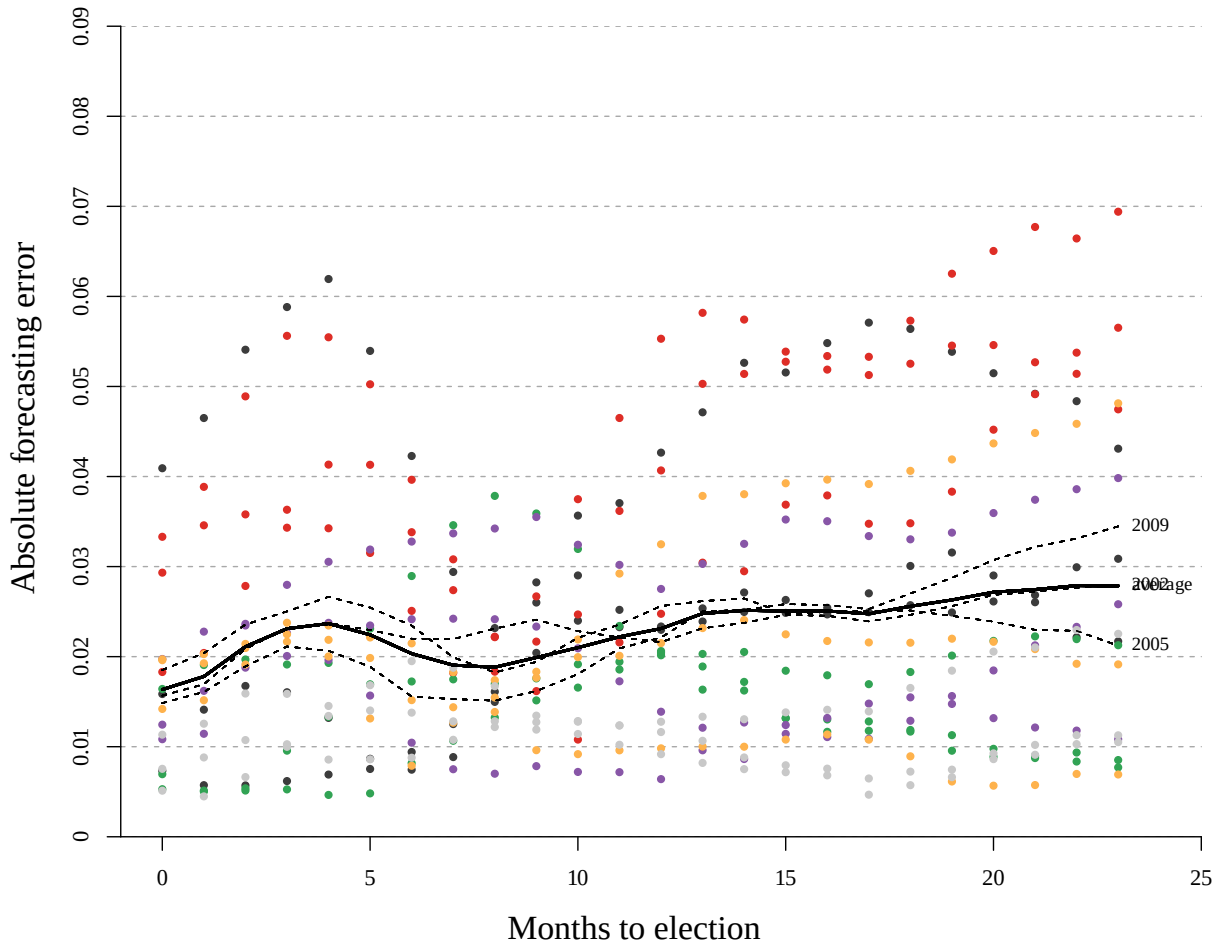
Polling forecast

TABLE 1
REML ESTIMATES OF THE MODEL OF PARTY VOTE SHARES IN PAST ELECTIONS, SEE EQUATION (1)

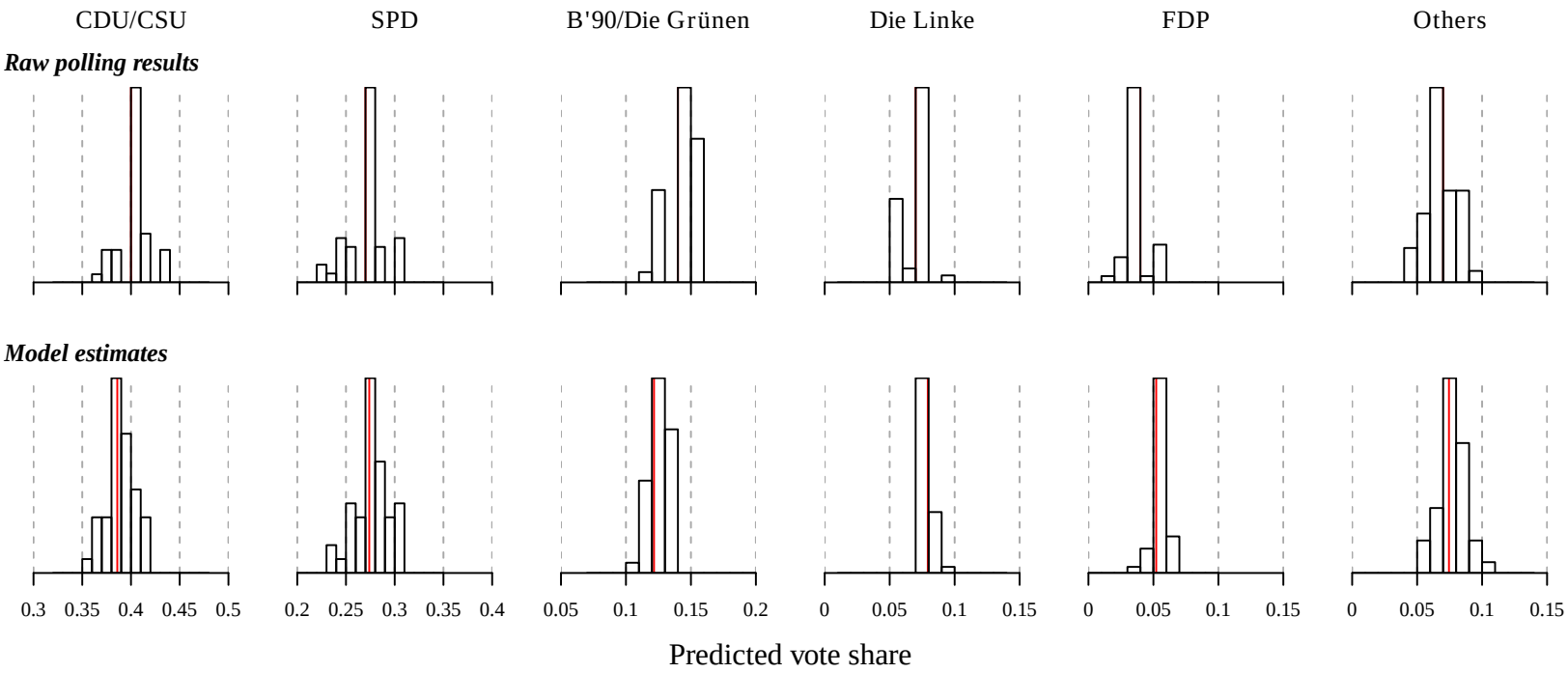
Coefficient	**Estimate (SE)**
Intercept α	0.0201 (0.0072)
Poll β	0.8742 (0.0216)
Party-level variance σ^2_ω	0.0002
Party–institute-level variance σ^2_ξ	0.0000
Residual variance σ^2_ψ	0.0004

Note: 123 polls conducted 8 to 10 months before the 1998 to 2009 elections are included.

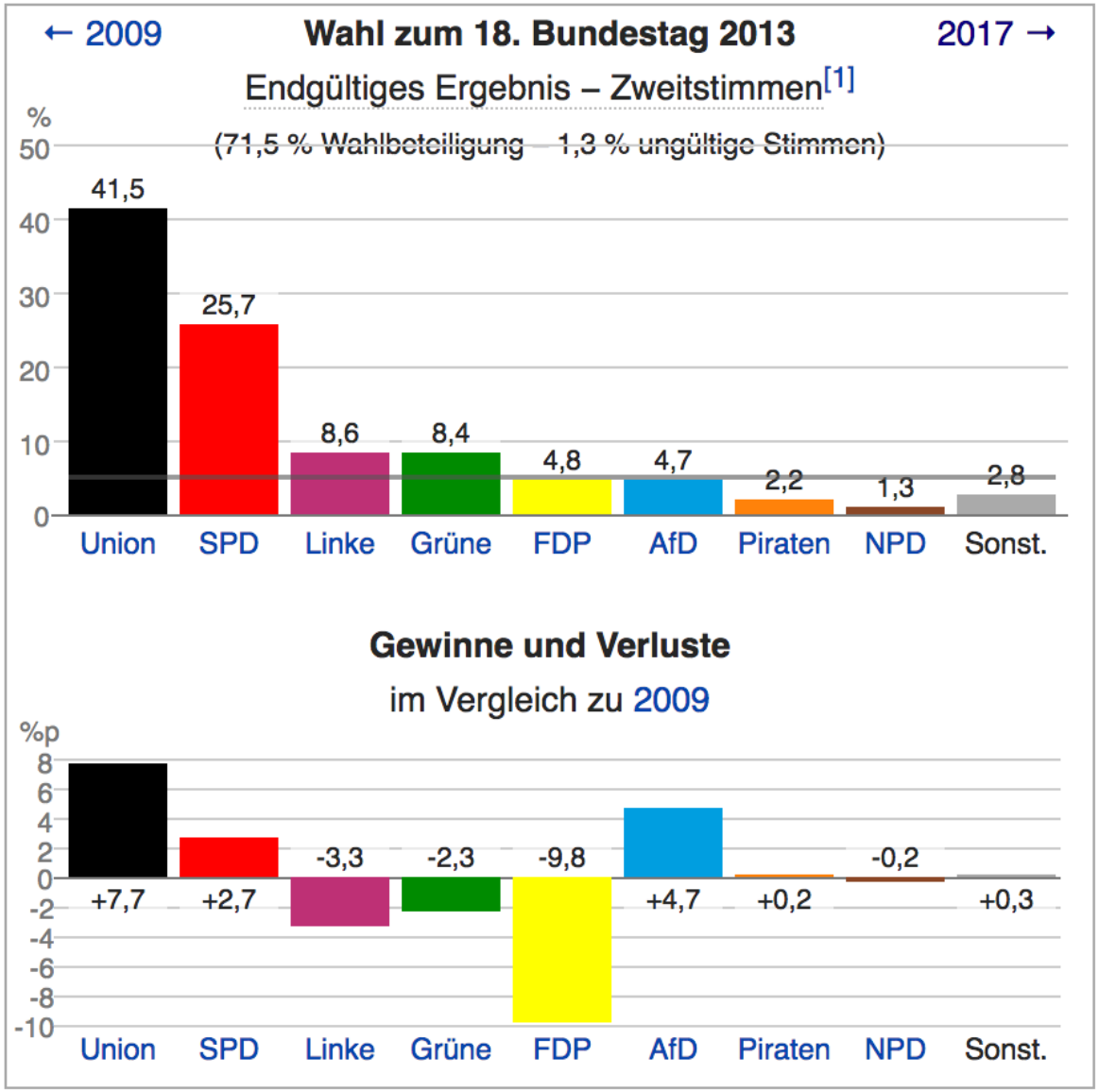
Polling forecast



Polling forecast



Results


← 2009
Wahl zum 18. Bundestag 2013
2017 →
Endgültiges Ergebnis – Zweitstimmen[1]
(71,5 % Wahlbeteiligung – 1,3 % ungültige Stimmen)
%
50
40
30
20
10
0
41,5
25,7
8,6
8,4
4,8
4,7
2,2
1,3
2,8
Union
SPD
Linke
Grüne
FDP
AfD
Piraten
NPD
Sonst.
Gewinne und Verluste
im Vergleich zu 2009
%p
8
6
4
2
0
-2
-4
-6
-8
-10
+7,7
+2,7
-3,3
-2,3
-9,8
+4,7
+0,2
-0,2
+0,3
Union
SPD
Linke
Grüne
FDP
AfD
Piraten
NPD
Sonst.

Forecast aftermath

Tabelle 2: Das offizielle Endergebnis und die Abweichungen der Prognosen und letzten Umfragen vor der Wahl vom tatsächlichen Wahlergebnis

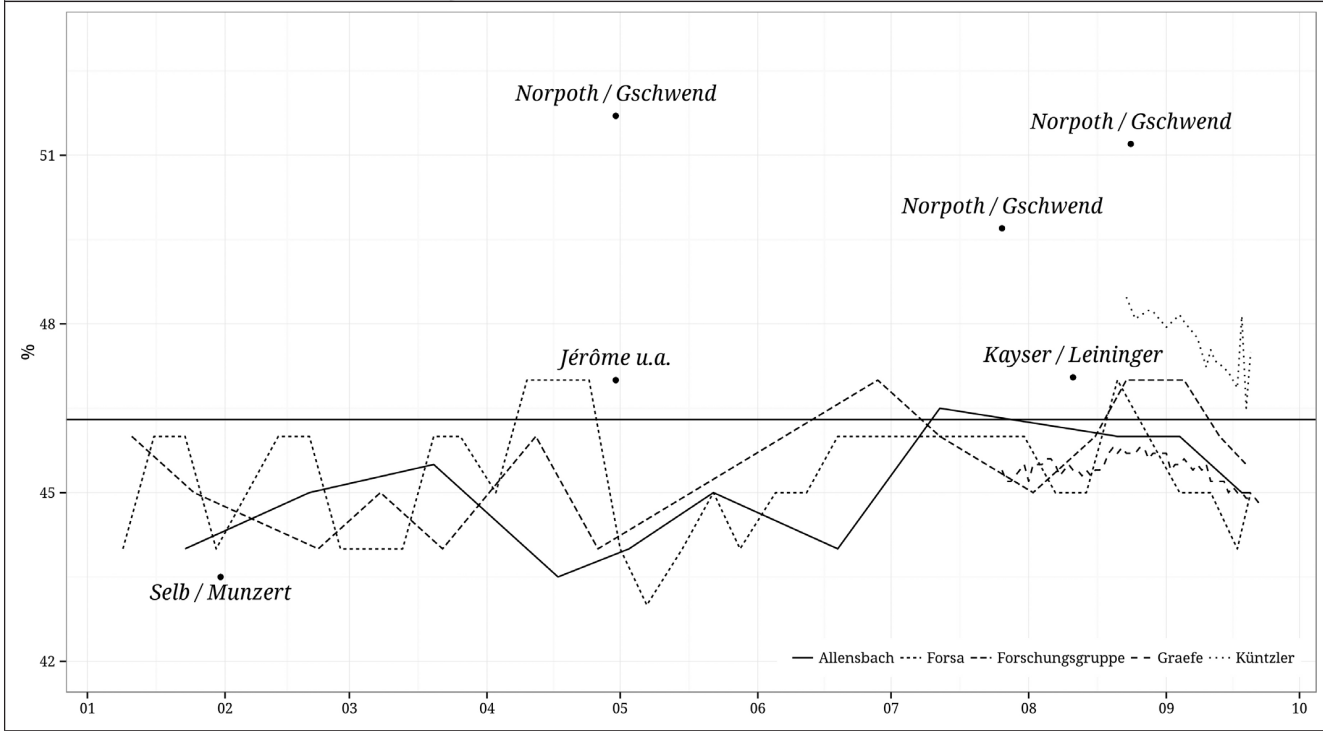
		Strukturelle Modelle				Synthetische Modelle		Umfragen		
	Endgültiges Ergebnis	*Jérôme* u.a.	*Norpoth / Gschwend*	*Kayser / Leininger*	*Selb / Munzert*	*Graefe*	*Küntzler*	Forschungsgruppe Wahlen (19.9.)	Forsa (20.9.)	Allensbach (20.9.)
Genauigkeit (MAE)	–	1,82	4,9	0,75	2,82	1,15	0,98	0,84	0,89	0,89
Vorlaufzeit (Monate)	–	5	5	2	8	2	1	3 Tage	3 Tage	3 Tage
Koalition	46,3	0,7	4,9	0,75	-2,8	1,5	0,98	-0,8	-1,3	-1,3
CDU/CSU	41,5	-0,5			3,4	-2,5		-1,5	-1,5	-2,0
FDP	4,8	1,2			0,6	1,0		-0,7	0,2	0,7
SPD	25,7	2,3			2,5	0,5		1,3	0,3	1,3
Grüne	8,4	1,6			5,1	1,9		0,6	1,6	0,6
Die Linke	8,6	0,4			-0,9	-0,2		0,1	0,4	0,4
Sonstige	10,9	-4,9			-4,4	-0,8		-0,9	-0,9	-0,9

Quelle: Eigene Zusammenstellung.

Leininger, Arndt. 2015. Wissenschaftliche Wahlprognosen - Alternative oder Ergänzung zu Umfragen? Zeitschrift für Parlamentsfragen 2015(4): 675–691.

Forecast aftermath

Abbildung 1: Zeitreihe der Wahlprognosen für die Summe der von Koalitionsparteien CDU/CSU und FDP zu erwartenden Stimmenanteile (Januar 2013 bis zur Wahl im September 2013)



Anmerkung: Modellbasierte Prognosen sind zum frühestmöglichen Zeitpunkt der Prognose eingetragen. Die Prognosen *Graefes* und *Küntzlers* sowie die durch Allensbach, Forsa und Forschungsgruppe Wahlen erhobenen Umfragewerte sind, um deren zeitliche Veränderungen darzustellen, als Linien abgetragen. Die horizontale Linie stellt das tatsächliche Wahlergebnis dar.
Quelle: Eigene Darstellung.

Leininger, Arndt. 2015. Wissenschaftliche Wahlprognosen - Alternative oder Ergänzung zu Umfragen? Zeitschrift für Parlamentsfragen 2015(4): 675–691.

See you next week!