THE RESEARCH INSTITUTE OF INDUSTRIAL ECONOMICS

Working Paper No. 596, 2003

Voter Turnout in Direct Democracy: Theory and Evidence

by Morten Søberg and Thomas P. Tangerås

IUI, The Research Institute of Industrial Economics
P.O. Box 5501
SE-114 85 Stockholm
Sweden

Morten Søberg and Thomas P. Tangerås

Voter turnout in direct democracy
Theory and evidence

June 18, 2003

Abstract:
We analyse voter turnout as a function of referendum types. An advisory referendum produces advice that a legislature may or may not take into account when choosing between two alternatives, whereas a binding referendum generates a decisive decision. In theory, voter turnout should be higher under binding than advisory referendums, higher in small than large electorates and higher in close than less close referendums. These predictions are corroborated by evidence from 230 local referendums in Norway. For example, a shift from an advisory to a semi-binding referendum leads to an average increase in voter turnout by 11.5 percentage points.

Keywords: Voting behaviour, referendum types, rational choice.

JEL classification: D72

Acknowledgement: Constructive comments from Dag Einar Sommervoll are highly appreciated. The usual disclaimer applies. Tangerås' research was financed by the Jan Wallander and Tom Hedelius Research Foundation.

Address: Morten Søberg: The Norwegian Parliament. E-mail: morten.soberg@stortinget.no
Thomas P. Tangerås: The Research Institute of Industrial Economics (IUI), Stockholm. E-mail: thomas.tangeras@iui.se

1. Introduction

Direct democract decision-making is becoming increasingly popular as a means for deciding on public policy issues. Nearly half of the referendums[1] recorded worldwide have been conducted since 1970 (Bjørklund, 1997). In many countries referendums supplement indirect democracy on local, regional and national levels, and typically are employed to decide on moral, territorial and constitutional issues (Gallagher *et al*., 1996).

Referendums can generally be categorized as either *advisory* or *binding* (Stordrange, 1991). A binding referendum implements the election outcome subject to specified turnout and/or majority quorums. One example is the 1979 referendum on Scottish devolution. The U.K. parliament committed itself to implementing constitutional change on the dual proviso that a simple majority of the registered votes and at least 40% of the Scottish electorate supported devolution (Nairne *et al*., 1996)[2]. Advisory referendums differ in that threshold and majority quorums are uncertain. Specifically, the referendum result constitutes advice to an elected institution such as parliament that considers and weighs both voter turnout and distribution of registered votes prior to deciding upon whether or not to implement the outcome of the referendum. In particular, an advisory referendum tends towards an opinion poll only and confers decreasing decisive influence on elected institutions as voter turnout declines. In the 1955 Swedish referendum on traffic rules 83% of voters supported the prevailing convention of driving on the left. However, voter turnout was only 53,2%, and the Swedish parliament subsequently introduced right hand side driving laws (Bjørklund, 1997). One interpretation of this decision is that greater weight was attributed to voter turnout than to the recorded distribution of votes.

Often referendums are employed in circumstances to secure legitimate change in the form of widespread popular support. The concern for legitimacy is reflected in practice by the specification of turnout thresholds in binding referendums and the implicit weight awarded to voter turnout in advisory referendums. In addition to being the most obvious manifestation of democracy, referendums have appealing efficiency properties. Much in the same way as prices in a market economy convey information about the marginal social valuation of goods, the distribution of votes reveal information about the social desirability of policy alternatives. Ledyard and Palfrey (1994 and 2002) forcefully

[1] We use the word referendums, not referenda, as a plural form meaning ballots on one issue. In constrast, the Latin plural gerundive referenda ("things to be referred") connotes a plurality of issues (cf. Nairne *et al*. 1996, p. 100).

[2] In fact, a slight majority - 51.6% - voted in favour of Scottish devolution. But with a turnout of 62.9%, the "Yes" vote was 32.9% of the electorate, and the status quo prevailed (Nairne *et al.* 1996).

demonstrate the potential of referendums as information transmitters. They show how sophisticated preference revelation mechanisms in large electorates can be effectively replaced by simple schemes in which participants simply vote in favour of or against the implementation of a project and the project is implemented if and only if attracting a sufficient number of favourable votes.

In as much as referendums generate socially valuable information, the participation and truthful expression voter opinion impose a positive externality on the rest of the electorate[3]. Moreover, to the extent that participation is voluntary and voters do not internalise this "voting" externality, voter turnout levels below 100% will be sub optimally low from society's point of view[4]. Hence, an examination of the effect of different referendum types on voter turnout is of considerable interest with regard to social welfare.

The objective of this paper is to analyse from a theoretical as well as an empirical perspective the effect of referendum type - binding versus advisory - on voter turnout. To this end we utilize a model in which voters, when deciding if and how to vote, weigh expected political influence and the value of it against the cost of voting. Political influence is a function of the expected probability of becoming the pivotal voter and the likelihood that the majority alternative is *de facto* implemented[5]. The expected probability of becoming the pivotal voter depends negatively on the size of the electorate, but positively on the degree of electoral competition as measured by the inverse of the expected difference in the vote shares of the alternatives. The likelihood that the majority alternative is implemented is higher under binding than under advisory referendums. We find the following: if the size of the electorate is sufficiently large, there is a unique symmetric equilibrium in which voter turnout is higher under binding than under advisory referendums, decreasing in the size of the electorate and the cost of voting and increasing in the degree of electoral competition and the value of political influence.

The empirical part of the analysis is a micro study of local Norwegian referendums concerning choice of language in schools. In 1885 the Norwegian parliament - Stortinget - established *nynorsk* as the second official language in addition to *bokmål*. Nynorsk is a written code based upon a wide range of

---

[3] Naturally, voters who hold opposing beliefs are hurt by an individual's decision to participate, but if the outcome of the referendum leads to the implementation of the socially efficient policy, the losers can, at least in principle, be fully compensated for their loss.

[4] This is true only in the absence of costs of voting. If there are costs of voting, the benefits of additional information must be traded off against the marginal cost of voting in the optimal mechanism.

[5] This is the standard "calculus of voting" approach taken by Downs (1957), Tullock (1967), Riker and Ordeshook (1968) and subsequently refined; see Aldrich (1993), Blais (2000) and Grossman and Helpman (2001) for surveys. As in Palfrey and Rosenthal (1983) and others, voters randomise between voting and abstaining. The additional feature considered in the present context is uncertainty as to the implementation of the outome.

Norwegian dialects. Bokmål is a Norwegianized version of Danish, established as the conventional language of Norway during the approximately 400 years of union with Denmark, which ended in 1814. Nowadays approximately 15% of Norwegians are taught and use nynorsk as their primary language.

In 1892 Stortinget ruled that advisory local referendums should be employed to decide which of the two should be used as the primary teaching language in local school districts. The referendum rules were changed in 1915, so that a majority vote in a referendum was binding conditional upon at least 40% of the electorate having participated. Henceforth we refer to these referendum rules as semi-binding referendums. In 1985 Stortinget amended the rules yet again, and since then referendums have been advisory (Norges Lover, 2002).

The empirical analysis below is based upon 230 referendums carried out during the period 1971-2001, 84 of which were advisory (Adamiak, 2001)[6]. One obvious advantage pertaining to this data set is its invariance with regard to topic, the implication of which is a control for the effect on turnout due to changes in the issues being decided upon in referendums.

Consistent with theoretical predictions we find that semi-binding referendums display higher voter turnout than advisory referendums. All other things equal, a shift from an advisory to a semi-binding referendum leads to an average increase in voter turnout by 11.5 percentage points. In addition, voter turnout depends negatively on the size of the electorate, but positively on electoral competition. All effects are highly significant[7].

The rationality of voting has been questioned ever since rational choice theory was first applied to the analysis of voter turnout. In large elections, it is argued; the impact of any single voter is so small that the net benefit of voting cannot possibly cover the cost of doing so. The obvious fact that voters nevertheless turn up in significant numbers has come to be known as the voting paradox. Some have taken the voting paradox so far as to question the whole application of rational choice to political science (Green and Shapiro, 1994), or economics, for that matter (Aldrich, 1997). We believe that the existence of a voting paradox is insufficient to discard rational choice, as a whole. With a sufficiently

[6] In both cases a referendum was conducted after at least 25% of the electorate had actively supported it by signing a petition.

[7] Ours is not the first paper to empirically test the importance of electoral size and competition on voter turnout. Blais (2000) contains a survey of 36 studies that analyze how turnout depends upon the size of the electorate and/or the closeness of the election. The hypothesis that turnout decreases with the size of the electoral unit has been confirmed (disconfirmed) in eight (five) studies. The verdict is clearer with regard to closeness: in 27 of 32 studies closeness was found to increase turnout. We are not aware of any empirical study besides ours of the effect of referendum type on voter participation.

small electorate, in our sample the electorate varies in size from 6 to a bit above 4000, with an average of 386, voter behaviour conforms extremely well to the predictions of rational choice theory. The failure of a theory to work in the large is no evidence that it will not work in the small.

The remainder of the paper is organized as follows. Section two presents the theoretical framework used to generate hypotheses against which the data are evaluated. The third section contains the data analysis. Concluding remarks are outlined in the last section. Some tedious calculations are relegated to appendix A. The data is contained in appendix B.

2. Theory

The following model is a variant of the one introduced by Palfrey and Rosenthal (1983). The members of the electorate randomise between participating and abstaining from voting. Consider a referendum in which voters may either support or oppose a given project. N denotes the size of the electorate. Each member V of the electorate values her most preferred policy at b and the alternative at *0*. The referendum is decided by simple majority rule (which is also the optimal voting scheme). However, the probability that the majority decision is actually implemented is only $m \in (0.5,1]$ (more on this below). There is a net cost $c < b(2m-1)$ of voting, which is identical for all voters. The net cost represents the cost of becoming informed plus “foot-sole” costs minus the intrinsic benefit of voting. Hence, c need not be positive. *V*’s expected utility of voting is

$$U_{vote} = \left[pm + (1-p)(1-m) \right] b - c, \tag{1.1}$$

where p signifies the probability that *V*’s favoured policy wins when she participates in the election. p depends on the number of voters who share *V*’s political views and the probability with which these voters actually vote, as well as the number of voters who do not share *V*’s political views and voter turnout in that group. *V*’s favoured policy is implemented if (*i*) it wins the referendum and the majority alternative is implemented or (*ii*) it loses the referendum, but the minority alternative is implemented. The probability of at least one of these events occurring is given by the term in brackets in equation (1.1). Multiply this by the value of winning - b - and subtract the cost of voting to obtain the expected utility of voting.

The expected utility from abstaining is

$$U_{abstain} = \left[p' + (1-p')(1-m) \right] b. \qquad (1.2)$$

V's most favoured policy is still implemented if either (*i*) or (*ii*) above occurs, but now the probability of winning the election has reduced to p' as V no longer participates in the election. p' depends on the same factors as p. By abstaining, the voter saves on the cost of voting at the expense of a lower probability of winning the referendum. Subtract (1.2) from (1.1) to obtain the net benefit of voting

$$u = p^e (2m-1) b - c.$$

When deciding whether to vote, the voter trades off her increased influence on the expected electoral outcome against the cost of voting. $p^e = p - p'$ is the expected probability of being the pivotal voter, as *V* influences the outcome of the election if and only if she is the decisive voter. As shown in appendix A, p^e can be approximated by[8]

$$p^e(q,\omega,N) = \frac{e^{-2N\frac{q}{1-q}(\omega-0.5)^2}}{\sqrt{2\pi Nq(1-q)}} \qquad (1.3)$$

when the size of the electorate - *N* - is sufficiently large. *q* is the probability that a member of the electorate actually votes and ω the expected fraction of the electorate who have the same policy preferences as *V*. In large elections, q is even voter turnout. In the remainder of the analysis we assume that voters behave as if the expected probability of being pivotal is exactly equal to (1.3). In interior equilibrium it must be the case that voters are indifferent between voting and staying at home. Hence equilibrium voter turnout *z* is implicitly given by $p^e(z,\varpi,N) = c / b(2m-1)$. Utilize (1.3), take logarithms and rewrite to obtain *z* as the implicit solution to

$$2(\varpi - 0.5)^2 N \frac{z}{1-z} + \frac{1}{2}\left[\ln N + \ln z + \ln(1-z)\right] + \ln c - \ln b - \ln(2m-1) + k = 0 \qquad (1.4)$$

where k is a constant. We maintain the following assumption throughout:

---

[8] See Owen and Grofman (1984) and Mueller (1989) for derivations of a similar approximation for $q = 0.5$.

Assumption I $4\varpi(1-\varpi) \le \frac{N-1}{N}$

Assumption I is sufficient (but not necessary) to guarantee that the expected probability of being pivotal be decreasing in voter turnout. It is satisfied if either preferences are sufficiently polarized, *i.e.*, ϖ is very small or very large, or if the electorate is sufficiently large. Upon differentiating (1.4), the following is easily established:

Proposition 1: *Under assumption I there exists a unique symmetric equilibrium. Equilibrium voter turnout is (i) increasing in the likelihood* m *that the majority alternative is implemented, (ii) increasing in the "expected closeness"* $|\varpi - 0.5|^{-1}$ *of the election, (iii) decreasing in the size* N *of the electorate, (iv) increasing in the valuation* b *of the outcome and (v) decreasing in the cost* c *of voting.*

These results are fairly intuitive. Consider for example the effect of increasing the size of the electorate. An increase in N leads to a reduced likelihood of becoming the pivotal voter, hence voter turnout drops. A drop in voter turnout leads to an increased likelihood of being the pivotal voter. Hence, voter turnout falls until the effect of the reduction in the size of the electorate is offset, keeping the equilibrium likelihood of being the pivotal voter constant.

Referendum design

The probability m that the majority result is implemented depends crucially on referendum design. In a *binding referendum* politicians are obliged to implement the majority alternative. Hence, $m = 1$. Adversely, in the *advisory referendum* case politicians are under no judicial constraint to implement the majority result. The election outcome produces merely advice that a legislature may or may not take into account. Consequently, $m \le 1$ under an advisory referendum. In light of proposition 1, we immediately obtain:

Corollary 1: *In symmetric equilibrium, voter turnout is (weakly) lower under an advisory than a binding referendum.*

The referendum rule employed in linguistic referendums in Norway between 1915 and 1985 constitutes a *semi-binding referendum* type. It is advisory on the proviso that less than 40% of the electorate participates and becomes a binding referendum if voter turnout exceeds this threshold.

Let z_B, z_A and z_S be equilibrium voter turnout in the binding, advisory and semi-binding referendums, respectively, while x denotes the threshold level above which the semi-binding referendum becomes binding.

Proposition 2: *Under assumption I and in symmetric equilibrium, the following holds:* (*i*) *if the threshold is sufficiently high, voter turnout is the same in the semi-binding as in the advisory referendum* ($z_S = z_A$ if $x > z_B$), (*ii*) *if the threshold is sufficiently low, voter turnout is the same in the semi-binding as in the binding referendum* ($z_S = z_B$ if $x < z_A$), (*iii*) *for intermediate threshold levels, there are multiple equilibria, with voter turnout being either the same as in the binding or the advisory referendum* ($z_S = \{z_A, z_B\}$ if $x \in [z_A, z_B]$).

> **Proof:** Under assumption I, $p^e(q)$ is decreasing in q. There are three cases to consider. Case (*i*): $x > z_B$. Suppose $q > x$. Now everybody expects the referendum to be binding. All voters abstain since $p^e(q) < p^e(x) < p^e(z_B) = c/b$. Hence $q > x$ cannot be an equilibrium. Suppose therefore that $q \leq x$. Now everybody expects the referendum to be advisory. The only possible symmetric equilibrium under an advisory referendum is $q = z_A < x$, hence $z_S = z_A$. Case (*ii*): $x < z_A$. Suppose $q < x$. In this case everybody expects the referendum to be advisory. All voters participate because $p^e(q) > p^e(x) > p^e(z_A) = c/b(2m-1)$. Thus $q < x$ cannot be an equilibrium. Suppose therefore that $q \geq x$. Now everybody expects the referendum to be binding. The only possible symmetric equilibrium under a binding referendum is $q = z_B > x$, hence $z_S = z_B$. Case (*iii*): $x \in [z_A, z_B]$. Suppose expected voter turnout is $q \leq x$. Now everybody expects the referendum to be advisory. In this case $z_S = z_A$ is an equilibrium because $z_A \leq x$. Suppose next $q \geq x$. Now everybody expects the referendum to be binding. Now $z_S = z_B$ is an equilibrium because $z_B \geq x$. Hence, in this final case both $q = z_A$ and $q = z_B$ are equilibria.□

The intuition is straightforward. If the threshold is set very high, every voter knows that voter turnout will never be sufficiently high to generate a binding referendum and voters behave as if the referendum is merely advisory. Conversely, if the threshold is set very low, voters know that the referendum will always be *de facto* binding; hence behave as if it were binding from the outset. In the intermediate case, whether the referendum is binding or not depends on the beliefs about voter turnout. From proposition 2 one immediately obtains:

Corollary 2: *In symmetric equilibrium, voter turnout is (weakly) higher [lower] in the semi-binding than in the advisory [binding] referendum.*

Hence, we are able to rank expected voter turnout with respect to the degree of commitment the legislative authority attaches to the outcome of the referendum. The stronger is this commitment, the higher is voter turnout. We now turn to an empirical investigation of the propositions above.

3. Evidence

Overview

The data set covers 230 referendums carried out between 1971 and 2001[9]. The referendums were quasi-local in that the result applied to choice of language in school districts within municipalities. Also, in 97.4% of these cases nynorsk represented the incumbent and bokmål made up the opposition. These referendums were conducted in school districts located in 76 different municipalities. During the relevant time period, the total number of Norwegian municipalities has been approximately 435.

Summary statistics relating to the key variables of interest are presented in Table 1. As can be seen from the second column, the average turnout in these referendums was 65%, and ranged between 100% and 5.8%. Voter turnout is defined as the percentage of eligible electors within the relevant school district who vote.

Table 1. Summary statistics

	Voter turnout	Voter turnout (advisory)	Voter turnout (semi-binding)	Size of electorate (N)	Closeness of referendum
Mean	0.651	0.518	0.727	386	23.719
St.dev.	0.234	0.024	0.017	534	50.690
Median	0.716	0.529	0.777	212	8.752
Max	1	1	1	4127	∞
Min	0.058	0.058	0.139	6	0

In total, 84 (36.5%) of these referendums were conducted after 1985, and thus were necessarily advisory by law. The mean turnout in this case was nearly 52%. In contrast, the average voter turnout in the semi-binding case was above 72%. Moreover, the evidence reveals that voter turnout exceeded

[9] The complete data set is listed in Appendix B.

the required 40% threshold in 129 of 146 semi-binding referendums. Equivalently, 88.36% of these referendums were *de facto* binding[10].

The table shows that the electorates were small, the average (median) being 386 (212) electors. Lastly, the closeness of the referendums is measured as the inverse of the difference in the vote shares gained by bokmål and nynorsk. A perfectly split vote produces infinite closeness, which did in fact occur twice. However, the average (median) inverse of the difference of vote shares was around 23.7 (8.75).

Tests of hypotheses

Proposition 1 asserts that equilibrium voter turnout is increasing in the expected closeness of the referendum and decreasing in the size of the electorate, while Corollary 2 predicts that turnout decreases when advisory referendum rules apply[11].

We test these hypotheses by means of regression analysis. The following one-way random effects panel data model is employed to evaluate the effect of referendum type, electoral size and voter expectations on voter turnout:

$$VT_{i,t} = \alpha + \beta_{Advisory} D_{i,t} + \beta_N N_{i,t} + \beta_{\varpi} \left|\varpi - 0.5\right|_{i,t} + e_{i,t} + u_i \qquad (1.5)$$

where subscript i denotes year ($i \in \{1971, 1972, \ldots, 2001\}$), and t signifies referendum in chronological order within any one year. The panel is unbalanced since the number of referendums within years varies ($t \in \{1, 2, .. , 18\}$).

The dependent variable *VT* measures voter turnout in a referendum, and α is a constant term. The binary variable *D* measures the qualitative shifts of referendum rules, and assumes the value 1 when a referendum is advisory. *N* signifies electoral size, and the expected closeness of the referendum - $|\varpi - 0.5|$ - is measured by actual split in the vote between *bokmål* and *nynorsk*. ϖ measures the fraction of the entire electorate who prefer *nynorsk* (or equivalently, *bokmål*). This is unobservable. In symmetric equilibrium, both *nynorsk* and *bokmål* voters vote with the same probability. Hence, the

[10] In 6 of the 84 advisory referendums the municipal legislative disregarded the majority vote. Also, 2 of the 17 semi-binding referendums that turned out to be advisory due to insuffifient turnout levels resulted in decisions that contrasted with the majority vote. *Ceteris paribus*, this provides empirical support for the assumption made in section 2 above with regard to *m* - the probability of the majority alternative being implemented - being below 1 under advisory referendums.

[11] Equivalently, the theoretical hypotheses do not relate to turnout *per se*, but are evaluated with regard to predicted changes in turnout. Also see Grofman (1993).

expected split in the election is identical to the split in the electorate. Since the average split is an unbiased estimator of expected split, we use actual split as an estimator of ϖ. Moreover, in order to avoid the case in which the explanatory variable equals infinity, closeness of referendums in represented in the regression by the absolute value of the actual split of vote shares instead of $|\varpi - 0.5|^{-1}$. Consequently, theory in the form of Proposition 1 implies a negative value of the parameter β_{ϖ}.

We do not include any lagged voter turnout variable in the model. Instead possible time effects are represented by u_i, which is a random disturbance term pertaining to the *i*th year. The motivation for this model specification is twofold. First, the referendums were local and exhibited marked geographical heterogeneity. Also, in any school district at least 5 years had to pass prior to another referendum being conducted. Taken together, these factors imply neglicant intercorrelation between individual observations of turnout levels. Second, model specification tests validate the random effects approach. On the one hand a Lagrange test does not result in the rejection of the null hypothesis of no heterogeneity across years (p-value = 0.0674). Moreover, a Hausman-test does not imply the rejection of the null hypothesis of fixed-time effects (p-value = 0.2325).

Both u_i and the classical error term $e_{i,t}$ are assumed to be identically and independently distributed with zero mean and constant variance. The covariance between the two disturbance terms is assumed to be zero both within and across years (Greene, 2000):

$$e_{i,t} \sim \text{iid}\left(0, \sigma_{\varepsilon}^{2}\right) \quad (1.6)$$

$$u_{i} \sim \text{iid}\left(0, \sigma_{u}^{2}\right) \quad (1.7)$$

$$E[e_{i,t}u_j] = 0, \forall i \ \forall t \ \forall j \quad (1.8)$$

Table 2 contains the regression estimates. The model as fitted explains 51% of the variation in voter turnout levels. The principal result is that substituting advisory referendums for semi-binding referendums causes a statistically significant decrease in voter turnout by an average of 11.5 percentage points. This corroborates Corollary 2. The estimates of β_N and β_{ϖ} are both negative. Hence, voter turnout is negatively correlated with the size of electorate and divergence from a closely split vote. These effects are statistically significant and in line with Proposition 1. However, electoral size does not have much real impact on voter turnout. An increase in the size of the electorate by a hundred people leads to an average decrease in voter turnout by a mere 0.02 percentage points. Electoral competition is more important for voter turnout. A reduction in the difference in popularity of the alternatives by four percentage points, say from 55-45 to 53-47, leads to a one percentage point increase in voter turnout. Note finally that the model predicts average voter turnout to be below 86%. Maximal participation would occur in extremely close, semi-binding referenda with a small electorate.

Table 2. Regression results

Parameter	Estimate	t-ratio	p-value[12]
α	0.858	41.105	0.0000
$\beta_{Advisory}$	-0.115	-4.202	0.0000
β_N	-0.00023	-10.138	0.0000
β_{ϖ}	-0.536	-5.910	0.0000
Number of observations:	230	R^2:	0.51

Our empirical analysis does not include any estimators relating to the costs and benefits of voting. Adding such estimators would increase the explanatory power of the analysis, but requires access to information on how electors rate electoral alternatives and value the opportunity cost of casting votes. Such data are not available. The listed regression results will tend to be biased if benefits and costs are correlated with the employed explanatory variables. Nevertheless, we should not expect any degree of correlation between the variable of primary interest, *i.e.*, changes of referendum type, and benefits/costs pertaining to individual referendums. Also, given the high degree of significance of our current estimators, we feel confident that introducing additional explanatory variables would not overthrow our fundamental predictions, namely that referendum type, the size of the electorate and the expected closeness of the election are significant determinants of voter turnout in direct democracy.

Our theoretical model builds on the assumption that voters in their decision to vote trade-off the expected influence, measured by the probability of being pivotal, times the value of deciding on policy less the net cost of voting. This rational choice theory has been criticized from its inception. The main argument is simple. Large elections are often decided by majorities of tens of thousands and sometimes more. The likelihood of becoming the pivotal voter is infinitesimal under such circumstances. Hence, the benefit of voting is negligible. Consequently, each voter would better off staying at home if she believes that a significant proportion of the electorate intend to vote. The fact that voters in general do not stay at home has come to be known as the voting paradox.[13]

We believe that the voting paradox is not a problem here. Electoral size is very small in our dataset compared with most other studies. Some referendums had as few as six voters and only in one case were there more than 2700 eligible voters. Several referendums were decided with a small majority, ten of them with the smallest possible (one vote). Two of the referendums were actually a tie. In circumstances like these voter influence can be substantial. Utilising the data on electoral size, the closeness of the election and voter participation, one can calculate the equilibrium probability p^e of being pivotal. Considering only the referendums for which voter participation was below 100%, the probability of being pivotal was in one instance as high as one in five[14]. In 65 of the elections, the probability of being pivotal was above one in one thousand. Given the importance of the question at hand, namely the choice of language in school, we would not be surprised to find the benefit of choosing policy to surpass the net cost of voting by a factor of one thousand.

Although we feel confident utilising simple rational choice theory to explain voter participation in this setting, we do not wish to argue that voters use calculus *only*, when deciding whether to participate. Take for example the case of *Vera* school district in the municipality of *Verdal*. In 1977 the whole electorate (all six of them) unanimously decided to vote down the proposal to implement *nynorsk*. Here the most favoured policy would have been implemented irrespective of the absence of one or more voters. Owing to the small size of the electorate, it is not unlikely that all voters knew this in advance. Hence the expected probability of being pivotal was zero. Still people voted. Hence, some sort of social pressure may have driven people to the voting booth anyhow.

4. Concluding remarks

The key objective of this paper has been to analyse differences in voter turnout with regard to advisory and (semi-)binding referendums. In our theoretical model, expected voter turnout is smaller in semi-binding than in binding referendums, but larger than in advisory referendums. Moreover, expected voter turnout is a decreasing function of the size of the electorate and the cost of voting, and an increasing function of the closeness of the election and the benefit of winning the election.

---

[12] The p-value for α ($\beta_{Advisory}$ /β_N /β_{ϖ}) is the value for a two-tailed (one-tailed) test of the hypothesis that the parameter equals zero.

[13] The voting paradox was described by Downs (1957) himself. See Mueller (1985) and Grossman and Helpman (2001) for a review of the criticism and attempts to escape the paradox.

Field data from local Norwegian referendums corroborates the prediction that semi-binding referendums display higher voter turnout than advisory referendums. Thus, voter turnout increases with the decisiveness of the referendum. In addition, the empirical evidence confirms the residual theoretical hypotheses in as much as voter turnout depends negatively on the size of the electorate, but positively on electoral competition as measured by the expected closeness of the referendum.

In political systems in which the referendum institution interacts with representative democracy, advisory referendum may produce referendum paradoxes: The majority of voters favour an alternative and the majority of members of a legislative its negation (Nurmi, 1998). One comparative advantage of binding referendums is the avoidance of such paradoxes in as much as such referendums produce decisive outcomes. Also, the analysis contained in this paper implies that binding referendums consistently generate higher voter turnout levels. Thus, if the core objective of referendum design were to maximise voter turnout, the implied policy recommendation would be straightforward: make all referendums binding. However, things are not so simple. Normally, the policy choice is between implementing a policy change and maintaining the status quo. As voters can sometimes be expected to know more about the status quo than about the proposed alternative, informational bias may be expected. Therefore, the design of socially optimal voting mechanism should weigh voter turnout against informational bias in the choice of threshold. To our knowledge, this trade-off between has yet to be explored.

---

[14] This was the case in the *Garnes* schooldistrict in the municipality of *Verdal*. In their 1980 referendum 46 people voted in favour of nynorsk and 45 against of a total of 95 eligible voters, yielding $p^e(0.96, 0.005, 95) \approx 0.19$, where we have used (1.3).

References

Adamiak, A. L. (2001): Local Referendums in Norway. With particular emphasis on the period 1970-2000. Master thesis, Department of Political Science, University of Oslo.

Aldrich, J.H. (1993): Rational Choice and Turnout, *American Journal of Political Science* **37**: 246-278.

Aldrich, J.H. (1993): When is it Rational to Vote?, in Mueller, D.C. (ed.): *Perspectives on Public Choice: A Handbook*, Cambridge, UK: Cambridge University Press: 373-390.

Bjørklund, T. (1997): *Om folkeavstemninger. Norge og Norden 1905-1994*. (On referendums. Norway and the Nordic countries 1905-1994), Oslo: Universitetsforlaget.

Blais, A. (2000): *To Vote or not to Vote. The Merits and Limits of Rational Choice Theory*, Pittsburgh, PA: University of Pittsburgh Press.

DeGroot, M.H. (1989): *Probability and Statistics*, *2nd Ed*, Reading, MA: Addison-Wesley.

Downs, A. (1957): *An Economic Theory of Democracy*, New York, NY: Harper and Row.

Gallagher, M. and P.V. Uleri (eds.) (1996): *The Referendum Experience in Europe*, Basingstoke: Macmillan.

Green, D.P. and I. Shapiro (1994): *Pathologies of Rational Choice Theory: A critique of applications in Political Science*, New Haven, CT: Yale University Press.

Greene, W. (2000): *Econometric Analysis*, London: Prentice Hall International.

Grofman, B., (1993): "Is Turnout the Paradox that Ate Rational Choice Theory?" in Grofman, B. (ed.): *Information, Participation, and Choice: An Economic Theory of Democracy in Perspective*, Ann Arbor, MI: University of Michigan Press: 93-103.

Grossman, G.M. and E. Helpman (2001): *Special Interest Politics*, Cambridge, MA: MIT Press.

Ledyard, J.O. and T.R. Palfrey (1994): Voting and Lottery Drafts as Efficient Public Goods Mechanisms, *Review of Economic Studies* **61**: 327-55.

Ledyard, J.O. and T.R. Palfrey (2002): The Approximation of Efficient Public Good Mechanisms by Simple Voting Schemes, *Journal of Public Economics* **83**: 153-71.

Mueller, D.C. (1989): *Public Choice II*, Cambridge, MA: Cambridge University Press.

Nairne, P. *et al*. (1996): *Report of the Commission on the Conduct of Referendums*. The Constitution Unit, London, U.K.

Norges Lover 1687-2001 (*Laws of Norway 1687-2001*) (2002), Faculty of Law, University of Oslo.

Nurmi, H. (1998): Voting Paradoxes and Referenda, *Social Choice and Welfare* **15**: 333-350.

Owen, G. and B. Grofman (1984): To Vote or Not to Vote: The Paradox of Nonvoting, *Public Choice* **42**: 311-325.

Palfrey, T.R. and H. Rosenthal (1983): A Strategic Calculus of Voting, *Public Choice* **41**: 7-53.

Riker, H.W. and P.C. Ordeshook (1968): A Theory of the Calculus of Voting, *American Political Science Review* **62**: 25-42.

Stordrange, B. (1991): Folkeavstemninger. (Referendums.) Report to the Norwegian Parliament.

Tullock, G. (1967): *Toward a Mathematics of Politics*, Ann Arbor, MI: University of Michigan Press

Appendix A

This appendix derives the large sample properties of p^e, the expected probability of being pivotal. Let ϖ and $[1-\varpi]$ be the proportion of the electorate who prefer the project [not] to be implemented. If q_{yes} $[q_{no}]$ is the unconditional probability that a random "yes" ["no"] voter participates in the referendum and all voters make their decisions simultaneously and independently, the expected probability that the election is won as perceived by a "yes" voter who has decided to participate is

$$p_{yes}(q_{yes}, q_{no}, \varpi, N) = \sum_{Y=0}^{(1-\varpi)N} \sum_{X=0}^{\varpi N-1} h(q_{yes}, \varpi N-1, X) h(q_{no}, (1-\varpi)N, Y) P(X+1, Y),$$

where X $[Y]$ is the (stochastic) number of "yes" ["no"] voters,

$$h(q, M, Z) = \frac{M!}{Z!(M-Z)!} q^Z (1-q)^{M-Z}$$

and $P(\cdot,\cdot)$ the probability that the "yes" alternative wins the election as a function of voter turnout. By majority rule, $P(X,Y)=1$ for all $X > Y$, $P(Y,Y)=0.5$ (both alternatives win with equal probability in case of a tie) and $P(X,Y)=0$ otherwise. If one "yes" voter drops out, the probability that the "yes" voters still win the referendum drops to

$$p'_{yes}(q_{yes}, q_{no}, \varpi, N) = \sum_{Y=0}^{(1-\varpi)N} \sum_{X=0}^{\varpi N-1} h(q_{yes}, \varpi N-1, X) h(q_{no}, (1-\varpi)N, Y) p(X, Y).$$

Hence,

$$p^e_{yes} = p_{yes} - p'_{yes} = \sum_{Y=0}^{(1-\varpi)N} h(q_{no}, (1-\varpi)N, Y) \frac{h(q_{yes}, \varpi N-1, Y) + h(q_{yes}, \varpi N-1, Y-1)}{2}.$$

For N sufficiently large, $h(q, M, Z) \approx F(Z+0.5 \mid \mu, \sigma^2) - F(Z-0.5 \mid \mu, \sigma^2)$ with $F(\cdot \mid \mu, \sigma^2)$ the cumulative of the normal distribution $f(\cdot \mid \mu, \sigma^2)$ with expectation $\mu = Mq$ and variance

$\sigma^2 = Mq(1-q)$ (see e.g. DeGroot, 1989). Let $\mu_{yes} = \varpi N q_{yes}$, $\sigma_{yes}^2 = \varpi N q_{yes}(1-q_{yes})$, and define μ_{no} and σ_{no}^2 correspondingly. Consequently,

$$2p_{yes}^e \approx \int_{-\infty}^{\infty} [F(Y+0.5 \mid \mu_{yes}, \sigma_{yes}^2) - F(Y-1.5 \mid \mu_{yes}, \sigma_{yes}^2)] f(Y \mid \mu_{no}, \sigma_{no}^2) dY.$$

Since $F(Y+0.5 \mid \mu_{yes}, \sigma_{yes}^2) - F(Y-1.5 \mid \mu_{yes}, \sigma_{yes}^2) \approx 2f(Y \mid \mu_{yes}, \sigma_{yes}^2)$ for N sufficiently large[15]:

$$p_{yes}^e \approx \int_{-\infty}^{\infty} f(Y \mid \mu_{yes}, \sigma_{yes}^2) f(Y \mid \mu_{no}, \sigma_{no}^2) dY = \int_{-\infty}^{\infty} \frac{1}{2\pi \sigma_{yes} \sigma_{no}} e^{-\frac{1}{2}\left[\left(\frac{Y-\mu_{yes}}{\sigma_{yes}}\right)^2 + \left(\frac{Y-\mu_{no}}{\sigma_{no}}\right)^2\right]} dY$$

Define three new variables:

$$\mu = \frac{\mu_{yes}\sigma_{no}^2 + \mu_{no}\sigma_{yes}^2}{\sigma_{yes}^2 + \sigma_{no}^2}, \ \sigma^2 = \frac{\sigma_{no}^2 \sigma_{yes}^2}{\sigma_{yes}^2 + \sigma_{no}^2} \text{ and } \kappa = \frac{(\mu_{yes} - \mu_{no})^2}{\sigma_{yes}^2 + \sigma_{no}^2}.$$

$$\left(\frac{Y-\mu_{yes}}{\sigma_{yes}}\right)^2 + \left(\frac{Y-\mu_{no}}{\sigma_{no}}\right)^2 = \left(\frac{Y-\mu}{\sigma}\right)^2 + \kappa \text{ and } \sigma_{no}\sigma_{yes} = \sigma\sqrt{\sigma_{yes}^2 + \sigma_{no}^2}$$

imply

$$p_{yes}^e \approx \frac{e^{-\frac{\kappa}{2}}}{\sqrt{2\pi(\sigma_{yes}^2 + \sigma_{no}^2)}} \int_{-\infty}^{\infty} \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{1}{2}\left(\frac{Y-\mu}{\sigma}\right)^2} dY = \frac{e^{-\frac{1}{2}\frac{N(\varpi q_{yes} - (1-\varpi)q_{no})^2}{(\varpi q_{yes}(1-q_{yes}) + (1-\varpi)q_{no}(1-q_{no}))}}}{\sqrt{2\pi N(\varpi q_{yes}(1-q_{yes}) + (1-\varpi)q_{no}(1-q_{no}))}},$$

where the last equality follows from the property of the Normal distribution and where we have plugged in the relevant expressions. By repeating the same steps for the "no" voter, we arrive at precisely the same expression as above. Hence, "yes" and "no" voters face identical probabilities of

---

[15] For continuous density, $2f^{\min}(Y) \le F(Y+0.5) - F(Y-1.5) \le 2f^{\max}(Y)$, where $f^{\max}(Y) \ge f(X)$ and $f^{\min}(Y) \le f(X)$ for all $X \in [Y-1.5, Y+0.5]$. Since $f^{\min}(Y) \le f(Y) \le f^{\max}(Y)$, we have $0 \le | F(Y+0.5) - F(Y-1.5) - 2f(Y) | \le 2[f^{\max}(Y) - f^{\min}(Y)]$. $f^{\max}(Y) - f^{\min}(Y) \to 0$ for $N \to \infty$ implies $F(Y+0.5) - F(Y-1.5) \to 2f(Y)$ for $N \to \infty$.

becoming pivotal under the chosen approximation. In this case it seems reasonable to assume voter turnout to be the same for both groups, *i.e.* $q_{yes} = q_{no} = q$, although asymmetric equilibria may exist. Plug this into the equation above and simplify to obtain:

$$p_{yes}^{e} = p_{no}^{e} \approx p^{e}(q,\varpi,N) = \frac{e^{-2N\frac{q}{1-q}(\varpi-0.5)^{2}}}{\sqrt{2\pi Nq(1-q)}}.$$

Appendix B

The data from the period 1971-2000 are reproduced from Adamiak (2001). The residual observations pertaining to 2001 have been collected from Noregs Mållag (www.nm.no).

Voter turnout	Advisory (=1)	Electorate	Closeness	Year	County	Municipality	School district
0,863	0	80	0,065	1971	Aust-Agder	Birkenes	Engesland
0,806	0	108	0,121	1971	Aust-Agder	Iveland	Iveland
0,861	0	36	0,081	1971	Aust-Agder	Iveland	Vatnstraum
0,800	0	145	0,095	1971	Oppland	Gausdal	Engjom
0,401	0	724	0,097	1971	Oppland	Sel	Otta
0,750	0	8	0,500	1971	Sør-Trøndelag	Osen	Brattjer
0,140	0	236	0,348	1971	Sør-Trøndelag	Selbu	Innstranda
0,218	0	444	0,345	1971	Sør-Trøndelag	Selbu	Vikvarvet
0,555	0	569	0,032	1971	Telemark	Sauherad	Øvre Sauherad
0,741	0	81	0,100	1972	Aust-Agder	Birkenes	Herefoss
0,941	0	102	0,125	1972	Hedmark	Folldal	Dalen
0,685	0	89	0,057	1972	Møre og Romsdal	Nesset	Vistdal
0,673	0	49	0,015	1972	Nordland	Leifjord	Tverlandet
0,916	0	227	0,101	1972	Nord-Trøndelag	Inderøy	Røra
0,768	0	538	0,113	1972	Oppland	Ringebu	Nord-Fåvang
0,614	0	516	0,153	1972	Oppland	Ringebu	Nord-Vekkom
0,789	0	90	0,021	1972	Oppland	Ringebu	Strand
0,792	0	371	0,316	1972	Oppland	Fron	Ruste
0,400	0	90	0,250	1972	Oppland	Sel	Selsverk
0,724	0	76	0,100	1972	Oppland	Ringebu	Sør-Fåvang
0,878	0	115	0,163	1972	Rogaland	Lund	Hovsherad
0,804	0	209	0,238	1972	Sør-Trøndelag	Rennebu	Berkåk
0,789	0	38	0,233	1972	Sør-Trøndelag	Rennebu	Nerskogen
0,734	0	335	0,037	1972	Vest-Agder	Vegårshei	Vegårshei
0,554	0	148	0,317	1973	Aust-Agder	Gjerstad	Fiane
0,650	0	143	0,210	1973	Aust-Agder	Gjerstad	Sunde
0,649	0	239	0,003	1973	Aust-Agder	Gjerstad	Gjerstad
0,701	0	67	0,011	1973	Aust-Agder	Gjerstad	Ungdomsskulen
0,828	0	180	0,037	1973	Buskerud	Gol	Herad
0,941	0	17	0,500	1973	Møre og Romsdal	Smøla	Edøy
0,963	0	27	0,367	1973	Møre og Romsdal	Molde	Sekken
0,748	0	246	0,125	1973	Møre og Romsdal	Gjemnes	Batnfjordsøra
0,785	0	256	0,027	1973	Møre og Romsdal	Halsa	Halsa/Blekken
0,832	0	149	0,161	1973	Nord-Trøndelag	Levanger	Ekne
0,667	0	18	0,417	1973	Nord-Trøndelag	Nærøy	Lund
0,858	0	106	0,082	1973	Nord-Trøndelag	Levanger	Okkenhaug
0,764	0	237	0,036	1973	Nord-Trøndelag	Inderøy	Sandvollan
0,836	0	152	0,256	1973	Nord-Trøndelag	Snåsa	Breide
0,741	0	135	0,080	1973	Nord-Trøndelag	Levanger	Tuv
0,917	0	12	0,409	1973	Sør-Trøndelag	Snillfjord	Fenes
0,525	0	322	0,311	1973	Sør-Trøndelag	Orkdal	Årlivoll
0,646	0	257	0,072	1973	Vest-Agder	Marnardal	Øyslebø
0,267	0	60	0,313	1974	Hordaland	Bømlo	Espevær
0,681	0	251	0,237	1974	Hordaland	Bømlo	Hillestveit
1,000	0	25	0,020	1974	Møre og Romsdal	Molde	Bolsøya
0,270	0	274	0,243	1974	Rogaland	Randaberg	Grødem
0,914	0	70	0,031	1974	Sør-Trøndelag	Snillfjord	Å
0,818	0	110	0,067	1974	Vest-Agder	Marnardal	Bjelland
0,725	0	149	0,065	1975	Møre og Romsdal	Rindal	Bolme
0,788	0	212	0,063	1975	Møre og Romsdal	Rindal	Rindal
0,862	0	29	0,020	1975	Møre og Romsdal	Rindal	Skogen
0,354	0	353	0,468	1975	Nord-Trøndelag	Steinkjer	Lø
0,413	0	80	0,409	1975	Nord-Trøndelag	Nærøy	Værum
0,377	0	69	0,462	1975	Rogaland	Tysvær	Stegaberg

0,705	0	302	0,303	1975	Sør-Trøndelag	Skaun	Børsa
0,316	0	98	0,113	1975	Sør-Trøndelag	Midtre Gauldal	Hauka
0,629	0	278	0,271	1975	Telemark	Drangedal	Kroken
0,794	0	262	0,024	1976	Møre og Romsdal	Molde	Vågsetra
0,714	0	119	0,076	1976	Nord-Trøndelag	Levanger	Finne
0,776	0	416	0,063	1976	Nord-Trøndelag	Inderøy	Sakshaug
0,835	0	418	0,010	1976	Nord-Trøndelag	Steinkjer	Beitstad
0,877	0	220	0,034	1976	Nord-Trøndelag	Inderøy	Utøy
0,614	0	88	0,204	1976	Oppland	Gausdal	Svatsum
0,273	0	860	0,147	1976	Sør-Trøndelag	Orkdal	Grøtte
0,773	0	66	0,206	1976	Sør-Trøndelag	Rennebu	Havdal/Gisnås
0,738	0	187	0,130	1976	Sør-Trøndelag	Rennebu	Voll
0,150	0	1160	0,374	1977	Møre og Romsdal	Ålesund	Lerstad
0,744	0	203	0,030	1977	Møre og Romsdal	Ålesund	Grimstad/Lorgja
0,861	0	79	0,118	1977	Møre og Romsdal	Nesset	Vistdal
0,955	0	177	0,038	1977	Nord-Trøndelag	Verdal	Ness
0,714	0	21	0,233	1977	Nord-Trøndelag	Verdal	Sul
1,000	0	6	0,500	1977	Nord-Trøndelag	Verdal	Vera
0,948	0	135	0,055	1977	Nord-Trøndelag	Steinkjer	Lysheim
0,699	0	269	0,218	1977	Oppland	Nord-Aurdal	Leira
0,630	0	467	0,272	1977	Rogaland	Randaberg	Goa
0,891	0	211	0,218	1977	Rogaland	Sauda	Austarheim
0,932	0	59	0,027	1977	Rogaland	Rennesøy	Bru/Sokn
0,886	0	140	0,065	1977	Sør-Trøndelag	Skaun	Venn
0,732	0	220	0,140	1977	Sør-Trøndelag	Meldal	Grefstad
0,510	0	147	0,233	1977	Sør-Trøndelag	Meldal	Å
0,860	0	57	0,092	1977	Telemark	Nome	Kjeldal
0,875	0	24	0,357	1977	Telemark	Nome	Kleppe
0,875	0	32	0,393	1977	Telemark	Nome	Svenseid
0,827	0	133	0,155	1978	Buskerud	Rollag	Rollag
0,772	0	193	0,077	1978	Hordaland	Fjell	Knarrevik
0,190	0	990	0,170	1978	Møre og Romsdal	Ålesund	Åse
0,806	0	165	0,192	1978	Møre og Romsdal	Fræna	Malmefjorden
1,000	0	30	0,000	1978	Nordland	Hattfjelldal	Grubben/Hattfjelldal
0,736	0	87	0,219	1978	Nord-Trøndelag	Levanger	Markabygd
0,795	0	210	0,249	1978	Nord-Trøndelag	Levanger	Reithaug
0,752	0	137	0,131	1978	Nord-Trøndelag	Levanger	Tuv
0,951	0	81	0,097	1978	Nord-Trøndelag	Steinkjer	Vålen
0,271	0	634	0,081	1978	Rogaland	Sola	Røyneberg
0,707	0	184	0,246	1978	Rogaland	Gjesdal	Oltedal
0,646	0	277	0,036	1978	Rogaland	Klepp	Orstad
0,756	0	213	0,140	1978	Rogaland	Karmøy	Stokkastrand
0,879	0	182	0,138	1978	Vest-Agder	Songdalen	Finsland
0,800	0	90	0,111	1979	Nord-Trøndelag	Inderøy	Lyngstad
0,738	0	107	0,006	1979	Nord-Trøndelag	Steinkjer	Følling
0,796	0	206	0,177	1979	Rogaland	Eigersund	Helleland
0,853	0	320	0,148	1979	Vest-Agder	Vegårshei	Vegårshei
0,783	0	92	0,208	1980	Aust-Agder	Evje/Hornnes	Lia
0,894	0	104	0,038	1980	Aust-Agder	Froland	Mykland
0,886	0	246	0,018	1980	Møre og Romsdal	Tingvoll	Straumsnes
0,958	0	95	0,005	1980	Nord-Trøndelag	Verdal	Garnes
0,844	0	302	0,010	1980	Nord-Trøndelag	Verdal	Vuku
0,809	0	141	0,088	1980	Sør-Trøndelag	Melhus	Gåsbakken
0,700	0	40	0,036	1980	Sør-Trøndelag	Rennebu	Nerskogen
0,982	0	109	0,089	1981	Hedmark	Folldal	Dalen
0,764	0	441	0,337	1981	Nord-Trøndelag	Steinkjer	Beitstad
0,778	0	90	0,257	1981	Nord-Trøndelag	Steinkjer	Moen
0,770	0	226	0,052	1981	Nord-Trøndelag	Steinkjer	Skarpnes
0,856	0	111	0,058	1981	Nord-Trøndelag	Steinkjer	Flekstad
0,804	0	240	0,070	1981	Oppland	Ringebu	Kjønås
0,923	0	91	0,333	1981	Sør-Trøndelag	Midtre Gauldal	Hauka
0,736	0	292	0,095	1981	Sør-Trøndelag	Midtre Gauldal	Soknedal
0,689	0	196	0,070	1981	Sør-Trøndelag	Rennebu	Voll
0,897	0	78	0,086	1981	Telemark	Sauherad	Hjuksebø

0,773	0	181	0,086	1981	Telemark	Sauherad	Øvre Sauherad
0,663	0	89	0,127	1982	Hordaland	Fjell	Bjorøy
0,822	0	309	0,020	1982	Møre og Romsdal	Molde	Vågsetra
0,776	0	58	0,122	1982	Sør-Trøndelag	Snillfjord	Ven
0,240	0	329	0,386	1983	Hordaland	Bergen	Hjellestad
0,261	0	403	0,443	1983	Hordaland	Bergen	Kaland
0,886	0	149	0,129	1983	Hordaland	Bergen	Krokeide
0,143	0	742	0,491	1983	Hordaland	Bergen	Søreide
0,304	0	392	0,130	1983	Hordaland	Bergen	Haukås
0,300	0	510	0,278	1983	Hordaland	Bergen	Liland
0,675	0	280	0,225	1983	Møre og Romsdal	Aukra	Riksfjord
0,788	0	52	0,061	1983	Nordland	Vestvågøy	Valberg
0,473	0	368	0,098	1983	Rogaland	Gjesdal	Berland
0,878	0	98	0,093	1983	Sør-Trøndelag	Skaun	Viggja
0,878	0	148	0,185	1983	Sør-Trøndelag	Meldal	Å
0,771	0	327	0,139	1983	Sør-Trøndelag	Orkdal	Årlivoll
0,718	0	71	0,147	1983	Telemark	Drangedal	Brødsjø
0,790	0	62	0,010	1983	Telemark	Drangedal	Henseid
0,962	0	52	0,020	1984	Møre og Romsdal	Gjemnes	Heggem
0,668	0	313	0,117	1984	Nord-Trøndelag	Verdal	Stiklestad
0,838	0	197	0,155	1984	Nord-Trøndelag	Inderøy	Utøy
0,806	0	144	0,026	1984	Nord-Trøndelag	Steinkjer	Røysing
0,905	0	190	0,041	1984	Vest-Agder	Songdalen	Finsland
0,700	1	257	0,094	1985	Hordaland	Bergen	Nordvik
0,145	1	1131	0,110	1985	Møre og Romsdal	Ålesund	Spjelkavik
0,821	0	212	0,126	1985	Møre og Romsdal	Tingvoll	Straumsnes
0,865	1	260	0,113	1985	Møre og Romsdal	Sunndal	Løykja
0,906	0	106	0,156	1985	Nord-Trøndelag	Snåsa	Breide
0,559	1	929	0,034	1985	Nord-Trøndelag	Høylandet	Høylandet
0,868	0	114	0,126	1985	Nord-Trøndelag	Steinkjer	Sem
0,191	1	209	0,400	1985	Nord-Trøndelag	Verdal	Sør-Leksdal
0,560	1	550	0,136	1985	Oppland	Lesja	Lesjaskog
1,000	0	66	0,106	1985	Oppland	Ringebu	Sør-Fåvang
0,684	1	212	0,052	1985	Telemark	Drangedal	Henseid
0,864	0	206	0,219	1985	Vest-Agder	Sirdal	Tonstad
0,443	1	271	0,008	1986	Aust-Agder	Åmli	Nelaug
0,560	1	464	0,085	1986	Møre og Romsdal	Rindal	Bolme
0,499	1	757	0,032	1986	Møre og Romsdal	Rindal	Rindal
0,534	1	163	0,109	1986	Møre og Romsdal	Rindal	Skogen
0,554	1	224	0,161	1986	Møre og Romsdal	Rindal	Lomundsjø
0,618	1	246	0,007	1986	Nord-Trøndelag	Verdal	Nord-Leksdal
0,526	1	1400	0,130	1986	Oppland	Nord-Fron	Sødorp
0,648	1	125	0,241	1986	Sør-Trøndelag	Rennebu	Nerskogen
0,737	1	338	0,155	1986	Vest-Agder	Marnardal	Bjelland
0,365	1	941	0,083	1987	Hordaland	Fjell	Foldnes
0,356	1	59	0,405	1987	Møre og Romsdal	Nesset	Gussiås
0,743	1	338	0,157	1987	Nord-Trøndelag	Verdal	Garnes
0,323	1	1811	0,119	1987	Nord-Trøndelag	Steinkjer	Mære
0,388	1	183	0,106	1987	Nord-Trøndelag	Steinkjer	Rygg
0,182	1	2165	0,115	1987	Rogaland	Sola	Stangeland
0,867	1	369	0,003	1987	Vest-Agder	Marnardal	Laudal
0,601	1	409	0,102	1988	Oppland	Gausdal	Svatsum
0,861	1	144	0,073	1988	Rogaland	Rennesøy	Bru
0,274	1	1781	0,246	1988	Rogaland	Sauda	Fløgstad
0,274	1	1000	0,245	1988	Telemark	Notodden	Rygi
0,630	1	827	0,118	1989	Hordaland	Bergen	Nordvik
0,766	1	304	0,178	1989	Møre og Romsdal	Rauma	Innfjord
0,539	1	334	0,083	1989	Møre og Romsdal	Rindal	Skogen/Løfall
0,381	1	755	0,007	1989	Sør-Trøndelag	Rennebu	Voll
0,392	1	375	0,051	1990	Telemark	Drangedal	Brødsjø
0,357	1	675	0,073	1990	Telemark	Drangedal	Kroken
0,706	1	524	0,189	1990	Vest-Agder	Audnedal	Byremo
0,609	1	481	0,145	1991	Buskerud	Rollag	Rollag
0,358	1	1254	0,119	1991	Møre og Romsdal	Nesset	Eidsvåg

0,520	1	256	0,169	1991	Nord-Trøndelag	Verdal	Nord-Leksdal
0,098	1	4127	0,204	1991	Rogaland	Gjesdal	Ålgård
0,527	1	486	0,156	1991	Vest-Agder	Kvinesdal	Gjemlestad
0,222	1	1466	0,149	1993	Hordaland	Bergen	Kyrkjekr.
0,363	1	936	0,015	1993	Nord-Trøndelag	Verdal	Vuku
0,420	1	443	0,075	1993	Oppland	Nord-Aurdal	Vestringb.
0,384	1	1780	0,087	1993	Rogaland	Karmøy	Vedavågen
0,285	1	1021	0,098	1994	Aust-Agder	Gjerstad	Gjerstad
0,381	1	352	0,075	1994	Nord-Trøndelag	Steinkjer	Flekstad
0,501	1	728	0,070	1994	Sør-Trøndelag	Rennebu	Voll
0,529	1	255	0,004	1995	Aust-Agder	Åmli	Nelaug
0,598	1	850	0,051	1995	Telemark	Drangedal	Kroken
0,547	1	825	0,032	1996	Møre og Romsdal	Gjemnes	Batnfjord
0,510	1	886	0,277	1996	Rogaland	Rennesøy	Bru/Mosterøy
0,989	1	280	0,132	1997	Buskerud	Rollag	Rollag
0,647	1	300	0,000	1997	Hedmark	Folldal	Dalen
0,129	1	2700	0,174	1997	Hordaland	Bergen	Ådnamarka og
0,327	1	150	0,235	1997	Møre og Romsdal	Aure	Nordlandet
0,191	1	1280	0,357	1997	Oppland	Ringebu	Vekkom
0,761	1	347	0,042	1997	Rogaland	Lund	Heskestad
0,537	1	1203	0,305	1997	Rogaland	Rennesøy	Rennesøy
0,608	1	347	0,002	1997	Sør-Trøndelag	Skaun	Jåren-Råbygda
0,358	1	424	0,059	1997	Telemark	Tinn	Bøen
0,654	1	405	0,006	1997	Vest-Agder	Marnardal	Laudal
0,656	1	500	0,070	1997	Vest-Agder	Kvinesdal	Vesterdalen
0,480	1	829	0,080	1998	Nord-Trøndelag	Verdal	Vuku
0,070	1	3053	0,308	1999	Rogaland	Sola	Sande
0,058	1	3053	0,110	1999	Rogaland	Sola	Stangeland
0,911	1	90	0,037	1999	Vest-Agder	Audnedal	Byremo
0,750	1	152	0,246	2000	Aust-Agder	Gjerstad	Gjerstad
0,960	1	25	0,042	2000	Buskerud	Hol	Skurdalen
0,547	1	633	0,191	2000	Hordaland	Bergen	Liland
0,465	1	480	0,025	2000	Møre og Romsdal	Ålesund	Flisnes
0,389	1	126	0,357	2000	Nord-Trøndelag	Steinkjer	Skarpnes
0,733	1	86	0,151	2000	Nord-Trøndelag	Steinkjer	Flekstad
0,444	1	365	0,302	2000	Nord-Trøndelag	Steinkjer	Mære
0,813	1	48	0,218	2000	Nord-Trøndelag	Verdal	Volden
1,000	1	48	0,083	2000	Nord-Trøndelag	Steinkjer	Vålen
0,714	1	161	0,013	2000	Rogaland	Sandnes	Sviland
0,331	1	800	0,013	2000	Rogaland	Sola	Håland
0,668	1	205	0,113	2000	Telemark	Notodden	Rygi
0,680	1	125	0,018	2000	Telemark	Notodden	Yli
0,811	1	106	0,244	2000	Vest-Agder	Kvinesdal	Vesterdalen
0,841	1	82	0,094	2000	Vest-Agder	Hægebostad	Kollemo
0,258	1	322	0,283	2001	Hordaland	Bergen	Nordvik
0,181	1	1781	0,186	2001	Møre og Romsdal	Fræna	Haukås
0,312	1	1185	0,073	2001	Oppland	Etnedal	Etnedal
0,529	1	736	0,071	2001	Rogaland	Sandnes	Sviland