A Spatial Model of Electoral Platforms

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Abstract

The reconstruction of political positions of parties, candidates and governments has made considerable headway during the last decades, not the least due to the efforts of the *Manifesto Research Group* the and *Comparative Manifestos Project*, which compiled and published a data set on the electoral platforms of political parties from most major democracies for most of the post-war era. A central assumption underlying the coding of electoral platforms into quantitative data as done by the MRG/CMP is that parties take positions by selective emphases of policy objectives, which put their accomplishments in a most positive light (Budge 2001) or are representative for their current polital/ideological positions. Consequently, the MRG/CMP data consist of percentages of the respective manifesto texts that refer to various policy objectives.

As a consequence both of this underlying assumption and of the structure of the CMP data, methods of classical multivariate analysis are not well suited to these data, due to the requirements to the data for an appropriate application of these methods (van der Brug 2001; Elff 2002). The paper offers an alternative method for reconstructing positions in political spaces based on latent trait modelling, which both reflects the assumptions underlying the coding of the texts and the peculiar structure of the data. Finally, the validity of the proposed method is demonstrated with respect to the average position of party families within reconstructed policy spaces. It turns out that communist, socialist, and social democrat parties differ clearly from "bourgeois" parties with regards to their positions on an economic left/right dimension, while British and Scandinavian conservative parties can be distinguished from Christian democratic parties by their respective positions on a libertarian/authoritarian and a traditionalist/modernist dimension. Similarly, the typical political positions of green (or "New Politics") parties can be distinguished from the positions of other party families.

1 Introduction

Political positions of parties play a central role in many areas of research in comparative politics. In contemporary research on the formation and duration of coalition governments, political positions of potential coalition member parties play a vital role (e.g. Laver and Hunt 1992). Also, the full potential of spatial models of voting can be realized only if measures of candidates' and parties' political positions are used that are independent of the voters' perceptions. Without such independent measures, spatial analyses of voting may fall victim to post-hoc rationalizations of the voters' decisions. Also most spatial theory of party competition relies on "objective" positions of the parties, while voters' uncertainty about parties positions usually serves as a modifier of the consequences of parties' positions for voting behavior.

When it comes to finding measures of parties', candidates', or governments' political positions, most of the extant literature relies on two types of sources: expert surveys and political texts. Expert surveys are based on ratings of parties or candidates by politicians, political scientists or other politics experts, usually based on a pre-determined scale Castles and Mair (1984); Huber and Inglehart (1995). While this may produce data immediately ready for quantitative analysis, this method suffers from a series of shortcomings. First, ratings may be affected by biases in the selection of the raters and the perception of the rated objects by the raters. Second, by virtue of the pre-determined rating scale, expert survey measurements often rest on untested or untestable assumptions regarding the dimensionality of the political space and the nature of its primary dimensions. Third, expert surveys usually deliver a temporal snapshot of parties' or candidates' positions and seldom include estimates of positions further back in time. Methodological considerations notwithstanding, the utility of expert surveys for dynamic analyses of political competition is thus severely limited. At least the last of these shortcomings clearly does not apply to reconstructions of political positions based on texts. Past political positions of parties or candidates can be reconstructed to the degree that the appropriate documents are available in historical records. There may be an availability bias in these records, to the degree that small parties or unsuccessful candidates are not considered in collections of historical documents, but at least in principle such biases can be tackled by increased efforts in recovering historical documents.

Among the approaches at reconstructing political positions from texts one may roughly distinguish between approaches based on classifying sentences or other semantic units of texts into a series of predetermined categories, and approaches directly working on word counts Laver *et al.* (2003); Klemmensen *et al.* (2007). Word count approaches have gained some popularity during the last couple of years, owing to the recent availability of easy-to-use software for automatically generating such word counts. While some argue that word-count based reconstruction of political positions are at least competitive to sentence-

classification based reconstructions, the word-count approaches have not yet gained the same acceptance in the political science community as sentence-based approaches. One reason may be the wide availability of the data produced by the *Manifesto Research Group* and the *Comparative Manifesto Project*, which are based a sentence-classification approach (Budge *et al.* 1987, 2001).

The *Manifesto Research Group* (MRG) was an research network of political science scholars that started collecting most of the electoral platforms (or in British parlance: party manifestos) of 20 post-war democracies for almost the whole post-war period and preparing them for quantitative analysis (Budge *et al.* 1987). This work was later continued by the *Comparative Manifestos Project* located at the Social Science Research Center in Berlin (WZB) (Budge *et al.* 2001). The texts of the collected electoral platforms were split into sentences or "quasi-sentences" and these were classified according to which of 56 predetermined policy objectives are (positively or negatively) mentioned in them. Based on these classifications, several editions of a data set were produced, which contains the percentage of the total text of each covered electoral platforms that deals with these policy objectives, along with some other information concerning the party that issued the platform, the date of the election gave the occasion, and the total number of sentences or "quasi-sentences" comprised.

Based on MRG/CMP data, several attempts have been made at reconstructing one or more general ideological dimensions of parties political positioning, mainly based either on principal components analysis or related methods (Bartolini and Mair 1990; Gabel and Huber 2000), additive-subtractive indices (Budge *et al.* 2001), or weighted additive-subtractive indices (Laver and Garry 2000). However, such linear approaches at reconstructing ideological dimensions based on CMP data overlook the fact that the relations among the variables in the CMP data are are intrinsically non-linear (van der Brug 2001; Elff 2002). Figure 1 illustrates this for the case of the relation between the percentages of mentions of the policy objective "Controlled economy" and the policy objective of protecting "Free enterprizes" — two clearly diverging policy objectives, one representing traditional state-centered socialism and one representing *laissez-faire* market liberalism. In a "linear world" the correlation between the emphases of these objectives should be strongly negative. However, the correlation between the percentages that correspond to these objectives in electoral platforms is very close to zero. The scatter plot of figure 1 suggests that this is mainly due to the highly non-linear relation between these two variables, and that this non-linear relation itself owes to the simple fact that percentages cannot be negative.

While some corrections for these non-linearities have already been proposed in the literature (van der Brug 2001; Elff 2002), they still lack a justification in terms of a formal and statistical model. In the present paper, I attempt to fill this gap by constructing a model

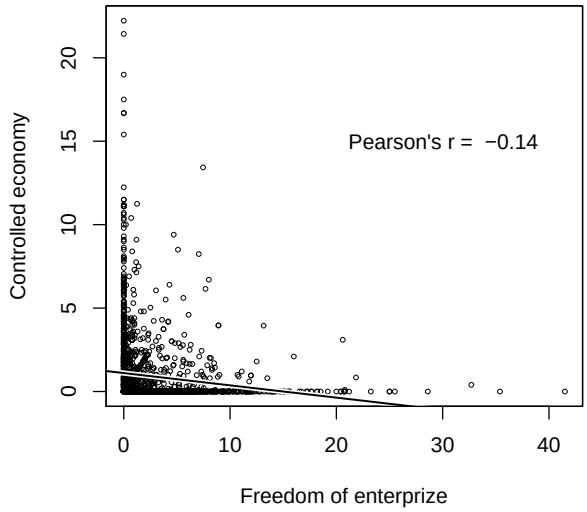

Figure 1: Percentages of sentences emphasizing the policy objectives "controlled economy" and "freedom of enterprize" in electoral platforms of parties from 25 countries, 1945-1998. *Data source:* CMP Dataset, CD-ROM included with Budge *et al.* (2001).

that explicitly connects parties' positions in political spaces to the frequency in which they mention various policy objectives in their electoral platforms. In the next section, I present some substantive considerations that motivate the construction of the model. In the succeeding section, the model is formally developed and the statistical estimation of its parameters is discussed. That section is followed by one that describes the reconstruction of parties' political positions from the spatial model fitted to the MRG/CMP data. The next to last section presents findings with regards to the average positions of party families on an economic left-right dimension, on a liberal-authoritarian dimension and on a modern-traditionalist political dimension. The paper is concluded with a summary of the results and some speculations about future directions of research.

2 Political positions and the emphasis of policy objectives

According to Budge (Budge *et al.* 2001), the coding of electoral platforms into quantitative data is guided by the "valency and saliency theory" of party competition (Robertson 1976; Budge and Farlie 1983a). The assumptions of this theory are summarized by Budge (in Budge *et al.* 2001: 82) as follows:

1. Party strategists see electors as overwhelmingly favoring one course of action on most issues. Hence all party programmes endorse the same position, with only minor exceptions.
2. Party strategists also think that electors see one party as more likely that the others to carry through the favored course of action.
3. Hence each party has a set of issues that 'belong' to it, in the sense that the centrality of these issues in an election will increase its vote.
4. A party therefore emphasizes its 'own' issues in its election programme, in an attempt to increase the salience of these for voters. It emphasizes 'rival' issues less or not at all.
5. Policy differences between parties thus consist of contrasting emphases placed on different policy areas.

Thus, instead of directly confronting each other on controversial issues, parties use their platforms to "talk past each other" in order to avoid to mention issues that are disadvantageous and to mention only those issues that they "own".

Prima facie, assumptions such as these are necessary to justify the relatively low proportion of coding categories employed by the MRG/CMP that explicitly oppose a specific objective or state of affairs. Also, in Budge's view the "valency and saliency theory" is well corroborated both by results of analyses of the manifesto data and by results of other scholars (Budge *et al.* 2001: 82–83). However, some critical reflections may lead to the conclusion that, on the one hand, these assumptions *contradict* rather than justify the use of MRG/CMP data to determine parties' genuine political or ideological positions — quite in contrast to the common use of these data to assign left-right positions to political parties. On the other hand, these assumptions are neither completely plausible nor are they necessary to justify the use of the MRG/CMP coding procedures for manifesto texts.

The first assumption explicitly states that all party platforms endorse the same position while the other assumptions state that differences between platforms of different parties come about by different nuances of this common position. Further, these nuances are mainly instrumental, so as to gain the most votes by emphasizing one's own strengths by virtue of "issue ownership." If these assumptions were true, then electoral platforms and party programmes might be used to explain and predict election results (Budge and Farlie 1983b), but using them to reconstruct genuine political/ideological positions of various political parties would be a hopeless endeavor, as there would not be any differences in the positions to begin with.

Unless one stretches the meaning of the concept of valence issue to a degree that its delimitation to the concept of position issue vanishes, one can hardly state that the most issues are valence issues without being challenged by numerous and prominent counterexamples. For example, both supporters and opponents of legalized abortion may frame their arguments as the positive affirmation of certain values, culminating in the phrases "pro-life" and "pro-choice", but rhetoric devices aside, the contrasting positions

on issues like this are more than just different emphases of different items form the same bundle of consensual values. Even if one grants that most parties, extremist parties aside, mention in their platforms subsets of the same set of basic values, this does not mean that they all endorse essentially the same position. Avoiding explicitly confrontative statements does not imply that different priorities among the same set of values does not preclude that these priorities express opposing ideological positions.

Downs characterizes of ideologies as "a verbal image of the good society and of the chief means of constructing such a society" (Downs 1957: 96). Thus, insofar as an ideology can be seen as a description of a desirable state of social affairs or of the good society, either as an utopian ideal or an idealized version of the status quo, it specifies goals. Extremist ideologies, on the one hand, may be characterized as centering on a single objective or a small collection of intertwined goals that may even take priority over human rights. Moderate ideologies, on the other hand, may be characterized as striking a balance of possible diverging objectives that nevertheless each correspond to important social or human values. Such qualifications notwithstanding, espousing an ideology usually will mean emphasizing a set of goals.

While this line of argument makes clear that different political and ideological positions will be expressed in different emphases of different political objectives, the emphasis of political objectives may also vary other grounds. The *salience* of more general areas of policy may vary over time (Laver 2001): For example, while in times of prosperity economic objectives may be important for the political discussion and have less appeal to voters, conflicts in the field of economic policy may heighten in times of recession, massive state deficits or inflation. The distinction between the emphasis of a policy objective as a means to espouse a political-ideological position and its emphasis because of the salience of a general range of policy problems suggests, that the 56 policy objectives considered by the MRG/CMP data can be grouped into *policy areas*. For example, those policy objectives denoted by the MRG/CMP as "freedom of enterprize" or "control of the economy" are (contrasting) objectives that both can be assigned to the broader area of economic policy.

Thus, if p_{ij} is the percentage of sentences/quasi-sentences of electoral platform j that mention the policy objective i, and if each policy objective belongs to one of several broader policy areas $a_1, \ldots, a_A$ then the sum of the percentages $s_a = \sum_{k \in a} p_{kj}$ is a natural measure of the salience of policy area a. On this base, it is possible to use the relative emphasis $r_{ij} := p_{ij}/s_a$ (if $i \in a$) as a "salience-corrected" measure of the emphasis of political objective i. Thus, Laver and Garry (2000) propose to use differences of such relative emphasis percentages rather than of raw emphasis percentages as measures of economic left-right positions and of non-economic, social left-right positions.

In spatial models of politics, policy alternatives or political outcomes are represented in a one- or multidimensional Euclidean space. Also the preferences of political actors

are represented by positions in this space in terms of their idealpoints: The alternative or outcome that represents the idealpoint is preferred over all other alternatives/outcomes, and from any pair of alternatives/outcomes, the one nearer the idealpoint is preferred over the other alternative/outcome. Usually, actors' preferences are formally represented by utility functions, such that for any pair of alternatives/outcomes, the one that is preferred over the other is assigned the higher value of the utility function. The utility of alternatives/outcomes for an actor consequently declines with their distance from the actor's ideal point. Often, it is assumed that utility of an alternative/outcome is related to the negative square of its distance to the actor's ideal point.

One may argue that the assumption of spatial models of political choice are not applicable to electoral platforms and the objectives that are adressed in them. First, parties may emphasize multiple objectives in their platforms, whereas a choice for one alternative is also a choice against the other alternatives. Second, models of political choice often view choices as instrumental, whereas the objectives addressed in electoral platforms may at least in some cases be regarded by the parties as ends in themselves. But on the base assumptions such as the following, a spatial model of electoral platform may nevertheless be substantively motivated:

1. Each broader policy area can be represented as a separate policy space. Each policy objective corresponds to a unique position in *one and only one* of these policy spaces.

2. By virtue of issuing an electoral platform, a party takes up a position in *each* of these policy spaces.

3. The probability that a policy objective from a specific policy area is mentioned in an electoral platform increases with the salience of the policy area.

4. Conditional on the salience of the policy area in question, the probability that a specific objective from this policy area is mentioned in an electoral platform increases with the the centrality of this objective for the current political position of the party, that is, the probability increases with the proximity of position of the policy objective to the parties' current political position.

Simple sum-and-difference scores (Budge *et al.* 2001) do not take into account the varying salience of different policy areas. Further, both simple and weighted sum-and-difference scores (Laver and Garry 2000) presuppose very strict assumptions about the distribution of policy objectives in a policy space. Suppose, for example, that objectives "nationalization" (government ownership of business enterprizes), "control of the economy", "economical planning", and "market regulation" are classified as "leftist" objectives in terms of economic policy, while objectives "freedom of enterprizes", "incentives", and "economic orthodoxy" (that is, monetary stability and budget retrenchment) are classified

as "rightist" objectives. If one constructs a left-right by computing a simple sum-difference score

$$LEFTRIGHT = (L_1 + L_2 + L3 + L4) - (R_1 + R_2 + R_3)$$

or a weighted sum-difference score

$$LEFTRIGHT = \frac{(L_1 + L_2 + L3 + L4) - (R_1 + R_2 + R_3)}{(L_1 + L_2 + L3 + L4) + (R_1 + R_2 + R_3)}$$

where L_1, L_2, L_3, L_4 denote the percentages of (quasi-)sentences that mention the first, second, third, and fourth "leftist" economic policy objective, respectively, and R_1, R_2, R_3 denote the respective percentages corresponding to mentioning the three "rightist" economic policy objectives, then one implicitly assumes all leftist and all rightist positions have the same distance from each political position indicated by the sum-difference-scores. If it were not for the non-linearity problems illustrated in the introduction of this paper, principle components analysis (Bartolini and Mair 1990; Gabel and Huber 2000) could be used to assign appropriate weights to these percentages. Even better, metric multidimensional unfolding (Schönemann 1970) could be used to directly recover the positions of both parties and policy objectives, if these percentages could be interpreted as proximities, that is, if their negatives could be interpreted as distances.

Yet for two reasons, percentages of sentences mentioning policy objectives cannot be linearly related to proximities between policy objectives and political positions in an Euclidean political space. First, in an Euclidean space linear relations among the distances between objectives and positions would be determined by the distances among the objectives and among the positions. Percentages, however, sum to one hundred by definition. Second, in a Euclidean space, there are no finite bounds to distances between points. But percentages are bounded between zero and one hundred by definition. These considerations suggest that there is a non-linear relation between the distances and the percentages, or, more in line with the assumptions proposed above, that there is a non-linear relation between the distances and the probabilities that lead to these percentages.

Put formally, I propose the following: Suppose there are policy objectives $i = 1, \ldots, I$ in a given policy area and parties $j = 1, \ldots, J$ publish electoral platforms on occasion of elections that take place at at $1 + K_j$ different points in time $t = t_{jk}, k = 0, \ldots, K_j$ (the parties may come from different countries, where the elections are held at different times). Both the policy objectives and the electoral platforms can be represented by points in a Euclidean space with D dimensions $d = 1, \ldots, D$. Call the positions of the policy objectives $\boldsymbol{\alpha}_i = (\alpha_{1i}, \ldots, \alpha_{Di})'$, the positions taken by the parties $\boldsymbol{\beta}_{jt} = (\beta_{1jt}, \ldots, \beta_{Djt})'$, the (directed) Euclidean distances between objectives and platforms $\boldsymbol{\alpha}_i - \boldsymbol{\beta}_{jt} = \boldsymbol{\Delta}_{ijt}$, and the squared absolute distances $\eta_{ijt} = \boldsymbol{\Delta}'_{ijt}\boldsymbol{\Delta}_{ijt} = ||\boldsymbol{\alpha}_i - \boldsymbol{\beta}_{jt}||^2 = \eta(\boldsymbol{\alpha}_i, \boldsymbol{\beta}_{jt})$. Then, I assume that

the probability π_{ijt} that party j uses a quasi-sentence mentioning policy objective i in its electoral platform issued at occasion t is given by

$$\pi_{ijt} = \frac{\mathrm{e}^{-\eta_{ijt}}}{\sum_k \mathrm{e}^{-\eta_{kjt}}}. \tag{1}$$

I further assume that the number y_{ijt} of (quasi-)sentences in an electoral platform published by party j at occasion t has a multinomial distribution with size n_{jt} and probability parameters $\pi_{1jt}, \ldots, \pi_{Ijt}$. These counts y_{ijt} can easily recovered from the percentages p_{ijt} in the MRG/CMP data since these data also contain the total number of encoded quasi-sentences of each manifesto.

The coordinates α_{di} of positions of policy objectives and the coordinates β_{djt} of positions of platforms could be interpreted as parameters of a statistical model so that the counts y_{ijt} have log-likelihood

$$\ell(\boldsymbol{\theta}|\boldsymbol{y}) = -\sum_i \sum_j \sum_t y_{ijt}\eta(\boldsymbol{\alpha}_i, \boldsymbol{\beta}_{jt}) - \sum_j \sum_t n_{jt} \ln\left(\sum_i \mathrm{e}^{-\eta(\boldsymbol{\alpha}_i, \boldsymbol{\beta}_{jt})}\right) + \sum_j \sum_t \ln \frac{n_{jt}!}{y_{1jt}! \cdots y_{Ijt}!} \tag{2}$$

(where $\boldsymbol{\theta}$ denotes the parameter vector formed of all scalar parameters α_{di}, β_{djt}, $\boldsymbol{\alpha}_i$ and $\boldsymbol{\beta}_{jt}$ are formed for the appropriate sets of these scalar parameters, and $\boldsymbol{y}$ is the vector formed of all observed counts y_{ijt} of sentences referring to specific policy objectives in the platforms.) It now seems that the positions of policy objectives and of platforms can be directly estimated using the method of maximum likelihood. Unfortunately, such a direct approach is not possible. First, distances are rotationally invariant. Consequently, there is no unique set of maximum likelihood estimates for α_{di} and β_{djt}: If $\hat{\boldsymbol{\alpha}}_i$ and $\hat{\boldsymbol{\beta}}_{jt}$ maximize the log-likelihood 2 and $\boldsymbol{Q}$ is a $(d \times d)$ orthogonal matrix, then $\boldsymbol{Q}\hat{\boldsymbol{\alpha}}_i$ and $\boldsymbol{Q}\hat{\boldsymbol{\beta}}_{jt}$ also maximize the log-likelihood. Second, some experiments with a direct ML approach have shown that, because

$$\frac{\mathrm{e}^{-\eta_{ijt}}}{\sum_k \mathrm{e}^{-\eta_{kjt}}} = \frac{\mathrm{e}^{c_{jt}-\eta_{ijt}}}{\sum_k \mathrm{e}^{c_{jt}-\eta_{kjt}}} \tag{3}$$

for any finite c_{jt}, the model suffers from a further (non-linear) identification problem. Third, since in the direct ML approach a distinct set of parameters $\beta_{1jt}, \ldots, \beta_{Djt}$ corresponds to each party platform, the number of parameters increases with the number of available data points. Consequently, consistent estimation is possible only for $n_{jt} \to \infty$ (the size of the platforms increases without bounds), but not for $j \to \infty$ and $t \to \infty$ (more platforms are added to the data set ad infinitum). Fourth, this model does not make use of the information that β_{djt} and β_{djt+1} are political positions of the *same* party at different points in time.

To use a direct maximum likelihood approach is thus neither feasible nor advisable. Instead I propose to consider the positions of the platforms not as parameters of the model

but as unobserved data or as *latent traits*, and to put certain a-priori constraints on the positions of the policy objectives. How such a model is constructed and how its parameters are estimated is discussed in the next section.

3 A latent data model of political positions

There are at least two different ways to deal with incidental parameters, that is, of parameters whose numbers increase with the data. The first strategy is to reformulate the statistical model in such a way that it conditions for the sufficient statistics of the incidental parameters. In the context of maximum likelihood estimation, this strategy depends on that the likelihood can appropriately factored (Lindsey 1996). An example of this strategy is the move from log-linear models to logit models in the context of contingency table analysis (Agresti 2002). Unfortunately, this strategy is not available for the case at hand. A second strategy of dealing with incidental parameters is to reformulate the statistical model in such a way that it contains unobserved data instead of incidental parameters. The most prominent example of this strategy is the use of random-effects or mixed-effects models (these models are also known as, dependent of the respective authors' continent of origin, as "hierarchical" or "multi-level" models). This strategy is also used in the present paper to get rid of the incidental parameters embodied in the electoral platform position parameters β_{djt} in the model introduced in the previous section. Instead of considering the positions of parties as parameters, they are treated as "unobserved data" or latent traits, which have a specific probability distribution.

Apart from the elimination incidental parameters, the move from representing parties' positions as parameters to representing them as random latent traits has the additional advantage to allow for taking into account the information contained in the fact that parties issue several electoral platforms on several occasions: When parties take a position on occasion $t = 1, \ldots, T_j$ the position at an earlier occasion $t - 1$ may have been a point of departure for the "new" the position taken t, that is, the positions of the same party form a *random walk*. This random walk, however, does not extend, as usually assumed in typical time-series analysis, infinitely into the past. Rather, there is a point in time where either the party took part in an election for the first time or where its electoral platform was firstly observed (which is denoted as $t = 0$). These first observed positions could also be assumed as latent traits.

Thus I propose the following assumptions about the parties' positions:

1. Let b_{djt_0} denote the position of party $j = 1, \ldots, J$, on dimension $d = 1, \ldots, D$ on a given policy space, when its electoral platform was observed for the first time. These initial positions of the parties have a normal distribution with mean zero and variance σ^2_{0d}.

2. Let b_{djt} denote the position of party j at occasion $t = 1, \ldots, T_j$ on dimension d of a given policy space. This position depends on an the position on an earlier occasion according to

$$b_{djt} = b_{djt-1} + \epsilon_{djt} \tag{4}$$

where ϵ_{djt} is a random error with normal distribution with mean zero and variance σ^2_{1d}.

This way of avoiding incidental parameters comes at a price, however. While the number of parameters is delimited, first, by the number of policy objectives that span the political space and, second, by the dimensionality of the political space, the log-likelihood of the latent-data model does no longer retain the relatively simple form of equation (2). Rather, the likelihood or log-likelihood function that is to be maximized in order to estimate the parameters α_{di}, σ^2_{0d} and σ^2_{1d} of the model involves a multidimensional integral: If the (latent) political positions b_{djt} were available, the *complete data* log likelihood would be of the form

$$\begin{aligned}\ell(\boldsymbol{\theta}|\boldsymbol{y},\boldsymbol{b}) = &\sum_i \sum_j \sum_t y_{ijt}\eta(\boldsymbol{\alpha}_i,\boldsymbol{b}_{jt}) - \sum_j \sum_t n_{jt} \ln\left(\sum_i \mathrm{e}^{\eta(\boldsymbol{\alpha}_i,\boldsymbol{b}_{jt})}\right) + \sum_j \sum_t \ln \frac{n_{jt}!}{y_{1jt}! \cdots y_{Ijt}!} \\ &+ \sum_j \left(\frac{1}{2}\ln|\boldsymbol{\Omega}_j| - \frac{1}{2}\boldsymbol{b}_j'\boldsymbol{\Omega}_j\boldsymbol{b}_j\right)\end{aligned} \tag{5}$$

(where $\boldsymbol{\Omega}_j$ is a matrix that depends on σ^2_{0d} and σ^2_{1d}, see the appendix for details). Since parties' positions are unobserved data one needs to use instead the marginal or *observed data* log-likelihood for the estimation of the model parameters, which is of the form:

$$\ell(\boldsymbol{\theta}|\boldsymbol{y}) = \sum_j \ln \int_{\mathcal{R}_{m_j}} \mathrm{e}^{\ell(\boldsymbol{\theta}|\boldsymbol{y}_j,\boldsymbol{b}_j)}\,\mathrm{d}\,\boldsymbol{b}_j \tag{6}$$

where $\ell(\boldsymbol{\theta}|\boldsymbol{y}_j,\boldsymbol{b}_j)$ is the complete data log-likelihood contribution of all electoral platforms of party j, $\boldsymbol{y}_j$ is the corresponding vector of sentence counts, and $\boldsymbol{b}_j$ is the vector composed of the positions of party j, $\mathcal{R}_{m_j}$ is the m_j-dimensional Cartesian product of the real line, and $m_j := (T_j + 1) \cdot D$ is the length of $\boldsymbol{b}_j$, D is the dimensionality of the policy space, $(T_j + 1)$ is the number of electoral platforms of party j. The first and second derivatives of this marginal log-likelihood are:

$$\frac{\partial \ell(\boldsymbol{\theta}|\boldsymbol{y})}{\partial \boldsymbol{\theta}} = \sum_j \int_{\mathcal{R}_{m_j}} \frac{\frac{\partial}{\partial \boldsymbol{\theta}}\ell(\boldsymbol{\theta}|\boldsymbol{y}_j,\boldsymbol{b}_j)}{\int_{\mathcal{R}_{m_j}} \mathrm{e}^{\ell(\boldsymbol{\theta}|\boldsymbol{y}_j,\boldsymbol{b}_j)}\,\mathrm{d}\,\boldsymbol{b}_j}\,\mathrm{d}\,\boldsymbol{b}_j = \sum_j \mathrm{E}_{\boldsymbol{b}_j}\left(\frac{\partial \ell(\boldsymbol{\theta}|\boldsymbol{y}_j,\boldsymbol{b}_j)}{\partial \boldsymbol{\theta}}\,\middle|\,\boldsymbol{y}_j\right) \tag{7}$$

and

$$\begin{aligned}\frac{\partial^2}{\partial\boldsymbol{\theta}\partial\boldsymbol{\theta}'}\ell(\boldsymbol{\theta}|\boldsymbol{y}) = &\sum_j \mathrm{E}_{\boldsymbol{b}_j}\left(\left.\frac{\partial^2\ell(\boldsymbol{\theta}|\boldsymbol{y}_j,\boldsymbol{b}_j)}{\partial\boldsymbol{\theta}\partial\boldsymbol{\theta}'}\right|\boldsymbol{y}_j\right) + \sum_j \mathrm{E}_{\boldsymbol{b}_j}\left(\left.\frac{\partial\ell(\boldsymbol{\theta}|\boldsymbol{y}_j,\boldsymbol{b}_j)}{\partial\boldsymbol{\theta}}\frac{\partial\ell(\boldsymbol{\theta}|\boldsymbol{y}_j,\boldsymbol{b}_j)}{\partial\boldsymbol{\theta}'}\right|\boldsymbol{y}_j\right)\\ &- \sum_j \mathrm{E}_{\boldsymbol{b}_j}\left(\left.\frac{\partial\ell(\boldsymbol{\theta}|\boldsymbol{y}_j,\boldsymbol{b}_j)}{\partial\boldsymbol{\theta}}\right|\boldsymbol{y}_j\right)\mathrm{E}_{\boldsymbol{b}_j}\left(\left.\frac{\partial\ell(\boldsymbol{\theta}|\boldsymbol{y}_j,\boldsymbol{b}_j)}{\partial\boldsymbol{\theta}}\right|\boldsymbol{y}_j\right)'.\end{aligned} \tag{8}$$

This suggests either a direct Newton-Raphson approach at maxizing (6) or the expectation-maximization iterations (Dempster *et al.* 1977; Lange 1995),

$$\boldsymbol{\theta}^{(s+1)} = \boldsymbol{\theta}^{(s)} - \left(\sum_j \mathrm{E}_{\boldsymbol{b}_j}\left[\left.\frac{\partial^2\ell(\boldsymbol{\theta}|\boldsymbol{y}_j,\boldsymbol{b}_j)}{\partial\boldsymbol{\theta}\partial\boldsymbol{\theta}'}\right|\boldsymbol{y}_j\right]\Bigg|_{\boldsymbol{\theta}=\boldsymbol{\theta}^{(s)}}\right)^{-1}\left(\sum_j \mathrm{E}_{\boldsymbol{b}_j}\left[\left.\frac{\partial\ell(\boldsymbol{\theta}|\boldsymbol{y}_j,\boldsymbol{b}_j)}{\partial\boldsymbol{\theta}}\right|\boldsymbol{y}_j\right]\Bigg|_{\boldsymbol{\theta}=\boldsymbol{\theta}^{(s)}}\right) \tag{9}$$

which in theory converge less quickly to a maximum likelihood solution than direct Newton-Raphson but are numerically more stable.

Since the integrals involved in equations (6) through (9) are not analytically tractable, an approximation is needed. Approximation by Gaussian quadrature is not feasible in this situation since the integrals tend to have a high dimensionality, so that a Monte-Carlo approximation seems the only feasible alternative. Thus, the algorithm (9) becomes a Monte-Carlo Expectation-Maximization (MCEM) algorithm (Wei and Tanner 1990).

Another problem arises from the identification problem demonstrated in equation (3). For this reason, two restrictions have to imposed on the parameters. For each dimension of the policy space, at least one or two positions of policy objectives have to be fixed in advance. Second, for each dimension d of the policy space, the sum of squares $\sum_i \alpha_{di}^2$ are fixed to a pre-determined value.

The complete procedure used to attain, first, maximum likelihood estimates $\hat{\alpha}_{id}$ for the position parameters of the policy objectives and maximum likelihood estimates of the variance parameters involves the following steps: First, the policy objectives i that are considered relevant for the policy space of a specific policy area are selected. Second, to obtain starting values for the MCEM algorithm, a metric multidimensional unfolding procedure is applied to non-linearly transformed counts of the sentences that mention these policy objectives: Because of the relation between the counts y_{ijt} and the squared distances $\eta_{ijt} = \boldsymbol{\Delta}_{ijt}'\boldsymbol{\Delta}_{ijt}$ as specified in equation (1) and the paragraph preceding it, a first approximation of these squared distances is

$$\eta_{ijt}^{(0)} := -\log\frac{\frac{1}{I} + y_{ijt}}{1 + \sum_i y_{ijt}} \tag{10}$$

where I is the number of policy objectives in the policy space. The method of Schönemann (1970) then is used to find a multidimensional unfolding solution for these squared distances, that is, to find two sets of points the squares of distances between which is as close as possible to the distances given in equation (10). This unfolding solution is subjected to a Procrustes rotation, such that the coordinates of a subset of the policy objectives of the policy area in question are as close as possible to a set of target values that are used to assure the interpretability of the resulting coordinate axes. For example, for the reconstruction of an liberalism-authoritarianism dimension, the target value of the coordinate of the policy objective "Law and order" is $+1$ and the target value of the coordinate of the policy objective "Democracy" is -1.

The Procrustes-rotated unfolding solution then gives the starting values $\alpha_{di}^{(0)}$ for the positions of the policy objectives and starting values $b_{djt}^{(0)}$ for the positions of the parties j taken by their respective electoral platforms at occasions t. Based on $b_{djt}^{(0)}$, starting values for the variance parameters are computed as

$$\sigma_{0d}^{2(0)} := \frac{1}{J}\sum_{j=1}^{J}\left(b_{dj0}^{(0)}\right)^2 \quad \text{and} \quad \sigma_{1d}^{2(0)} := \frac{1}{\sum_j T_j}\sum_{j=1}^{J}\sum_{t=1}^{K_j}\left(b_{djt}^{(0)} - b_{djt-1}^{(0)}\right)^2$$

where $T_j + 1$ is the number of electoral platforms issued by party j at occasions $t = 0, 1, \ldots, T_j$, and J is the total number of parties. Since some of the policy objective parameters have to be fixed to assure the identification of the model, those positions of policy objectives for which target values were specified in the Procrustes rotation are held fixed in the succeeding iterations of the MCEM algorithm. To provide for another necessary constraint, the MCEM algorithm is designed such that the sums of squares $\sum_d \alpha_{di}^2$ of the coordinates of the policy objectives are identical to the sums of squares of their respective starting values.

Based on these starting values, the MCEM algorithm involves, until convergence is reached, the repeated execution of the following steps:

1. For each j, values $\tilde{\boldsymbol{b}}_j^{(s)}$ for the party positions are computed that maximize the the complete-data log-likelihood contribution $\ell(\boldsymbol{\theta}^{(s)}|\boldsymbol{y}_j, \boldsymbol{b}_j)$ for $\boldsymbol{b}_j$, where $\boldsymbol{\theta}^{(s)}$ are the parameter values at the current iteration s.

2. For each j, R random draws $\boldsymbol{b}_j^{*(s,1)}, \ldots, \boldsymbol{b}_j^{*(s,R)}$ from an *instrumental* or *proposal distribution* with density $g(\boldsymbol{b}_j)$ are drawn, were $g(\boldsymbol{b}_j)$ is an approximation of

$\exp[\ell(\boldsymbol{\theta}^{(s)}|\boldsymbol{y}_j, \boldsymbol{b}_j)]$. For the present paper, a product-Student distribution is used with nine degrees of freedom, mean $\tilde{\boldsymbol{b}}_j^{(s)}$ and covariance matrix

$$\boldsymbol{V}_j^{(s)} = - \left(\frac{\partial^2 \ell(\boldsymbol{\theta}^{(s)}|\boldsymbol{y}_j, \boldsymbol{b}_j)}{\partial \boldsymbol{b}_j \partial \boldsymbol{b}_j'} \right)^{-1} \Bigg|_{\boldsymbol{b}_j = \tilde{\boldsymbol{b}}_j^{(s)}}.$$

A product-Student distribution is used instead of a genuine multivariate Student distribution (Johnson and Kotz 1972: 132ff), to take advantage of the lower approximation error of Monte-Carlo integration (Shaw 1988). Instead of using usual (pseudo-)random numbers with a Student distribution, m_j-dimensional Halton-sequences (Shaw 1988) are generated and transformed by the inverse distribution function of the Student-t distribution with 9 degrees of freedom. The resulting vectors of independent t-distributed quasi-random numbers are multiplied by the Cholesky factor of $\boldsymbol{V}_j^{(s)}$ and the maximizing vectors $\tilde{\boldsymbol{b}}_j^{(s)}$ are added to them. Thus it can be avoided to draw new samples of random numbers in each iteration. Instead, effectively a constant set of quasi-random numbers is re-used in each iteration. While the use of quasi-random numbers helps to reduce the error of the Monte-Carlo integral approximation, the re-use of a constant sample of quasi-random numbers assures that the approximated likelihood and its derivatives are the same smooth functions of the parameter values across different iterations.

3. *Importance sampling* approximations (Robert and Casella 2004; Booth and Hobert 1999) of the integrals that are involved in equations (6) through (9) are computed for each j as

$$\int \boldsymbol{F}(\boldsymbol{b}_j)\, \mathrm{e}^{\ell(\boldsymbol{\theta}^{(s)}|\boldsymbol{y}_j, \boldsymbol{b}_j)}\, \mathrm{d}\, \boldsymbol{b}_j \approx \frac{1}{R} \sum_r \boldsymbol{F}(\boldsymbol{b}_j^{*(s,r)}) \frac{\mathrm{e}^{\ell(\boldsymbol{\theta}^{(s)}|\boldsymbol{y}_j, \boldsymbol{b}_j^{*(s,r)})}}{g(\boldsymbol{b}_j^{*(s,r)})} = \frac{1}{R} \sum_r \boldsymbol{F}(\boldsymbol{b}_j^{*(s,r)}) w_r^*$$

where $\boldsymbol{F}(\boldsymbol{b}_j)$ is either 1, the gradient or the information matrix of the complete data log-likelihood contribution $\ell(\boldsymbol{\theta}|\boldsymbol{y}_j, \boldsymbol{b}_j)$ and $w_r^* := \exp[\ell(\boldsymbol{\theta}^{(s)}|\boldsymbol{y}_j, \boldsymbol{b}_j^{*(s,r)})]/g(\boldsymbol{b}_j^{*(s,r)})$ are importance weights.

4. Values for *Lagrange multipliers* (Aitchison and Silvey 1958) $\lambda_1, \ldots, \lambda_D$ are determined numerically, such that sum of squared coordinates $\sum_d (\alpha_{di}^{(s+1)})^2$ of the policy objectives are equal to values fixed in advance or as close as possible to them, where

$$\boldsymbol{\alpha}^{(s+1)} = \boldsymbol{\alpha}^{(s)} + \left(\boldsymbol{K}_{\boldsymbol{\Lambda}}^{(s)} \right) \boldsymbol{g}_{\boldsymbol{\Lambda}}^{(s)}, \qquad \boldsymbol{g}_{\boldsymbol{\Lambda}}^{(s)} := \boldsymbol{g}^{(s)} - \boldsymbol{\Lambda} \boldsymbol{\alpha}^{(s)},$$

$$\boldsymbol{K}_{\boldsymbol{\Lambda}}^{(s)} := (\boldsymbol{H} + \boldsymbol{\Lambda})^{-1} - (\boldsymbol{H}^{(s)} + \boldsymbol{\Lambda})^{-1} \boldsymbol{C} [\boldsymbol{C}' (\boldsymbol{H}^{(s)} + \boldsymbol{\Lambda})^{-1} \boldsymbol{C}]^{-1} \boldsymbol{C}' (\boldsymbol{H}^{(s)} + \boldsymbol{\Lambda})^{-1},$$

$$\boldsymbol{H}^{(s)} \approx -\,\mathrm{E}_{\boldsymbol{b}}\left(\frac{\partial^2 \ell(\boldsymbol{\theta}|\boldsymbol{y},\boldsymbol{b})}{\partial\boldsymbol{\theta}\partial\boldsymbol{\theta}'}\,\middle|\,\boldsymbol{y}\right)\Bigg|_{\boldsymbol{\theta}=\boldsymbol{\theta}^{(s)}}, \quad \boldsymbol{g}^{(s)} \approx \mathrm{E}_{\boldsymbol{b}}\left(\frac{\partial \ell(\boldsymbol{\theta}|\boldsymbol{y},\boldsymbol{b})}{\partial\boldsymbol{\theta}}\,\middle|\,\boldsymbol{y}\right)\Bigg|_{\boldsymbol{\theta}=\boldsymbol{\theta}^{(s)}},$$

$\boldsymbol{\Lambda} := \mathrm{diag}(\lambda_1, \ldots, \lambda_D)$ and $\boldsymbol{C}$ is a matrix such that $\boldsymbol{C}'\boldsymbol{\alpha} - \boldsymbol{\gamma}_0 = 0$, if $\boldsymbol{\gamma}_0$ is a vector of values to which a subset of $\boldsymbol{\alpha}$ is fixed in advance. The approximate negative information matrix $\boldsymbol{H}^{(s)}$ and the approximate gradient vector $\boldsymbol{g}^{(s)}$ are those computed by importance sampling in step 3.

The modifications to the original MCEM step that appear in step 4 can be derived from penalizing the observed data log-likelihood (6) by Lagrange-multiplier terms $\sum_d \lambda_d(\sum_i \alpha_{di}^2 - \gamma_{1d})$ and $(\boldsymbol{C}'\boldsymbol{\alpha} - \boldsymbol{\gamma}_0)'\boldsymbol{\kappa}$. Without restrictions of the form $\sum_i \alpha_{di}^2 = \gamma_{1d}$ and $\boldsymbol{C}'\boldsymbol{\alpha} = \boldsymbol{\gamma}_0$ the model would not be identified and no convergence of the MCEM algorithm could be achieved. The "target values" of the restriction $\sum_i \alpha_{di}^2 = \gamma_{1d}$ are obtained from the automatic starting values generated from the multidimensional unfolding procedure, that is $\gamma_{1d} := \sum_i (\alpha_{di}^{(0)})^2$. The values in the vector $\boldsymbol{\gamma}_0$ are attained by an appropriate Procrustes rotation of the raw unfolding solution to target values that the user of the algorithm must supply judiciously. In case of a multidimensional model, that is $D > 1$, such target values can also be used to initially adjust the coordinate axes of the policy space in such a way as to give them a substantive meaning.

Table 1 gives the results of this procedure as applied to the area of economic policy. The policy area is considered as one-dimensional, contrasting from typical "laissez-faire" positions to typical "state-interventionist" or even "state-socialist" positions on an *economic left/right* dimension. Thus only one dimension is assumed in the corresponding spatial model. The target value of the Procrustes rotation of an initial two-dimensional unfolding solution was -1 for the policy objective "Government ownership" or "Nationalization". Since the coordinate value of this policy objective is fixed to a specific value, only standard errors for free parameters of the model are reported in table 1.

The positions of the policy objectives on the reconstructed economic left/right dimension conform with the expectations: Policy objectives "Government ownership", "Controlled economy", and "Economic planning" have negative coordinate values, indicating that they represent the "state-interventionlist" side of the economic left/right dimension, whereas policy objectives "Incentives", "Freedom of enterprize", and "Economic orthodoxy" have clearly positive coordinate values, indicating that they form a cluster of "laissez-faire" objectives. It should be noted that the signs of these coordinate values should not be interpreted substantially, only differences in the signs. The model is empirically equivalent to a model in which the signs are reversed, such that positive coordinate values become negative coordinate values and vice versa. This is a consequence of the rotational invariance of distances.

The estimates of the variance components indicate that the economic left/right dimension mirrors an important aspects of parties' ideologies: The variance component that

Table 1: Positions of policy objectives and parties in the space of economic policy — fixed parameter values, maximum likelihood estimates with standard errors and model summaries

	Econ. left/right	
Positions		
Government ownership	−0.604	
Controlled economy	−0.519	(0.021)
Economic planning	−0.208	(0.022)
Market regulation	0.208	(0.032)
Incentives	0.600	(0.025)
Freedom of enterprize	1.073	(0.013)
Economic orthodoxy	0.778	(0.021)
Variance components		
Parties	1.064	(0.089)
Time	0.157	(0.005)
Log-likelihood	−38539	
Deviance	60543	
N	83675	

Note: Estimates of free parameters are listed with standard errors in parentheses, fixed parameter values are listed without standard errors.
Data source: CMP Dataset, CD-ROM included with Budge *et al.* (2001).

represents the variation of parties' initial positions is considerably larger than the variance components that represents over-time changes of the parties positions in their movements through the economic policy space. That is, the parties' positions on the economic left/right dimension are quite stable relative to the differences of the positions of different parties. The deviance, which can be interpreted as a likelihood-ratio statistic relative to a *saturated* model (Agresti 2002: 118f), in which there is one free parameter for each observation, is smaller than the total number N of sentences that mention the economic policy objectives considered here. This indicates that the fit of the model to the data is quite good.

Table 2 reports the estimates for a spatial model of the area of domestic and social policy. In contrast to the economic policy space I expected the domestic and social policy space as two-dimensional, spanned by a *liberal/authoritarian* and a *modernist/traditionalist* dimension. The liberal/authoritarian is considered as contrasting positions with regards to citizens' rights and liberties vis-a-vis juridical and government agencies, whereas the modernist/traditionalist dimension is considered as contrasting positions that support individuals' opportunities of self-actualization to positions that uphold traditional moral and religious values. This political/ideological dimension is pertinent to issues such as gender equality, abortion, same-sex marriage, divorce etc. This two-dimensional conception of the domestic and social policy space is different from the conception of only

Table 2: Positions of policy objectives and parties in the space of domestic and social policy — fixed parameter values, maximum likelihood estimates with standard errors and model summaries

	Lib./Auth.		Mod./Trad.	
Positions				
National way of life +	0.801		0.764	(0.007)
Traditional morals +	0.012		0.825	
Traditional morals −	0.006	(0.009)	−1.277	
Law and order	0.734		−0.064	
Freedom and human rights	−0.011	(0.000)	−0.239	(0.006)
Democracy	−0.717		−0.156	(0.002)
Variance components				
Parties	0.700	(0.058)	0.376	(0.031)
Time	0.285	(0.010)	0.059	(0.002)
Log-likelihood		−29746		
Deviance		45886		
N		83873		

Note: Estimates of free parameters are listed with standard errors in parentheses, fixed parameter values are listed without standard errors.
Data source: CMP Dataset, CD-ROM included with Budge *et al.* (2001).

one dimension of social policy as in Laver and Garry (2000). It is, however, motivated by historical contrasts between state-oriented conservatism and confessional/religious social conservatism as found e.g. in the DNVP and Center Party, respectively, of the German Weimar Republic.

In order to keep the two conjectured dimensions of the domestic and social policy space distinct, several parameter fixations are needed. Thus the coordinates of the policy objectives "National way of life (positive)", "Traditional morals (positive)", "Law and Order", and "Democracy" on the liberal/authoritarian dimension are fixed to the values that result from Procrustes rotation, where the target values are $1, 0, 1$, and -1, respectively; and the coordinates of the policy objectives "Traditional morals (positive)", "Traditional morals (negative)", and "Law and Order" on the modernist/traditionalist dimension are fixed to Procrustes-rotation results with target values 1, -1, and 0, respectively.

The estimation results shown in table 2 suggest that they are not just artifacts produced either by fixing certain parameter values or by coercing a one-dimensional space into a two-dimensional one: The variance component corresponding to the parties' initial positions on the modernist/traditionalist dimension is somewhat smaller than that of the variance component corresponding to initial positions on the authoritarian/liberal dimension. Yet it is not so small as to suggest the redundancy of a second dimension of this policy space.

Besides, the parties' positions on the modernist/traditionalist dimension are considerably more stable than positions on the authoritarian/liberal dimension.

4 The reconstruction of parties' political positions on the base of the spatial model of electoral platforms

The latent data construction of the spatial model of electoral platform was used so far only to get estimates of the positions of the policy objectives that make up a given policy space. It has not yet been shown how the political positions of the parties are reconstructed on the base of this model. The present section demonstrates how this is done.

Tables 1 and 2 of the previous section give estimates for the positions of policy objectives in two policy spaces and estimates for variance parameters of the political positions taken by parties with their electoral platforms. That estimates for the parties' positions have not yet been given is not only the consequence of the large number of such positions (1991 electoral platforms are covered by the MRG/CMP data), which is to high to fit them all into a couple of tables. The other reason is that they are not, unlike the maximum likelihood estimates of the positions of the policy objectives and of the variance parameters, an immediate result of the model-fitting process. Rather, *predictions* about the parties have to be made on the base of the fitted models. How such predictions are generated, based on the empirical Bayes method, and what the results are with regards to the average political positions of party families is discussed in the following.

Scholars familiar with the concepts and the formalism of Bayesian analysis will realize that some of the terms involved in equations (7) through (9) take the form of *posterior expectations* of functions of the parties' positions $\boldsymbol{b}_j$, with a multivariate normal distribution with zero means and covariance matrix $\boldsymbol{\Omega}_j$ as prior distribution. In order to make predictions about the parties' political positions, one will also need their posterior distributions. In contrast to classical Bayesian analysis, where prior distributions usually are determined in advance, in the present case the parameters σ_{0d}^2 and σ_{1d}^2 that determine the covariance matrix of the prior distribution are estimated with the help of empirically observed data. In so far, the use of the posterior distributions of the parties' political positions qualifies as an *empirical Bayes* approach. Yet because they involve analytically intractable multidimensional integrals, these posterior distributions do not exist in closed form. Nevertheless, it is possible to *sample* from these posterior distributions in order to generate multiple imputations for the parties' unobserved political positions.

In the previous section, an importance sampling method was used to approximate the needed posterior expectations of functions of $\boldsymbol{b}_j$. While this is variant of Monte-Carlo integration is relatively efficient for the computations discussed in the previous section, it is less convenient for directly sampling from the posterior: Not only sampled

values $\boldsymbol{b}_j^{*(1)}, \ldots, \boldsymbol{b}_j^{*(R)}$ have to be considered, but also the associated importance weights $w_j^{*(1)}, \ldots, w_j^{*(R)}$. For situations like this, Rubin (1987) proposes a *sampling/importance resampling* (SIR) algorithm in order to generate sampled values that do not need importance weights. For the case at hand, to generate a sample of size m from the posterior distribution of the positions of party j at occasions $t = 0, 1, \ldots, T_j$ at dimensions $d = 1, \ldots, D$, which form the vector $\boldsymbol{b}_j$ this SIR algorithm involves the following steps:

1. R random vectors $\boldsymbol{b}_j^{*(1)}, \ldots, \boldsymbol{b}_j^{*(R)}$ are sampled from a proposal distribution that is an approximation to the complete-data log-likelihood contribution $\ell(\boldsymbol{\theta}|\boldsymbol{y}_j, \boldsymbol{b}_j)$. Since sample re-use is not needed here, this proposal distribution can be a genuine multivariate Student's t-distribution, with mean vector $\tilde{\boldsymbol{b}}_j$ and covariance matrix $\tilde{\boldsymbol{V}}_j$ as defined in the previous section.

2. For each random vector $\boldsymbol{b}_j^{*(r)}$, an importance weight $w_j^{*(r)}$ is computed as described in the previous section.

3. R random numbers $u_j^{*(1)}, \ldots, u_j^{*(R)}$ are generated from the uniform distribution over the interval $[0; M_j]$ such that $M_j > w_j^{*(r)}$ for all $r = 1, \ldots, R$.

4. For each $r = 1, \ldots, R$, if $u_j^{*(r)} < w_j^{*(r)}$ the random vector $\boldsymbol{b}_j^{*(r)}$ is accepted as a sample value of the posterior distribution, otherwise $\boldsymbol{b}_j^{*(r)}$ is rejected.

5. If the number of accepted random vectors $\boldsymbol{b}_j^{*(r)}$ is lower than m, R is increased and the algorithm restarts at 1. Otherwise, m of the accepted random vectors are retained for further use.

Practical experience with this algorithm suggests that for the one-dimensional model of the economic policy space, a size of $R = 10m$ for the proposal sample suffices to generate m sample values from the posterior density if M_j is chosen to be just above the maximum of the importance weights for the random vectors of the proposal sample. Random samples from the posterior distributions of the parties' political positions are used in the next section to locate various party families in the spaces of economic policy and domestic and social policy.

5 The spatial positions of party families

Most of the literature on the comparative study of parties and party systems distinguishes, at least among West European and parties and with sometimes differing labels, the following party families (von Beyme 1985; Ware 1996; Gallagher *et al.* 1997; Mair and Mudde 1998):

- *Liberal parties* Most of these parties embody the continuity of classical European liberalism which starts with the British *Whigs* and the secular-liberal parties of France and Italy.

- *Conservative parties* The conservative family of parties came to existence in Western Europe as a reaction to the challenge of liberalism to the traditional structures of authority. Modern variants of conservatism typically endorse rather stiff "law and order" policies, exclusive conceptions of citizenship, and orthodox free-market policies.

- *Social democrat parties* These parties represent the first generation of parties that emerged first from the European labor movement. They are characterized by an egalitarian approach to democracy and a strong support for the welfare state.

- *Communist parties* These parties emerged from a radical, unabashedly revolutionary currents within the labor movement, which supported the Russian Revolution and the dissemination of its relatively authoritarian version of socialism to other countries.

- *Christian democrat and confessional parties* One could argue about whether these parties really constitute a single party family, since the sources from which these parties emerged are manifold. The largest subgroup of these parties, the Christian democrats in the narrow sense, emerged from Catholic layspeople movements in France and Italy that purported to strike a balance between modern democracy and Christian faith. The second current are the religious revivalist parties that first emerged in Scandinavia but also in the more traditional fringe of the Calvinist sector of the Dutch society. The third current are parties that center on the denominational identity of a specific confession of Christianity, especially Catholicism, but also the two major variants of Calvinism in the Netherlands. (For a discussion of these various sources of Christian politics in Europe see Madeley 1991).

- *Right wing parties* This group is rather a residual category of all parties that are regarded as being positioned to the right of the conservatives. With regards to the welfare state and the economy this groups seems to be ambivalent. What unites this group of parties is the emphasis of state authority, an emphasis on the the majoritarian ethnicity and, especially in more recent decades, a strong opposition to immigration.

- *Ethnic/linguistic/regional parties* This is perhaps the most heterogeneous group of parties. The emphasis of the rights of ethnic and/or regional minorities is probably the only aspect that characterizes this group. Beside that, one finds many other ideological currents of the other party families among these parties.

- *Agrarian/rural parties* The agrarian or rural parties are peculiarity of Scandinavia, whith its unique prevalence of smallholding in the early centuries of the Modern Age. These parties have been the strongest supporters of the welfare state next to the social democrats.

- *Left socialist and new left parties* This group is also rather a residual category of all those parties that, one the one hand, consider themselves as "left" from social democracy but stand, on the other hand, in opposition to pro-soviet orthodox communism.

- *Green parties* The green parties, or as they are sometimes called, "New Politics" parties are a group of relatively recent origin. Most of them did not exist before 1980. What distinguishes them the most from other parties is their emphasis on environmental protection, consumer interest, and — at least in their earlier decades — an anti-industrialist utopianism. On the other hand, the strongest supporters of post-traditional life-styles and of the rights of individuals and minorities can be found among these parties.

In case of small parties the classification into one of these party families often proves difficult. This is so not the least because there is no consensual definition of what constitutes a specific party family. Nevertheless, with regards to major parties like the British Labour Party, the Dutch *CDA* or the German *FDP*, there seems to be a consensus on which party family they belong to. A tentative and incomplete classification of the parties covered by the MRG/CMP data is given in the appendix.

The question of whether party families can be distinguished based on the empirical Bayes predictions as developed in the preceding section can be thought of as corresponding to two different objectives. On the one hand, a positive answer to this question will lend face validity to the results obtained from the procedures developed in the two preceding sections. On the hand, a positive answer will give a more quantitative and operational underpinning to the perhaps somewhat vague notion of party families. A provisional answer to this question is given by figures 2 and 3.

Figure 2 uses a kernel density estimate to depict the distribution of the empirical Bayes predictions about the parties' positions on the economic left/right dimension. Superimposed to the plot of the kernel density estimate are vertical spikes, which indicate the average positions of the party families introduced above. They are computed as the arithmetic means of all predicted positions of parties that are classified in each of the respective party families. These average positions conform quite well to the descriptions of the political positions of various party families as given in the literature (von Beyme 1985; Ware 1996; Gallagher *et al.* 1997; Mair and Mudde 1998). The three families of labor parties, that is, the left-socialist, communist and social democratic party families are clearly positioned "left" to the bourgeois party families of the liberal, conservative and right wing

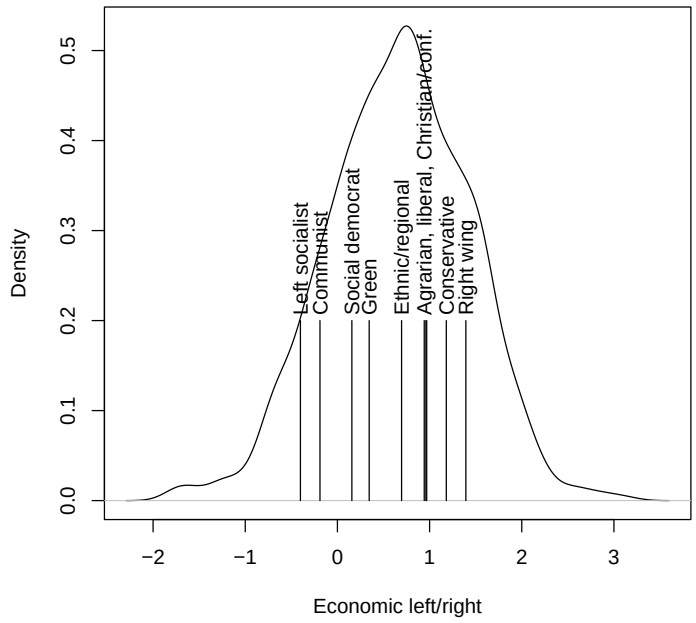

Figure 2: Positions of party families in the space of economic policy — (empirical Bayes) posterior expectations and averages broken down by party family
Data source: CMP Dataset, CD-ROM included with Budge *et al.* (2001)

parties, with the conservatives and the right-wing parties obtaining the position most to the "right". The remaining party families obtain position more to the "center" of the economic left/right dimension. This result seems to corroborate the common notion that labor parties prefer "state-interventionist" policies, whereas bourgeois parties rather refer "laissez-faire" policies for the economy. The position of the liberal party family close to the center of the economic left/right dimension might surprise those observers of West European politics that identify European liberalism with "free-market" liberalism, that is, with "laissez-faire" economic policies. The reason for the rather "centrist" position of the liberals on this dimension stems from the fact that the family of liberal parties is quite heterogeneous. One the one hand there are "left-liberal" or social liberal parties like the Dutch *D'66*, which emphasize individual freedom, including a freedom from economic hardship. On the other hand there are traditional liberal parties, which put a stronger emphasis on economic freedom of enterprise, again exemplified by a Dutch party, the *VVD*. If a distinction between a family of social liberal parties and a family of liberal-conservative parties can be made, as proposed by some authors, surely deserves some

further study. However, for the present purpose, it suffices to state that the party families can be distinguished at least in terms of their average positions on the economic left/right dimension.

Figure 3 summarizes the average positions of the party families in terms of their positions in the domestic and social policy space. It superimposes a contour plot of a kernel density estimate of the empirical distribution of the parties' positions on the liberal/authoritarian and modernist/traditionalist dimensions with dots that indicate the average positions of the party families on the respective dimensions of this policy space. These average positions of the party families suggest that it is quite reasonable to distinguish between these two dimensions of the domestic and social policy space: It turns out that the family of Christian democrat and confessional parties and the family of agrarian parties have as most distinctive feature their support for traditional moral norms rather than a support for state authority. What make green parties distinctive as a party family also becomes obvious: They are the party family with the most modernist positions in terms of social policy and they are second in terms of liberal positions on the liberalism/authoritarianism dimension only to the party family of the communist parties. The liberal position of the communist party family, however, is quite at odds with fact that communist parties constitute a dogmatic and in some respect authoritarian wing of the labor movement. This anomalous result may be reflect the fact that communist parties, presenting themselves as a fundamental opposition to the existing political and social order will strongly distance themselves from policy objectives like "Law and order" or support for the "National way of life". Another speculative explanation is that this position of the communist party family is the result of an emphasis of democracy in the guise of "workplace democracy" or "soviet democracy". Wether this is the case or an emphasis of liberal positions is only a common rhetorical device used by communist parties, cannot be decided at the current stage of analysis. Answering this question would need a more detailed analysis of communist electoral platform beyond the coding schema of the MRG/CMP.

The positions of the remaining party families on the liberal/authoritarian dimension seems to support the notion of a more general ideological left/right dimension that unifies both economic and non-economic concerns: The left socialist, social democratic, liberal, conservative, and right wing parties are ordered in the same way on the liberal/authoritarian dimension as they are ordered on the economic left/right dimension. However, in contrast to the economic left/right dimension, liberal parties are closer to the social democratic parties on the liberal/authoritarian dimension than to conservative parties.

In sum, the results contained in figures 2 and 3 are, with the exception of an anomalous result with regards to the positions of communist parties, mostly consistent with common

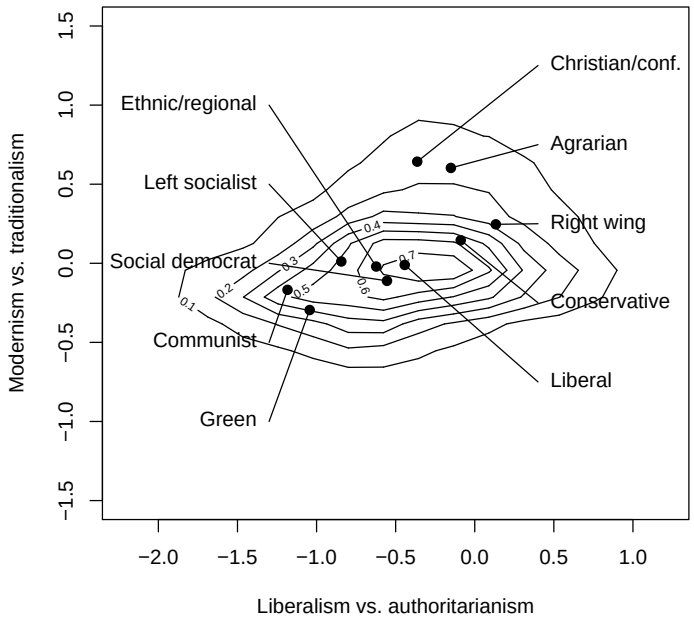

Figure 3: Positions of party families in the space of domestic and social policy — (empirical Bayes) posterior expectations and averages broken down by party family
Data source: CMP Dataset, CD-ROM included with Budge *et al.* (2001)

notions about the "typical" political positions of the various party families. One may count this as a corroboration of the concept of party family. In the present context, however, the results may serve to indicate that the spatial model of electoral platforms proposed in this paper delivers substantially valid descriptions of parties political positions.

6 Discussion and conclusion

In the present paper I propose a spatial model of electoral platforms, which gives an account for the connection between positions of parties in more or less abstract political spaces and the emphases they put on different policy objectives. It differs from earlier approaches at reconstructing political positions of parties from electoral platforms in so far as (1) it makes the connection between positions and emphases of policy objectives formally explicit, (2) constructs this connection in such a way as to take into account the intrinsically non-linear relationships among the percentages of policy emphasis as encountered in the MRG/CMP data, (3) provides a method for the statistical estimation

of positions of policy objectives and party positions, based on a combination of maximum-likelihood via Monte-Carlo expectation-maximization and empirical Bayes predictions, (4) allows for the reconstruction of multiple dimensions of multiple policy spaces, and (5) takes into account the serial dependence of succeeding electoral platforms of the same party. In addition, it shows how party families can be distinguished in terms of their positions on an economic left/right, a liberal/authoritarian, and a modernist/traditionalist dimension. Yet still, the estimation method employed in this paper leaves room for improvement and still leaves some research questions unanswered.

The MCEM procedure used to compute estimates of the model parameters can be made computationally more efficient in two ways. First, the importance sampling procedure of Monte-Carlo approximation involved in the E-step of the MCEM procedure can be substituted by a mixed deterministic-stochastic version of spherical-radial quadrature as proposed e.g. by Monahan and Genz (1997) This may require less sample values to attain the degree of accuracy of approximation as with the importance sampling procedure. Second, the importance sampling procedure uses a fixed sample size throughout all iterations. However, it is argued by Booth and Hobert (1999) and Caffo *et al.* (2005) that in earlier iterations of an MCEM algorithm, the approximation of the gradient and the information matrix need not be as accurate as in later iterations. Thus they propose to start with small Monte-Carlo sample sizes in earlier iterations of MCEM and increase the sample sizes throughout the iterations of the algorithm. However, it remains to be seen whether the additional effort of the adaptation of these improvements, which were so far developed for the estimation of generalized linear mixed models, to the somewhat more complex spatial model of electoral platforms and the additional programming effort is made worthwhile by gains in computation speed.

Another, more substantive question left open is how the spatial model of electoral platforms performs in terms of showing the dynamic development of parties' political positions. By the modelling parties' positions as random-walks, the model proposed here seems better equipped to describe such dynamics than extant methods that rely on sum-and-difference scores or scores obtained from principal components analysis. Although such further analyses are clearly worth their while, they are beyond the scope of the current paper, which focuses on justification, formal derivation and practical implementation of the proposed model.

A Notational details for equation (5)

In the third section the assumption was made that parties' political positions form a (multidimensional) random-walk with

$$\begin{aligned} b_{dj0} &\sim \mathcal{N}(0, \sigma_{0d}^2) \\ b_{djt} &= b_{djt-1} + \epsilon_{djt} \quad \text{with} \quad \epsilon_{djt} \sim \mathcal{N}(0, \sigma_{1d}^2) \\ \text{or, equivalently} \qquad b_{djt} - b_{djt-1} &\sim \mathcal{N}(0, \sigma_{1d}^2) \end{aligned}$$

The density of the joint distribution of $b_{dj0}, b_{dj1}, \ldots, b_{djT_j}$ then has the form

$$f(b_{dj0}, b_{dj1}, \ldots, b_{djT_j}) = \frac{1}{\sqrt{2\pi\sigma_{0d}^2}} \frac{1}{\left(\sqrt{2\pi\sigma_{1d}^2}\right)^{T_j}} \exp\left(-\frac{1}{2}\frac{b_{dj0}^2}{\sigma_{0d}^2} - \frac{1}{2}\frac{\sum_t (b_{djt} - b_{djt-1})^2}{\sigma_{1d}^2}\right) \quad (11)$$

If the vector $\boldsymbol{b}_{dj}$ and the diagonal matrix $\boldsymbol{\Sigma}_{dj}$ and the lower triangular matrix $\boldsymbol{L}_j$ are introduced as

$$\boldsymbol{b}_{dj} := \begin{pmatrix} b_{dj0} \\ b_{dj1} \\ \vdots \\ b_{djT_j} \end{pmatrix} \qquad \boldsymbol{\Sigma}_{dj} := \begin{pmatrix} \sigma_{0d}^2 & & & \\ & \sigma_{1d}^2 & & \\ & & \ddots & \\ & & & \sigma_{1d}^2 \end{pmatrix} \quad \text{and} \quad \boldsymbol{L}_{dj} := \begin{pmatrix} 1 & & & \\ -1 & 1 & & \\ & \ddots & \ddots & \\ & & -1 & 1 \end{pmatrix}$$

the density (11) can be re-written, with $\boldsymbol{\Omega}_{dj} := \boldsymbol{L}_{dj}\boldsymbol{\Sigma}_{dj}^{-1}\boldsymbol{L}_{dj}$ and because of the determinant $|\boldsymbol{L}_{dj}|$ equals one, as

$$f(\boldsymbol{b}_{dj}) = |2\pi\boldsymbol{\Sigma}_{dj}|^{-1} \exp\left(-\frac{1}{2}\boldsymbol{b}_{dj}'\boldsymbol{L}_{dj}\boldsymbol{\Sigma}_{dj}^{-1}\boldsymbol{L}_{dj}\boldsymbol{b}_j\right) = \frac{1}{\sqrt{2\pi}}|\boldsymbol{\Omega}_{dj}| \exp\left(-\frac{1}{2}\boldsymbol{b}_{dj}'\boldsymbol{\Omega}_{dj}\boldsymbol{b}_j\right)$$

With

$$\boldsymbol{b}_j := \begin{pmatrix} \boldsymbol{b}_{1j} \\ \vdots \\ \boldsymbol{b}_{Dj} \end{pmatrix} \qquad \text{and} \qquad \boldsymbol{\Omega}_j := \begin{pmatrix} \boldsymbol{\Omega}_{1j} & & \\ & \ddots & \\ & & \boldsymbol{\Omega}_{Dj} \end{pmatrix}$$

it becomes immediately clear that the terms in the second row of equation (5) which involve $\boldsymbol{b}_j$ and $\boldsymbol{\Omega}_j$ correspond to the logarithm of the density of $\boldsymbol{b}_j$.

Note that the vectors $\boldsymbol{b}_{jt}$ in the first row of equation (5) are defined as $\boldsymbol{b}_{jt} := (b_{1jt}, \ldots, b_{Djt})'$.

B Classification of parties into party families

The following list shows how the parties whose electoral platforms are covered by MRG/CMP data are assigned to party families. The list uses the party labels of the MRG/CMP data set. Note that most of the Turkish and Israeli parties have not yet been classified into party families and therefore do not appear in this list.

***Liberal parties*:** Australia: AD Democrats; Australia: LPA Liberals; Austria: LF Liberal Forum; Belgium: PLDP Brussels Liberals; Belgium: PLP-PVV Liberals; Belgium: PRL/FDF Francophone Liberal and Democratic Front; Belgium: PRL Francophone Liberals; Belgium: PVV Flemish Liberals; Canada: LP Liberals; Denmark: CD Centre Democrats; Denmark: DS Danish Union; Denmark: LC Liberal Centre; Denmark: RF Justice Party; Denmark: RV Radicals; Denmark: V Liberals; Finland: LKP Liberals; Finland: SK Finnish Centre; Germany: FDP Free Democrats; Great Britain: LDP Liberal Democrats; Great Britain: Liberals; Greece: EDIK Centre Democrats; Ireland: PD Progressive Democratic Party; Italy: AD Democratic Alliance; Italy: LR La Rete; Italy: PI Pact for Italy; Italy: PLI Liberals; Italy: PRI Republicans; Italy: PR Radicals; Italy: RI Italian Renewal; Japan: CGP Clean Government; Japan: DPJ Democratic Party; Japan: JNP Japan New Party; Japan: JRP Renewal Party; Japan: NLC New Liberal Club; Netherlands: D 66 Libertarians; Netherlands: PPR Radical Political Party; Netherlands: VVD Liberals; Norway: DLF Liberal Peoples Party; Norway: V Liberals; Portugal: MDP Democratic Movement; Portugal: PRD Democratic Renewal Party; Spain: PL Liberals; Sweden: FP Liberals; Switzerland: FDP-PRD Radical Democrats; United States: Democrats

***Conservative parties*:** Australia: DLP Democratic Labour; Australia: NPA National Party; Canada: PCP Conservatives; Denmark: DU Independents Party; Denmark: KF Conservatives; Finland: KK National Coalition; France: Conservatives; France: Gaullists; France: RPR; Germany: DP German Party; Great Britain: Conservatives; Greece: EP National Alignment; Greece: ND New Democracy; Greece: Pola Political Spring; Israel: Likud Union; Italy: FI Forza Italia; Italy: RC New Communists; Japan: LDP Liberal Democrats; New Zealand: NP National Party; New Zealand: NZPF First Party; Norway: H Conservatives; Portugal: PPM Popular Monarchist Party; Portugal: PSD Social Democrats; Spain: AP,PP Conservatives; Spain: PCE-IU Communists; Spain: PDP Popular Democratic Party; Sweden: MSP Conservatives; Switzerland: SVP-UDC Peoples Party; United States: Republicans

***Social democrat parties*:** Australia: ALP Labour; Austria: SPO Socialists; Belgium: PSB-BSP Socialists; Belgium: PS Francophone Socialists; Belgium: SP Flemish Socialists; Canada: NDP New Democratic Party; Denmark: SD Social Democrats; Finland:

SSDP Social Democrats; France: PS Socialists; Germany: SPD Social Democrats; Great Britain: Labour; Great Britain: SDP Social Democratic Party; Greece: DIKKI; Greece: PASOK Socialists; Ireland: LP Labour Party; Israel: Labour Party; Italy: PSDI Social Democrats; Italy: PSI Socialists; Japan: DSP Democratic Socialists; Japan: SDF Social Democratic Federation; Luxembourg: POSL LSAP Social Democrats; Netherlands: DS 70 Democratic Socialists 70; Netherlands: PvdA Labour; New Zealand: LP Labour; Norway: DNA Labour; Portugal: ASDI Indep Social Democrats; Portugal: NA; Portugal: PSP Socialists; Spain: CDS Centre Democrats; Spain: PSOE Socialists; Sweden: SdaP Social Democrats; Switzerland: SPS-PSS Social Democrats

***Communist parties*:** Denmark: DKP Communists; Finland: DEVA Democratic Alternative; Finland: SKDL Peoples Democratic Union; France: PCF Communists; Germany: KPD Communist Party; Greece: KKE Communists; Italy: PCI-PDS Communists; Japan: JCP Communists; Japan: JSP Socialists; Luxembourg: PCL KPL Communists; Norway: NKP Communists; Portugal: PCP Communists; Portugal: UDP Popular Democratic Union; Sweden: Vp Communists

***Christian/confessional parties*:** Austria: OVP Christian Democrats; Belgium: CVP Flemish Christian Peoples Party; Belgium: PSC-CVP Christian Peoples Party; Belgium: PSC Francophone Christian Social Party; Denmark: KrF Christian Peoples Party; Finland: SKL Christian Union; France: CDP Centre Democracy Progress; France: Centre Democrats; France: MRP Popular Republicans; France: MR Reformers Movement; France: UDF; Germany: CDU-CSU Christian Democrats; Germany: DZ Centre Party; Italy: CCD Christian Democratic Center; Italy: PPI-DC Christian Democrats; Luxembourg: PCS CSV Christian Social Party; Netherlands: ARP Anti-Revolutionary Party; Netherlands: CDA Christian Democrats; Netherlands: CHU Christian Historical Union; Netherlands: KVP Catholic Peoples Party; Norway: KrF Christian Peoples Party; Portugal: PP Popular Party; Spain: UCD Democratic Centre; Sweden: KdS Christian Democrats; Switzerland: CVP-PDC Christian Democrats; Switzerland: EVP-PEP Protestant Peoples Party

***Right wing parties*:** Austria: FPO Freedom Movement; Belgium: VB Flemish Block; Denmark: FP Progress Party; France: FN National Front; France: Poujadists; Germany: DKP-DRP German Reich Party; Italy: AN National Alliance; Norway: FrP Progress Party; Sweden: NyD New Democracy; Switzerland: FPS Freedom Party; Switzerland: SD Democrats

***Ethnic/regional parties*:** Belgium: FDF French-Speaking Front; Belgium: RW Walloon Rally; Belgium: VU Flemish Peoples Union; Canada: BQ Bloc Quebecois; Finland: RKP SFP Swedish Peoples Party; Germany: BP Bavarian Party; Germany: SSW South Schleswig League; Israel: United Arab List; Italy: LN Northern League; Spain: CiU

Convergence and Unity; Spain: EA Basque Solidarity; Spain: EE Basque Left; Spain: ERC Catalan Republican Left; Spain: PA Andalusian Party; Spain: PAR Aragonese Regionalist Party; Spain: PNV EAJ Basque National Party

***Agrarian parties*:** Finland: SMP Rural Party; Norway: SP Centre Party; Sweden: CP Centre Party

***Left socialist parties*:** Denmark: FK Common Course; Denmark: SF Socialist Peoples Party; Denmark: VS Left Socialists; Finland: TPSL Social Democratic League; Finland: VL Left Wing Alliance; France: RRRS Radical Socialists; Germany: PDS Party for Democratic Socialism; Greece: SAP Coalition Left and Progress; Ireland: DLP Democratic Left; Ireland: WP Workers Party; Italy: DP Proletarian Democracy; Italy: PdUP Proletarian Unity; Italy: PSU United Socialists; New Zealand: Alliance; Norway: SV Left Socialists

***Green parties*:** Austria: GA Greens; Belgium: Agalev Flemish Greens; Belgium: Ecolo Francophone Ecologists; Denmark: EL Unity List; Finland: VL Greens; France: Ecology Generation; France: Greens; Germany: Alliance 90-Greens; Germany: Greens; Germany: Greens-Alliance 90; Ireland: Greens; Italy: FdV Greens; Luxembourg: GAP Alternatives; Luxembourg: Glei Gap Green Alternatives; Luxembourg: GLEI Greens; Netherlands: GL Greens; Portugal: PEV Greens; Sweden: Greens; Switzerland: Greens

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