Online Appendix to "Mechanical and Psychological Effects of Electoral Reform"

Jon H. Fiva[*]   Olle Folke[†]

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Abstract

This note provides supplementary material to "Mechanical and Psychological Effects of Electoral Reform". In Appendix A, we explain the mechanics of the D'Hondt and Modified Sainte-Laguë seat allocation methods. Using simulated data we show that the DH method gives an advantage to large parties, while the MSL method almost achieves a proportional allocation. In Appendix B, we describe the institutional setting and data used in our analyses. In Appendix C, we present a set of placebo regressions and analyze the potential impact of other changes in the electoral law that coincided with the change in the electoral formula.

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[*]BI Norwegian Business School. E-mail: jon.h.fiva@bi.no

[†]SIPA Columbia University and Research Institute of Industrial Economics (IFN), E-mail: of2152@columbia.edu

Appendix A: Seat Allocation Methods

D'Hondt (DH) and Modified Sainte-Laguë (MSL) are seat allocation methods within the class of highest average methods. The basic principle of this method class is to distribute seats in consecutive rounds to the party that "most deserves" a seat. This is achieved by using a series of divisors, which depend on the seats previously awarded to the party in previous rounds. The division series is used to calculate "comparison numbers" and the party with the highest comparison number is awarded the seat. This procedure is repeated until all seats have been allocated.

Highest average methods are differentiated by what divisor series is used. The DH method uses the divisor series "1, 2, 3, 4, ...", the regular (unmodified) SL method uses the divisor series "1, 3, 5, 7, ...", and the MSL method uses the divisor series "1.4, 3, 5, 7, ...". The formulas for the comparison numbers can be expressed as functions of the total number of votes received (v) and the number of seats previously awarded (s) (initially zero). For the DH method it is $v/(1+s)$, for the SL method it is $v/(1+2s)$, and for the MSL method it is $v/(1+2s)$ when $s \geq 1$ and $v/1.4$ when $s = 0$.

To illustrate the differences between the seat allocation methods we will first turn to Figure A.1. This simplex illustrates the simplest possible setting of a proportional election system, which is the allocation of three seats between three parties. Each region in the simplex represents a specific seat allocation. This allocation is displayed by three numbers at the center of each region in the simplex. For example, in the region in the bottom left corner, Party 3 receives all seats, S=(0, 0, 3), since the other parties get too few votes. The seat thresholds are the boundaries between the contiguous regions, drawn as solid black lines for DH, dotted black for MSL, and dotted gray for SL. Crossing such a threshold changes the seat allocation. For example, suppose that we start from the bottom left corner and move right along the "bottom" line of the simplex, along which Party 2 holds a vote share of zero. Moving along this line, Party 1 will gain its first seat when its vote share surpasses 17 percent if we use SL, 22 percent for MSL and 25 percent

Figure A.1: Allocation of Three Seats to Three Parties
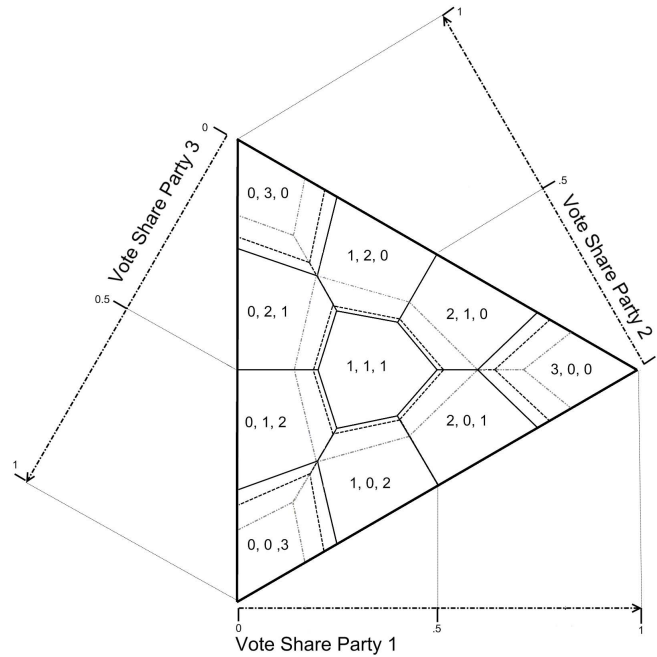
Note: This simplex illustrates the allocation of three seats between three parties. Each region in the simplex represents a specific seat allocation. This allocation is displayed by three numbers at the center of each region in the simplex. The seat thresholds are the boundaries between the contiguous regions, drawn as solid black lines for DH, dotted black for MSL, and dotted gray for SL.

if we use DH. This seat that Party 1 gains was previously held by Party 3. In other words, the seat allocation changes from S=(0, 0, 3) to S=(1, 0, 2).

The graph illustrate two main points. The first one is that there is no explicit vote share threshold for when a party will receive another seat. This is because the seats a party is awarded depend not only on its vote share, but also on the vote shares for the other parties. This is true for all seat allocation methods. Also, it is evident that the variation in the vote share threshold increases with the vote share. The second key point is that the threshold for getting the first seat is highest using DH and lowest using SL. Furthermore the threshold for the second and third seats is lowest for DH, while highest for SL. This validates the fact that large parties are advantaged when we use DH.

To illustrate how large the real world advantages and disadvantages can be expected to be we turn to a more realistic setting where we simulate probable vote share distributions.

In the simulation we use a party structure similar to that in the Scandinavian countries. The average size relationship between the parties is 6, 4, 3, 2, 1, 0.5, 0.5. In the simulations the size coefficient for the party is multiplied by a uniformly distributed term. The simulated votes are then used to allocate seats in 100,000 councils that have the same size distribution as Norwegian municipal councils: an average size of 27 members, a minimal size of 11 members, and a maximum size of 85 members.

Figure A.2 shows the average difference between the seat share and vote share (i.e. the 'seat bias') as function of the vote share. The simulated data shows that the DH method gives an advantage to large parties at the expense of small parties. A party holding 40 percent of the votes, receives an average "seat share bonus" of 3 percentage points, while a party with 5 percent receives an average penalty of 1 percentage point. The MSL method almost achieves a proportional allocation. The moderate disadvantage for small parties under the MSL method stems from the divisor used for the first seat (1.4 instead of 1, as in the traditional Sainte-Laguë formula).

Figure A.2: Seat Share-Vote Share Curvature, Simulated Data
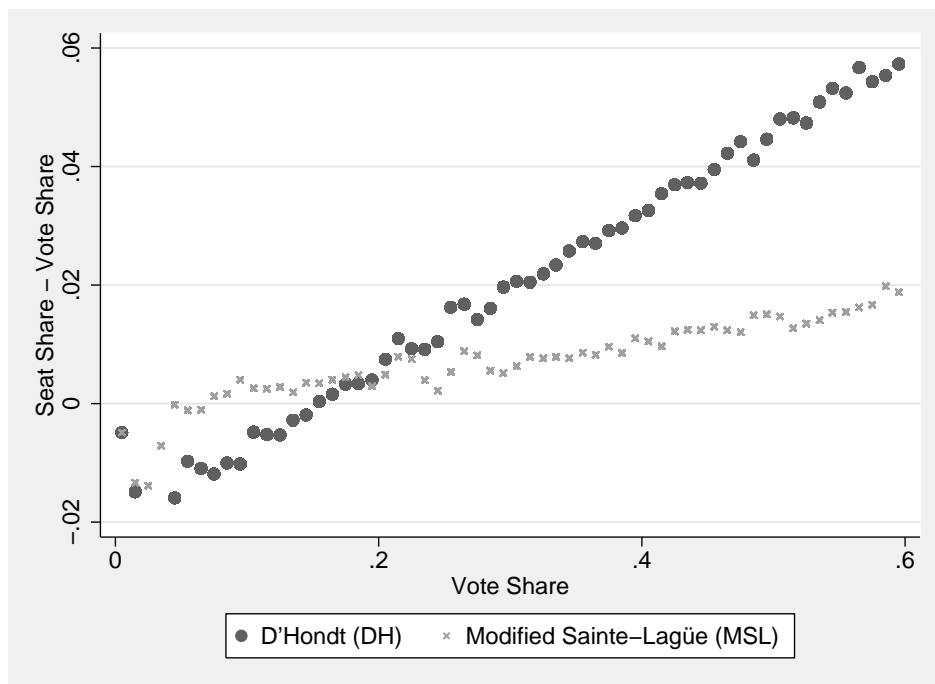
Note: The figure is constructed by grouping (binning) parties together based on their vote share, using a bandwidth of 1 percentage point. The simulated data is based on a party structure similar to that actually observed in Norway.

Appendix B: Institutional Setting and Descriptives

Institutional Setting

Norwegian municipalities are multipurpose authorities responsible for the provision of major welfare services, like schooling, elderly care, and child care. In 2007 they spent on average NOK 67,000 (USD 11,500) per capita.[1] Together with the regional level of government, the counties, the municipalities account for about 18 percent of mainland GDP.

Each municipality is run by a local council that makes decisions based on simple majority rule. The local councils are elected every fourth year in September in an open list proportional representation election system. The open list proportional representation system offers both voters and parties instruments for affecting candidate selection.[2]

All municipalities consist of one electoral district. There are three tiers of government in Norway: municipal, county, and national governments. Municipal elections coincide with elections for the county level of government, a feature that we exploit in our empirical strategy.[3] There are 19 counties in total.

Most of the party lists that participate in municipal elections also are represented in the national political arena. The main political divide is between the left-leaning socialist and the right-leaning conservative camp. The left-wing bloc consists of the Red Electoral Alliance (RV), the Socialist Left Party (SV) and the Labor Party (DNA). This bloc is dominated by the Labor Party which typically gets around 30 percent of local election votes. The right-wing bloc is more fragmented. Ordered from the center to the right, this bloc consists of the Centre Party (SP), the Christian Democratic Party (KrF), the Liberal Party (V), the Conservative Party (H), and the Progress Party (FrP). With the

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[1] "Voting when the stakes are high."

[2] In the 1999 election voters could cast personal votes to particular candidates (from any party lists) and delete candidates from their chosen party lists. In 2003 the option to delete candidates from the chosen party list was abolished. This institutional change is likely to matter for candidate selection *within party lists*, but not *across party lists* (cf. *Effekter av en eventuell gjeninnføring av strykninger ved kommunestyrevalg*).

[3] National elections also have a fixed four-year election cycle, but these elections lag the municipal and county elections by two years.

exception of the Red Electoral Alliance and the Liberal Party, these six parties have been represented in the national assembly continuously since 1981. There are also smaller political parties that obtain little nationwide support and party independent local lists. Finally, parties may form joint lists where the seats are allocated to the parties jointly.

The number of council members is chosen by the previous local council (within the first three years of the election period), but the local discretion is subject to restrictions imposed by the Local Government Act of 1992. The minimum size of the local council depends on the number of inhabitants.[4]

Given that the strategic manipulation of the council size is an option incumbents may utilize, we provide some additional information on this aspect. Starting with the 1995 election, the size of the local council was regulated by the Local Government Act of 1992. Previously, the size of the local council was regulated by the Local Government Act of 1954. In both acts population size limited the discretion of the local politicians to set the size of the local council. The 1954 act did, however, include more population thresholds and also included an upper limit on the council size for each bracket. With a supermajority of the sitting local council a municipality could choose a size of the council that differed from the size stipulated by the local government act, subject to approval from the central government.

In Table B.1 we provide descriptive statistics on the average council size, the number of reductions and increases, and the number of councils at the legal minimum, legal maximum, or above the maximum size. The descriptive statistics are based on a balanced panel covering 368 municipalities.[5]

In the period governed by the 1954 act the average sized council had around 30 members. After the implementation of the 1992 act there was a gradual decline in the

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[4] The number of council members must be an uneven number. With less than 5,000 inhabitants the number of council members must be at least 11. Above 5,000 but below 10,000 inhabitants, it must be at least 19. Above 10,000 but below 50,000 inhabitants, it must be at least 27. Above 50,000 but below 100,000 inhabitants it must be at least 35. Above 100,000 inhabitants it must be at least 43.

[5] In this period the total number of municipalities fluctuates between 462 and 430. The descriptive statistics are based on municipalities that existed over the entire period and were not involved in any mergers. Municipalities that had parliamentary systems (two municipalities) or held plurality elections (three municipalities) are also excluded.

7

Table B.1: Descriptive Statistics on Council Size

Election Period	Average	Reductions	Increases	Loc. Gov. Act	At Min.	At Max.	Above Max.
1975–1979	30.0	1	21	1954	27	99	19
1979–1983	30.2	1	16	1954	26	94	20
1983–1987	30.3	4	14	1954	24	93	16
1987–1991	30.3	7	9	1954	23	98	15
1991–1995	29.6	29	0	1954	32	88	8
1995–1999	29.1	28	12	1992	0	-	-
1999–2003	28.2	47	1	1992	5	-	-
2003–2007	25.7	138	1	1992	10	-	-
2007–2011	25.4	30	9	1992	10	-	-

Note: The number of council members is chosen by the previous local council, but discretion is subject to restrictions imposed by the Local Government Acts of 1954 and 1992, respectively. In the 1954 act nine population threshold regulate the minimum and maximum size of the local council. In the 1992 act five population thresholds regulate the minimum size of the local council. Descriptive statistics are based on a balanced sample of 368 municipalities for elections held during the period 1975–2007. Data from Fiva, Halse and Natvik.[6]

average council size. The most noticeable change, however, occurs at the time of the implementation of the new seat allocation method. From the 1999–2003 to the 2003–2007 election period the average council size fell by 2.5 members, corresponding to an average reduction of about 10 percent. More than one third of the municipalities reduced the council size, while only one municipality increased it.

Main Outcome Variables

Table B.2 offer descriptive statistics on the main outcome variables we use in the empirical analysis. These are the number of parties winning representation (NoP), the effective number of parties (ENoP), an index developed by Laakso and Taagepera, and the index of disproportionality proposed by Gallagher.[7]

In addition we provide descriptive statistics for some underlying factors that may also be affected by electoral reform. These are the number of parties running, the effective number of parties based on votes cast (ENoP^{Votes}), the number of joint lists and the council size.

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[7] "'Effective' Number of Parties: A Measure with Application to West Europe"; "Proportionality, Disproportionality and Electoral Systems."

There is substantial variation across municipalities in the number of parties winning representation. As shown in Table B.2 the average number of parties is 6.10, and varies from 2 to 11. The number of parties running is on average 6.54, implying that 93 percent of parties running win representation.

The ENoP index accounts for both the number of parties represented and their relative strengths and is given by

$$ENoP = \frac{1}{\sum_{i=1}^{n} SeatShare_i^2},$$

where $SeatShare_i$ is the proportion of seats of the i-th party. It is widely used for describing party systems at the national level (see, for example, Lijphart).[8] The average value in our sample is 4.24, considerably lower than the average number of parties that are represented in the local council, which reflects that parties are generally not equal in strength. This is similar to the effective number of parties found at the national level in Norway. The advantage given to large parties by the seat allocation method results in a slightly higher ENoP based on votes cast relative to ENoP based on the allocation of seats.

The Gallagher index is based on the vote-seat share deviation of all running parties. More formally, the index is defined as

$$Index = \sqrt{1/2\sum_{i=1}^{n} (VoteShare_i - SeatShare_i)^2}$$

where $SeatShare_i$ ($VoteShare_i$) is the proportion of seats (votes) of the i-th party. For ease of interpretation, we multiply the index by 100. The index can then take values from 0 (complete proportionality) to 100 (complete disproportionality). In our sample the average value of the Gallagher index is 2.66. This is similar to the historically observed level in countries such as Germany and Switzerland and somewhat smaller than what is observed at the national level in Norway.[9]

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[8] *Patterns of Democracy: Government Forms and Performance in Thirty-Six Countries.*
[9] *Patterns of Democracy: Government Forms and Performance in Thirty-Six Countries.*

Table B.2: Descriptive Statistics

	Mean	Std. Dev.	Min.	Max.
Main Outcomes				
Number of Parties (NoP)	6.099	1.603	2.000	11.000
Effective Number of Parties (ENoP)	4.242	1.080	1.665	7.367
Disproportionality Index	2.659	1.020	0.254	6.711
Underlying Factors				
Number of Parties Running	6.536	1.966	2.000	15.000
ENoP^{Votes}	4.420	1.111	1.652	9.249
Number of Joint Lists	0.076	0.275	0.000	2.000
Council Size	26.729	10.590	11.000	85.000

Note: The main outcome variables are the number of party lists represented in the council (NoP), the effective number of parties (ENoP), and the Gallagher index measuring the disproportionality of the electoral system (Index). Descriptives based on municipal elections in 1999 and 2003 (n=774). Data from Local Government Dataset.

Finally, we note that the average local council consists of about 27 council members. Variation in size of the local council is closely related to municipality's population (with a correlation coefficient of 0.80).

The Labor Party is running in almost all municipalities. The other major parties are also present in most, but far from all municipalities. Independent local lists are common, and in 37 percent of the municipalities at least one independent local list is running. Party lists that are rarely seen at the national political arena are running in about 21 percent of municipal elections. Joint lists are running in about 7 percent of the municipal elections.

Political Support Across Parties

In Table B.3 we offer descriptive statistics by party lists. The Labor Party is the largest party, and is represented in almost all municipalities. During the period that we study, the average (unweighted) vote share is 30 percent. The other parties represented at the national political arena also are present in most, but not all municipalities. The

smallest of these parties is the Red Electoral Alliance, which was running in only about 22 percent of the municipalities and represented on local councils in about 9 percent of the municipalities.

As is evident from column three and four of Table B.3, the parties tend to obtain roughly the same national level support at the municipal and county elections. Figure B.1 further illustrates the strong degree of overlap in the voting patterns across the two offices. It appears like voters only to a moderate degree use the two elections to express different political sympathies.

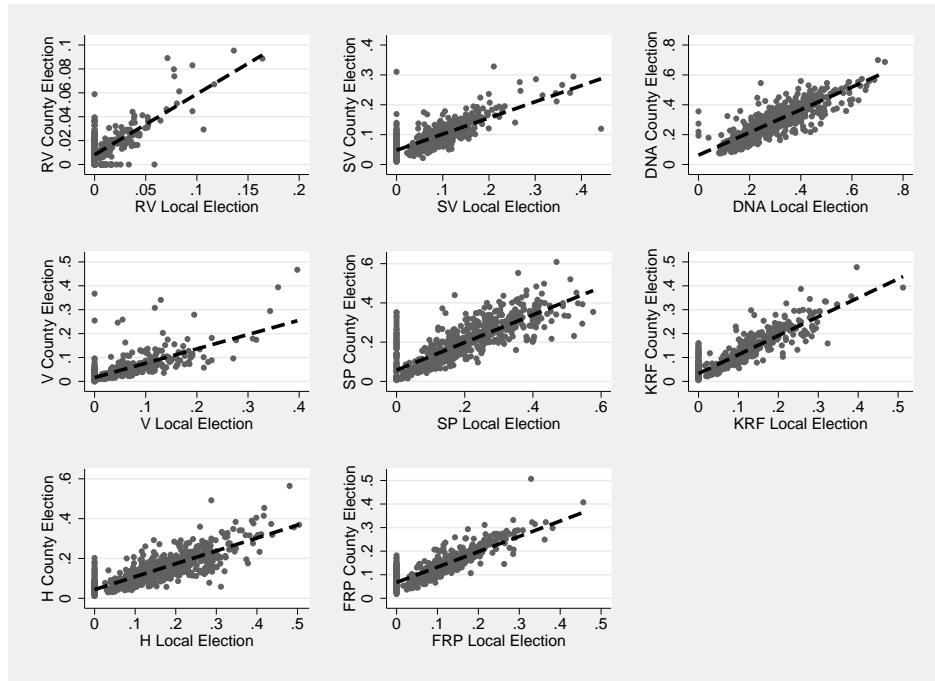Table B.3: Descriptive Statistics by Party List

Party List	Running	Council	Votes Municip.	Votes County
Red Electoral Alliance (RV)	0.216	0.089	0.006	0.011
Socialist Left Party (SV)	0.683	0.676	0.070	0.086
Labor Party (DNA)	0.995	0.995	0.299	0.290
Liberal Party (V)	0.660	0.572	0.045	0.043
Centre Party (SP)	0.902	0.879	0.167	0.175
Christian Democratic Party (KrF)	0.753	0.733	0.083	0.099
Conservative Party (H)	0.863	0.855	0.141	0.135
Progress Party (FrP)	0.658	0.641	0.087	0.124
Independent List	0.370	0.349	0.057	0.000
Other Lists	0.213	0.149	0.015	0.037
Joint Lists Left	0.014	0.013	0.002	0.001
Joint Lists Right	0.061	0.059	0.017	0.000

Note: Descriptives based on municipal and county elections in 1999 and 2003 (n=774). Reported are (i) the fraction of municipalities where the party list is running, (ii) the fraction of municipalities where the party list is winning representation in the council, (iii) the fraction of votes cast for the party list at the municipal election (iv) the fraction of votes cast for the party list at the county election.

Distribution of Votes

In Figure B.2 we show the cumulative vote distribution, both for the counties and the municipalities, before and after the electoral reform. Since we expect to see the clearest shift in votes towards small parties we show both the full distribution and for parties below 10 percentage points of the vote share. The vote distribution before the reform is shown by the solid line, while the vote distribution after the reform is shown by the dotted line. In the municipal elections we do not see a clear shift in the full the vote distribution.

Figure B.1: Parties' share of votes at municipal and county elections

However, when we focus on parties under 10 percentage points of the vote share, we can see a noticeable shift in votes towards small parties at the municipal elections after the reform. For example, the share of votes for parties that receive less than 5 percent of the total votes increases by about one-third. For the county elections there is also a noticeable shift, but this shift is for slightly larger parties and goes in the opposite direction.

Figure B.2: Cumulative Vote Distribution
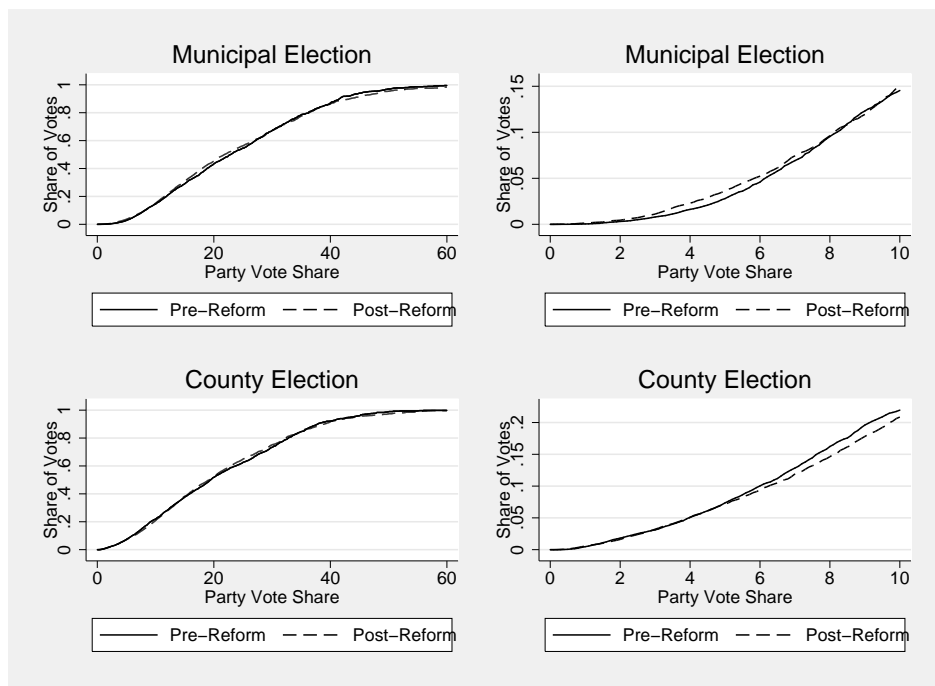
Note: Figures to the left gives the entire vote distribution, while figures to the right give the vote distribution only for parties with less than 10 percent of the vote. The data are from municipal and county elections in 1999 and 2003.

13

Appendix C: Robustness

Placebo Regressions

Our identification strategy is based on the assumption that there are no time trends in our outcome variables which are specific to the municipal elections. To investigate the plausibility of this assumption we add information from elections held in 1995 and 2007 and conduct two sets of placebo analyses.[10] The upper panel in Table B.4 shows the results for an analysis that uses data from 1995 and 1999, while the lower panel shows results for an analysis using voting data from 2003 and 2007. In this analysis we will focus on the psychological effect, and its two subcomponents, since these are the ones that are subject to potential endogeneity problems. This means that it is not relevant to examine the total effect (A to D) in our placebo regressions since this per definition is a combination of the psychological effect (which we examine) and the mechanical effect (which, per definition, is unaffected by endogeneity issues).

The results will be presented in the following order. In the first row we present the total psychological effect, i.e. from B to D in Figure 3. We then turn to the subcomponents of the psychological effects. Row 2 shows the effect of the shift in the vote distribution while keeping the seat allocation constant, while row 3 shows the part of the psychological effect that operates through the mechanical effect. As in the main analysis we show the results both with and without the county controls.

For the number of parties we do not find any psychological effects on in the placebo regression, either before or after the reform. This is true irrespective if we use the county controls or not.

When we turn to the effective number of parties we find a psychological effect in the placebo regression when we do not include the county control. The magnitude is similar

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[10]For the 1995 election we only have complete voting data for municipalities that had no more than a maximum of one independent party list, one "other" party list, or one joint list (about 90 percent fulfill this criteria). Official election statistics lumps together votes for parties belonging to each of these categories prior to the 1999 election. For the first placebo analysis we therefore construct a panel where we only include observations where we have exact voting data both for 1995 and 1999.

Table B.4: Effects of Placebo Reforms in 1999 and 2007

Outcome	(1) NoP	(2) NoP	(3) ENoP	(4) ENoP	(5) Index	(6) Index
Placebo Reform 1999						
$B \rightarrow D$	0.016	-0.008	0.196***	0.027	0.087**	0.087**
	(0.043)	(0.044)	(0.034)	(0.039)	(0.038)	(0.038)
$A \rightarrow C$	0.024	-0.010	0.195***	-0.009	-0.024	0.018
	(0.046)	(0.045)	(0.035)	(0.041)	(0.071)	(0.071)
$[C \rightarrow D] - [A \rightarrow B]$	-0.008	0.001	0.001	0.001	0.111*	0.093
	(0.026)	(0.027)	(0.015)	(0.015)	(0.061)	(0.063)
N	738	738	738	738	738	738
County Control	No	Yes	No	Yes	No	Yes
Placebo Reform 2007						
$B \rightarrow D$	-0.022	0.007	-0.217***	-0.011	-0.014	-0.011
	(0.044)	(0.044)	(0.039)	(0.041)	(0.050)	(0.050)
$A \rightarrow C$	-0.049	0.029	-0.216***	-0.008	0.063	0.060
	(0.044)	(0.042)	(0.037)	(0.037)	(0.083)	(0.089)
$[C \rightarrow D] - [A \rightarrow B]$	0.027	0.014	-0.001	-0.001	-0.077	-0.077
	(0.029)	(0.029)	(0.016)	(0.016)	(0.071)	(0.071)
N	732	732	732	732	732	732
County Control	No	Yes	No	Yes	No	Yes

Note: For explanatory details, see Table 5.

to our estimates of the reform effect, but is negative after the reform. However, unlike the reform effect, the placebo effects go away as we include the county control. This illustrates both that we need to include the county control and that the county control works.

For the Gallagher index, we do not find any significant effect in the placebo estimates in 2007. We do, however, find a small but statistically significant effect in the placebo estimates from 1999, which does not go away when we include the county control. The point estimates suggest that the placebo effect operates through the ex-post mechanical effect. There are two important things to note with respect to this. First the effect is quantitatively small (about one tenth of the total effect of the reform). Secondly, and most importantly, it is only in one out of 18 regressions in which we include the county controls that we find an effect. This is about what we would expect to find by pure chance.

Other Changes in Electoral Law

As mentioned in Section 2, the electoral reform that we study is not fully clean. The electoral law did not only change the seat allocation method from DH to MSL, but also (i) increased the number of citizen signatures required for party-independent local lists, (ii) reduced the scope for casting preferential votes, and (iii) reduced the number of candidates required per party list. The psychological effects on the number of represented parties, reported in Table 3, seem to be driven by entry of new party lists, particularly from two parties, the Socialist Left Party (SV) and the Progress Party (FrP). Could the additional changes in the electoral law be driving these psychological effects? We discuss each of the three changes in turn.

Before the electoral reform party-independent lists needed a number of citizen signatures equal to the size of local council, while after the reform they would need 2 percent of the voting population to sign (but 300 signatures is always sufficient). This may have contributed to the slight reduction we observe in the number of independent party lists

running from 39 percent to 35 percent.[11] If anything this change in the electoral law implies that we would underestimate the psychological effects.

The reduction in the scope for preferential voting from the 2003 election onwards, mattered only for candidate selection *within party lists*, but not *across party lists*, and therefore do not incentive either strategic voting nor strategic entry. There is also no evidence that this feature of the reform increased voter turnout. It is therefore unlikely to be a confounding factor for our analysis.

The change in the candidate requirement may, however, be a potentially confounding factor. Until the 1999 election parties, irrespective of expected electoral support, would need to provide a ballot with candidates sufficient to fill at least half the local council. From 2003 onwards, this requirement was relaxed. Party lists needed only a minimum of seven candidates to be allowed to participate in the election. For small parties this may have reduced the cost of running, and could therefore potentially contaminate the estimates of psychological effects.

We have contacted the national party organizations of SV and FrP and asked how the party organization responded to the change in the electoral law. Both national party organizations report that they sent out information about the new electoral law to their local parties and that the candidate requirement was relevant. Interestingly, FrP circulated an electronic spreadsheet where local politicians could plug in votes, council size and calculate the seat allocation based on the new seat allocation method (MSL).

To investigate whether the candidate requirement was a binding constraint for these two parties we relate information on the number of candidates on the ballot and the minimum requirement specified by the electoral law. Prior to the changes in the electoral law there is little bunching on the minimum required number of candidates for either of these parties.[12] We have also considered whether the party lists emerging in 2003 had a

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[11]For a municipality with a median sized voting population (of about 3000) and a council size of 25 the number of signatures needed for a party independent lists would increase from 25 to 60. Political parties registered in "Partiregisteret" would only need two signatures, both before and after the electoral reform. In 2003, 22 political parties were listed in "Partiregisteret".

[12]On average, SV lists have 15 candidates more than the minimum required number. 0.4 percent of the SV lists were exactly on the minimum required number of candidates. On average, FrP lists have 13

sufficient number of candidates also to run if the previous rule had been in place. For the vast majority of new party lists this is the case.[13] Both these results indicate that the reduction in the candidate requirement was not the key explanation for the entry of new lists from these parties.

In conclusion, we argue that other changes in the electoral law are unlikely to have a severe impact on the psychological effects estimates. We cannot rule out that the reduction in the candidate requirement played a role, but it does not seem to be a key explanation.

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candidates more than the minimum required number. Of the FrP lists, 3.9 percent were exactly on the minimum required number of candidates.

[13]We find that 51 of 59 new FrP lists and 55 of 62 new SV lists have a number of candidates above the minimum required level. If we base the minimum required level on the council size existing in 1999 the number of party lists above the threshold falls slightly, to 48 and 52 for FRP and SV, respectively.