DOI:
10.1111/1475-6765.12522

Document Version
Peer reviewed version

The electoral benefits of environmental position-taking: Floods and electoral outcomes in England 2010-2019 - Supplementary Materials

This appendix consists of the following ten sections:

1. Analysis of flooding as an issue on party manifestos 2015, 2017 and 2019
2. Data sources, variable construction and data manipulation
3. Summary statistics
4. Pretests for parallel trends
5. Models of flood effects over consecutive elections
6. Models of the impact of flooding and flood defences using two-way fixed effects
7. Models of flooding and flood defences with interactions
8. Models of support for the constituency incumbent
9. Models of flood intensity
10. Calculations of the figures for the electoral benefit of flood defence spending reported in Section 4

1 Analysis of flooding as an issue on party manifestos 2015, 2017 and 2019

To complement the broad-brush overview of flooding as an issue, the analysis provided here of party manifestos at the three elections sheds fine-textured light on how the issue of flooding developed over the period under investigation, but also how the parties approached it differently. In its 2015 election manifesto, the Conservative party put emphasis on its track record on spending £3b on flood defence schemes and promised future spending, heralding the start of a Flood and Coastal Risk Management 6 Year Capital Programme planned for 2015-2021 that was to protect

300,000 homes.[1] The Labour manifesto was vaguer on spending plans, but it was more explicit in linking flooding to climate change.[2] The Liberal Democrats offered to spend £3.2b on "flood management and defences"; like Labour, they also made an explicit link between flooding and climate change.[3] Thus Labour and the Liberal Democrats are arguably more 'radical' in framing flooding as a climate-related issue, but the Conservatives go furthest in making precise claims about spending and "protecting" homes. As part of the 2010-15 coalition government, the Liberal Democrats held the environmental ministerial portfolio (the Department for Energy and Climate Change), yet they had limited success in implementing pro-environmental policies (Carter 2016). The party's dramatic loss of all but eight seats at the 2015 General Election meant that they were nearly eclipsed in the 2015-17 period.

By 2017, the Conservatives had shifted their emphasis somewhat from hard flood defences to natural flood management, in line with the broader policy shift that had taken place in the intervening years (Butler and Pigeon 2011; Johnson and Priest 2008). In their election manifesto they voiced their "commitment" to this approach but also reiterated their pledge two years previously to protect 300,000 homes by 2021 and promised to spend £2.5b to this end.[4] The Labour party manifesto again shied away from promising a specific sum to be spent on flood-related policy, instead attacking the Conservatives for what they construed as a "cut in the funding for flood defences". the party also promised to rationalize flood relief efforts and to improve flood risk forecasting.[5] The Liberal Democrats, for their part, offered £2b for "flood prevention" and climate adaptation.[6] By 2019, all the main parties were attaching specific sums to their

[1] "The Conservative Party Manifesto 2015: Strong Leadership, a Clear Economic Plan and a Brighter, More Secure Future", http://ucrel.lancs.ac.uk/wmatrix/ukmanifestos2015/localpdf/Conservatives.pdf

[2] "The Labour Party Manifesto 2015", https://action.labour.org.uk/page/-/A4%20BIG%20_PRINT_ENG_LABOUR %20MANIFESTO_TEXT%20LAYOUT.pdf

[3] "Manifesto 2015: Stronger Economy. Fairer Society. Opportunity for Everyone," https://d3n8a8pro7vhmx.cloudfront.net/libdems/pages/8907/attachments/original/1429028133/ Liberal_Democrat_General_Election_Manifesto_2015.pdf?1429028133

[4] "Forward, Together: Our Plan for a Stronger Britain and a Prosperous Future," https://general-election-2010.co.uk/2017-general-election-manifestos/conservative-manifesto-2017.pdf

[5] "For the Many not the Few: The Labour Party Manifesto 2017," https://labour.org.uk/wp-content/uploads/2017/10/labour-manifesto-2017.pdf

[6] "Change Britain's Future: Liberal Democrat Manifesto 2017," https://d3n8a8pro7vhmx.cloudfront.net/themes/5909d4366ad575794c000000/attachments/original/1495020157/Manifesto-Final.pdf?1495020157

flood-related spending pledges, such was the prominence of the issue that had occupied national headlines for a good part of the campaign period. In its manifesto, the Conservative party pledged £4b in new money for flood protection, a sum considerably larger than the £2.5b pledged in 2017 and the £3b the party claimed to have spent in 2015.[7] The Labour party manifesto went even further, offering £5.6b for flood defences, and reiterated also its 2017 pledge to reorganize flood risk and flood relief management and promised to prioritize certain parts of the country - the north and the Midlands – 'neglected' by the Conservative government.[8] It also gave the party's proposed "green industrial revolution" pride of place, emphasizing the party's recent green turn. The Liberal Democrat manifesto offered £5b for flood protection and made an explicit link between climate change and the recently-experienced flooding.[9] The shift in Labour's policy was starkest; though the Conservatives were consistently coy about linking flooding to climate change, they made regular pledges to spend on flood alleviation and flood risk management. The Liberal Democrats did the same, going further in linking the UK's experience of floods to global climatic trends. It was only at the 2019 election that Labour 'caught up' with the other two parties, though the shift was considerable. Leader Jeremy Corbyn said explicitly in the run-up to the General Election that "Flooding isn't a natural disaster – it's human-made" (Labour Party 2019). By contrast, Conservative Prime Minister Boris Johnson struck a more fatalist tone on a visit to a flood-affected region that same day, saying "you've got to face the reality that places like this are vulnerable to flooding" (Sky News 2019). Though the Conservative party was criticized in the run-up to the 2019 General Election for back-pedalling on a number of environmental issues and missing several climate targets (Laville and Taylor 2019), a broad-ranging consensus on the need to make a major effort to tackle climate change was by 2019 firmly established as part of

[7] "Get Brexit Done: Unleash Britain's Potential: The Conservative and Unionist Manifesto 2019," https://assets-global.website-files.com/5da42e2cae7ebd3f8bde353c/5dda924905da587992a064ba_Conservative%202019%20Manifesto.pdf

[8] "It's Time for Real Change: The Labour Party Manifesto 2019," https://labour.org.uk/wp-contet/uploads/2019/11/Real-Change-Labour-Manifesto-2019.pdf

[9] "Stop Brexit: Build a Brighter Future: Manifesto 2019", https://d3n8a8pro7vhmx.cloudfront.net/libdems/pages/57333 /attachments/original/1574258742/Lib_Dem_Manifesto_2019.pdf?1574258742

the political landscape.

2 Data Sources, Variable Construction and Data Manipulation

Chapel Hill Expert Survey data: The position indicator used is "ENVIRONMENT = position towards environmental sustainability", in which a score of 0 refers to an extremely pro-environmental position: "Strongly supports environmental protection even at the cost of economic growth" and a score of 10 reflects an anti-environmental position: "Strongly supports economic growth even at the cost of environmental protection". This scale is inverted for the purposes of display in Figure 3. The salience indicator used is "ENVIRO_SALIENCE = importance/salience of environmental sustainability", where a score of 0 corresponds to "Not important at all" and 10 corresponds to "Extremely important" (Bakker et al. 2015; Bakker et al. 2020).

Flood data are taken from the following sources: The Environment Agency's "Recorded Flood Outlines" dataset,[10] which includes geocoded data for each flood event in England since 1946; these data are used in conjunction with constituency shapefiles from the Office of National Statistics (ONS)[11] to calculate the number of flood events in each seat in each period.

Flood defence spending data: Data were supplied to the author by UK Environment Agency. The data take the form of annual counts of the number of homes protected by the government's 'Flood and Coastal Risk Management 6 Year Capital Programme 2015-2021'. For the 2015-2017 period, the March 2016 and March 2017 counts of homes protected were summed to provide a proxy for homes protected between the May 2015 and June 2017 General Elections. For the 2017-2019 period, the counts generated in March 2018, March 2019 and March 2020 were used for this purpose.

[10] The June 2020 version of this dataset was downloaded from the Environment Agency website at https://data.gov.uk/dataset/16e32c53-35a6-4d54-a111-ca09031eaaaf/recorded-flood-outlines

[11] Westminster Parliamentary Constituencies (December 2017) Full Clipped Boundaries in the UK, ONS: https://data.gov.uk/dataset/77c7d97c-7d8d-4867-aab8-d31eacd46d3f/westminster-parliamentary-constituencies-december-2017-full-clipped-boundaries-in-the-uk

Election result data: Data for 2010-2019 are from Pippa Norris's "British General Election Constituency Results, 2010-2019 dataset" (http://pippanorris.com); notional 2005 vote percentages calculated for the 2010 constituencies are from Pippa Norris's "British Parliamentary Constituency General Election 2019 Version 5" dataset. Aggregate 2017 election results for England were taken from the House of Commons website: https://electionresults.parliament.uk/election/2017-06-08/Results/Location/Country/England. Aggregate 2019 election results for England were taken from the House of Commons website: https://electionresults.parliament.uk/election/2019-12-12/Results/Location/Country/England.

Covariates:

Deprivation: The measure employed is a 2011 census measure of the proportion of households recorded as being deprived on one dimension of deprivation (census table QS119). This variable aggregated by parliamentary constituency in Pippa Norris's "British General Election Constituency Results, 2010-2019 dataset", from which it was extracted for use in this analysis.

Job density: Job density data are from the National Online Manpower Information System (NOMIS) database (nomisweb.co.uk).

House prices: The indicator for house price data (all dwelling types) is constructed as follows: mean house price data for 2009 are used as a measure for house prices in the run-up to the May 2010 election; mean house prices in 2014 are used in connection with the May 2015 election. Data for both years are available from the ONS by parliamentary constituency (https://www.ons.gov.uk/peoplepopulationandcommunity/housing/datasets/housepricestatisticsforsmallareas). Data for the June 2017 election are mean prices for 2016; data for the December 2019 election and mean prices for 2019. For both these years, data were aggregated from ward-level ONS house price data (https://www.ons.gov.uk/peoplepopulationandcommunity/hous-

ing/datasets/medianpricepaidbywardhpssadataset37) as the mean of ward house prices in each constituency. Aggregation was carried out using the 'Ward to Westminster Parliamentary Constituency to Local Authority District Lookup in the United Kingdom' files (https://data.gov.uk/dataset/7b9300c5-2b8b-481c-b1ca-ec086132ff89/ward-to-westminster-parliamentary-constituency-to-local-authority-district-december-2016-lookup-in-the-united-kingdom and https://data.gov.uk/dataset/700e207d-f747-4899-a83c-44575097c694/ward-to-westminster-parliamentary-constituency-to-local-authority-district-december-2019-lookup-in-the-united-kingdom).

Data manipulation: The number of flood events in each seat in each inter-electoral period was calculated by first subsetting the geocoded flood data by inter-election period, merging each subset with a set of constituency shapefiles for England, intersecting the constituencies with the flood outlines, then counting the number of flood events that took place within each seat in each inter-electoral period. The resulting spatial datasets were then merged with datasets of constituency-level electoral results and associated demographic indicators, to create data files that could be used in regression analysis. The data analysis was carried out in R version 4.0.4, and the spatial data manipulation was performed using the sf package.

3 Summary Statistics

Table A1: Summary Statistics

Variable
2015
Flooding (binary)
Flooding (number of floods (log))
Conservative vote share†
Labour vote share†
Liberal Democrat vote share†
Deprivation
House prices (£k)
Job density
2017
Flooding (binary)
Flooding (number of floods (log))
Conservative vote share†
Labour vote share†
Liberal Democrat vote share†
Flood defences (homes protected, k)
Deprivation
House prices (£k)
Job density
2019
Flooding (binary)
Flooding (number of floods (log))
Conservative vote share†
Labour vote share†
Liberal Democrat vote share†
Flood defences (homes protected, k)
Deprivation
House prices (£k)
Job density

†The means for party vote shares are mean values across constituencies; they therefore do not correspond exa

4 Pretests for Parallel Trends

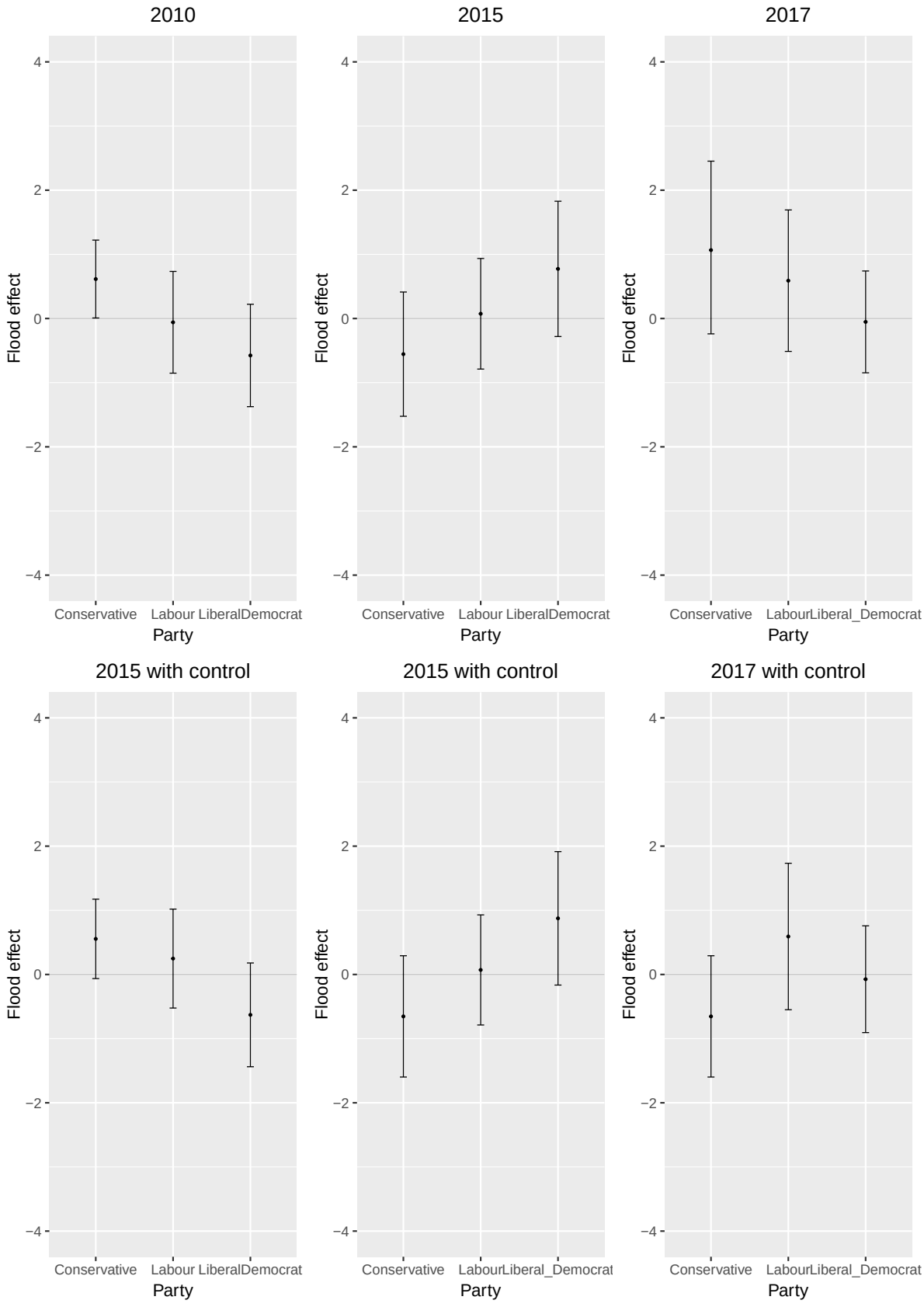
Table A2 presents pretests (placebo tests) where the independent variable in each case is flooding in the period *following* the election in question. These models test the parallel trends assumption. The resulting effects are plotted in Figure A1.

Table A2: Models of the Impact of Flooding on Preceding General Election Results

	Conservative		**Labour**		**Liberal Democrat**	
			2010			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Inter-electoral flooding (binary) 2010-15	.615* (.309)	.555 (.316)	-.059 (.404)	.248 (.393)	-.576 (.406)	-.630 (.413)
Demographic control	No	Yes	No	Yes	No	Yes
N	1065	1065	1064	1064	1064	1064
			2015			
	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Inter-electoral flooding (binary) 2015-17	-.556 (.493)	-.654 (.482)	.074 (.439)	.071 (.438)	.774 (.537)	.875 (.531)
Demographic control	No	Yes	No	Yes	No	Yes
N	1065	1065	1063	1063	1063	1063
			2017			
	Model 13	Model 14	Model 15	Model 16	Model 17	Model 18
Inter-electoral flooding (binary) 2017-19	1.006 (.685)	-.654 (.482)	.589 (.561)	.592 (.582)	-.053 (.404)	.074 (.425)
Demographic control	No	Yes	No	Yes	No	Yes
N	1065	1065	1064	1064	1062	1062

Notes: Models 1, 3, 5, 7, 9, 11, 13, 15, 17 are two-way fixed effects models with constituency and election fixed effects and standard errors clustered by constituency. Models 2, 4, 6, 8, 10, 12, 14, 16 and 18 are doubly-robust models (Sant'Anna and Zhao 2020), also with constituency and election fixed effects and with the outcome conditioned on a covariate for deprivation. Cell entries are coefficients (standard errors); * = p >.05; ** = p >.01; *** p >.001.

Figure A1: Pretest Plots



5 Models of Flood Effects Over Consecutive Elections

Table A3: Effect of 2010-15 Floods on 2017 and 2019 Election Results

	Conservative	Labour	Liberal Democrat
	2017		
	Model 1	Model 2	Model 3
Inter-electoral flooding (binary) 2010-15	.241 (.429)	-.574 (.383)	.841* (.366)
Demographic control	Yes	Yes	Yes
N	1064	1064	1062
	2019		
	Model 4	Model 5	Model 6
Inter-electoral flooding (binary) 2010-15	-.617 (.385)	.332 (.375)	.124 (.439)
Demographic control	Yes	Yes	Yes
N	1064	1064	1062

Notes: These are doubly-robust models (Sant'Anna and Zhao 2020) with constituency and election fixed effects and with the outcome conditioned on a covariate for deprivation. Cell entries are coefficients (standard errors); * = p >.05; ** = p >.01; *** p >.001.

6 Models of the Impact of Flooding and Flood Defences Using Two-way Fixed Effects

Table A4: Models of the Impact of Flooding on the General Election Results with Flood Defences (Homes Protected) Using Two-way Fixed Effects

	Conservative		**Labour**		**Liberal Democrat**	
			2017			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Inter-electoral flooding (binary)	.767 (.520)	.078 (.513)	.331 (.429)	.495 (.438)	-.654 (.420)	-.571 (.426)
Flood defences erected	1.773*** (.480)	1.102* (.468)	-.136 (.391)	.016 (.399)	-.343 (.299)	-.230 (.311)
Demographic controls	No	Yes	No	Yes	No	Yes
N	1064	1021	1064	1020	1062	1018
			2019			
	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Inter-electoral flooding (binary)	.666 (.518)	.465 (.517)	1.317* (.528)	1.406** (.530)	-2.187** (.676)	-2.058** (.661)
Flood defences erected	1.472*** (.392)	1.229** (.402)	-1.186* (.375)	-1.047** (.385)	-.672 (.415)	-.534 (.425)
Demographic controls	No	Yes	No	Yes	No	Yes
N	1064	1012	1064	1012	1062	1010

Notes: These are linear models with constituency and election fixed effects and standard errors clustered by constituency. Demographic controls include job density and houseprices. Cell entries are coefficients (standard errors); * = p >.05; ** = p >.01; *** p >.001.

7 Models of Flooding and Flood Defences with Interactions

Table A5: Models of the Impact of Flooding on the General Election Results with Flood Defences (Homes Protected) with Interactions Using Two-way Fixed Effects

	Conservative	**Labour**	**Liberal Democrat**
	2017		
Variable	Model 1	Model 2	Model 3
Inter-electoral flooding (binary)	1.190 (.682)	.092 (.501)	-.851 (.588)
Flood defences erected	2.025*** (.562)	2.025*** (.562)	-.465 (.335)
Flooding * flood defences	-1.263 (1.017)	.713 (.952)	.611 (.750)
N	1064	1064	1062
	2019		
	Conservative	**Labour**	**Liberal Democrat**
	Model 4	Model 5	Model 6
Inter-electoral flooding (binary)	.648 (.883)	.632 (.888)	-2.827* (1.210)
Flood defences erected	1.468** (.425)	-1.319** (.404)	-.796 (.436)
Flooding * flood defences	.032 (1.085)	1.173 (1.095)	1.105 (1.431)
N	1064	1064	1062

Notes: These are linear models with constituency and election fixed effects and standard errors clustered by constituency. Cell entries are coefficients (standard errors); * = p >.05; ** = p >.01; *** p >.001.

8 Models of Support for the Constituency Incumbent

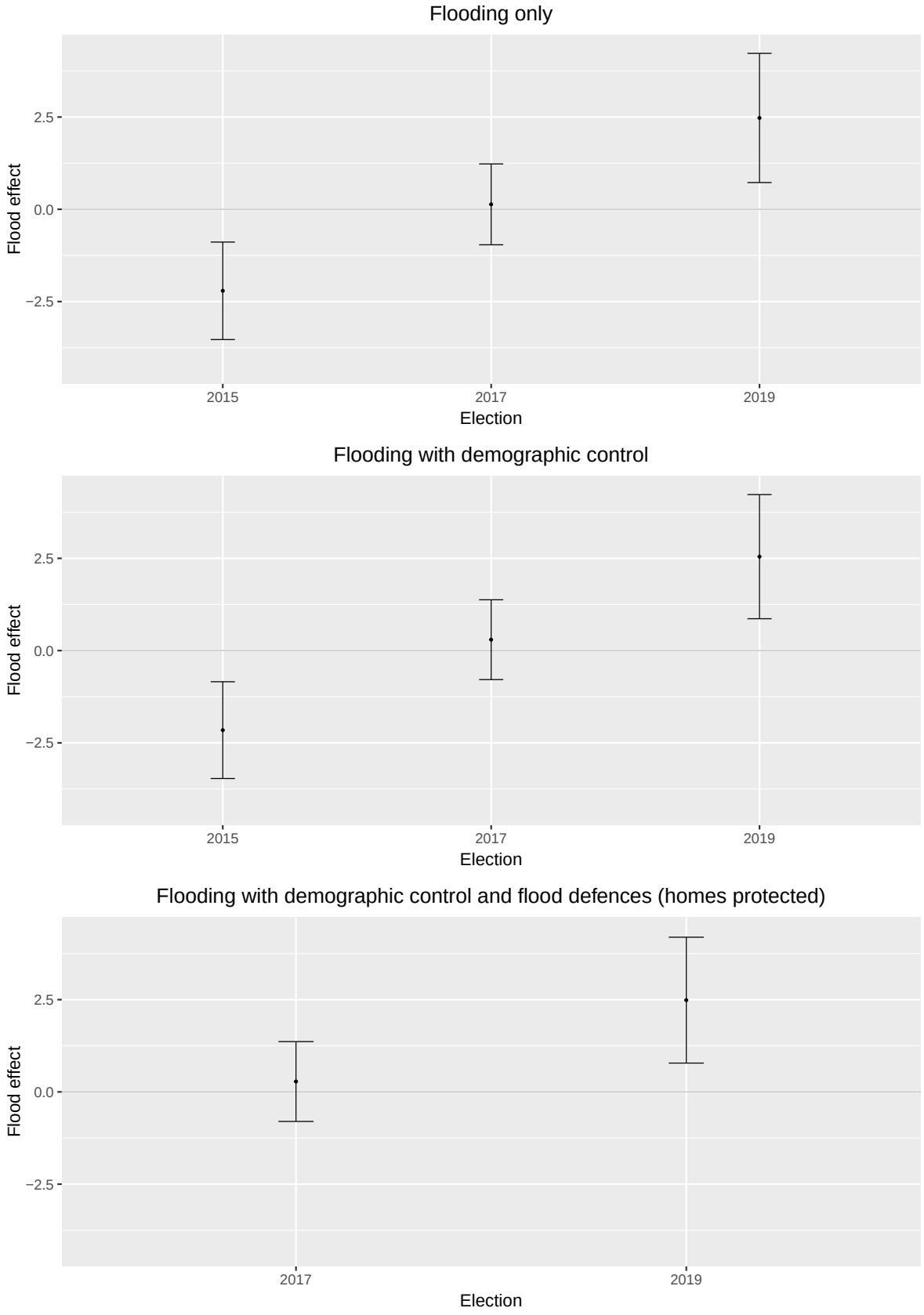
Table A6 and Figure A2 show models of support for the constituency incumbent.

Table A6: Models of Support for the Constituency Incumbent

	2015		2017			2019		
Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Inter-electoral flooding (binary)	-2.209** (.672)	-2.156** (.669)	.134 (.558)	.230 (.551)	.281 (.552)	2.476** (.891)	2.546** (.858)	2.486** (.870)
Flood defences erected	No	No	No	No	Yes	No	No	Yes
Demo-graphic control	No	Yes	No	Yes	Yes	No	Yes	Yes
N	1055	1055	1061	1061	1061	1062	1062	1062

Notes: Models 1, 3 and 6 are two-way fixed effects models with constituency and election fixed effects and standard errors clustered by constituency. Models 2, 4, 5, 7 and 8 are doubly-robust linear models (Sant'Anna and Zhao 2020), also with constituency and election fixed effects and with the outcome conditioned on covariates for deprivation and in Models 5 and 8 also a covariate for homes protected from floods. Cell entries are coefficients (standard errors); * = p >.05; ** = p >.01; *** p >.001.

Figure A2: Constituency Support Plots



9 Models of Flood Intensity

Table A7: Models of flood intensity

	Conservative		Labour		Liberal Democrat	
			2015			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Number inter-electoral floods (log)	1.789***	1.639***	-1.204***	-.860*	-1.906***	-1.771***
	(.322)	(.324)	(.355)	(.352)	(.477)	(.482)
Job density		8.070**		-3.664		-.688
		(2.551)		(2.886)		(3.044)
Houseprices (£k)		.001		.006***		-.002
		(.002)		(.001)		(.002)
N	1065	1020	1063	1018	1063	1018
			2017			
	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Number inter-electoral floods (log)	.072	.226	.448	.345	-.377	-.341
	(.529)	(.535)	(.445)	(.443)	(.405)	(.404)
Job density	1.385	.477	-1.048	-.618	1.011	.966
	(3.805)	(3.832)	(3.019)	(3.049)	(2.874)	(2.846)
Houseprices (£k)	-.009**	.004	.004**	.0001	-.001	-.002
	(.003)	(.002)	(.001)	(.001)	(.002)	(.002)
Flood defences erected (homes protected (k))		.585*		.064		-.087
		(.236)		(.113)		(.055)
N	1021	1021	1020	1020	1018	1018
			2019			
	Model 13	Model 14	Model 15	Model 16	Model 17	Model 18
Number inter-electoral floods (log)	1.605**	1.312*	2.041**	2.144***	-3.268***	-3.221***
	(.610)	(.582)	(.643)	(.651)	(.835)	(.850)
Job density	-3.093	-3.607	-.313	-.197	3.959	4.143
	(2.454)	(2.461)	(2.514)	(2.514)	(2.816)	(2.810)
Houseprices (£k)	.001	.003***	-.0005	.0003	-.002	-.003*
	(.002)	(.001)	(.001)	(.001)	(.002)	(.001)
Flood defences erected (homes protected (k))		.493*		-.197		-.046
		(.245)		(.254)		(.154)
N	1012	1012	1012	1012	1010	10610

Notes: The models in this table are linear two-way fixed effects models with constituency and election fixed effects and standard errors clustered by constituency. Cell entries are coefficients (standard errors); * = p >.05; ** = p >.01; *** p >.001.

10 Calculations of the figures for the electoral benefit of flood defence spending reported in Section 4

This section details how the figures on the per-vote 'cost' of flood defence spending reported in Section 4 were calculated. Flood spending years do not correspond precisely to inter-electoral periods but there is a rough correspondence.

2017 spending figures: in the 2015-16 and 2016-17 budget years, the government spent £908m on flood defences in England (in 2019-20 prices) (Finlay 2020).

2019 spending figures: spending for 2017-18 and 2018-19, plus .75 of 2019-20 (to account for the fact that the 2019 election took place approximately three quarters of the way into the 2019-20 budget year), was £1,256m (in 2019-20 prices) (Finlay 2020).

Model 1 in Table A3 predicts a 1.773% boost in the 2017 election for the Conservatives in seats where flood defences were erected. A total of 27,154,352 votes were cast in England at this election; this translates into a 481,447 vote benefit for a £908,000,000 investment, or £1,886 per additional vote won.

Model 4 in Table A3 predicts a 1.472% advantage for the Conservatives in 2019 in seats where flood defences were erected. In the 2019 election, 26,893,298 votes were cast in England at this election; this translates into a 395,869 vote benefit for a £1,256,000,000 investment, or a 'cost' of £3,173 per vote in 2019.

References

Bakker, Ryan et al. (2015). "Measuring party positions in Europe: The Chapel Hill expert survey trend file, 1999-2010". In: *Party Politics* 21.1, pp. 143–152.

— (2020). *Measuring Party Positions in Europe: The Chapel Hill Expert Survey Trend File, 1999-2010*. Version Version 1.2. URL: http://www.chesdata.eu.

Butler, Catherine and Nick Pigeon (2011). "From 'Flood Defence' to 'Flood Risk Management': Exploring Governance, Responsibility, and Blame". In: *Environment and Planning C: Government and Policy* 29, pp. 533–547.

Carter, Neil (2016). "The Coalition's Climate and Energy Policy: From Consensus to Conflict". In: *Journal of Liberal History* 92, pp. 46–54.

Finlay, Jonathan (2020). "Autumn and Winter Floods 2019-20". House of Commons Library Briefing paper CBP 8803.

Johnson, Clare L. and Sally J. Priest (2008). "Flood Risk Management in England: A Changing Landscape of Risk Responsibility?" In: *International Journal of Water Resources Development* 24.4, pp. 513–525.

Labour Party (Nov. 9, 2019). *Tory Cuts have pushed our emergency services to breaking point – Jeremy Corbyn to Visit Flood-Affected South Yorkshire*. URL: https://labour.org.uk/press/tory-cuts-have-pushed-our-emergency-services-to-breaking-point-jeremy-corbyn-to-visit-flood-affected-south-yorkshire/.

Laville, Sandra and Matthew Taylor (Nov. 17, 2019). *Scientists and Climate Advisers Condemn Tory Environmental Record*. Guardian. URL: https://www.theguardian.com/environment/2019/nov/17/scientists-and-climate-advisers-condemn-tory-environmental-record.

Sant'Anna, Pedro H.C. and Jun Zhao (2020). "Doubly Robust Difference-in-Differences Estimators". In: *Journal of Econometrics* 219, pp. 101–122.

Sky News (Nov. 9, 2019). *UK Weather: Boris Johnson Says Flooding Does not amount to a 'National Emergency*. URL: https://news.sky.com/story/uk-weather-public-urged-to-stay-away-from-swollen-rivers-amid-extensive-flooding-11857056.