Supporting information: The distribution of individual cabinet positions in coalition governments – A sequential approach

Appendix A

The sequential bargaining approach uses empirical data on party preferences and legislative seat shares. It estimates predicted probabilities $\hat{P}_{ijk}$ that portfolio $j$ ($1 \leq j \leq J$) is allocated to party $i$ ($1 \leq i \leq N$) using mechanism $k$. Using these predicted probabilities we obtain three empirical outcomes of interest: i) predictive success, ii) predictive accuracy, and iii) the associated weighting parameters $\alpha_i$. This appendix describes in greater detail the algorithm to obtain these estimates. To simplify the discussion and to avoid further subscripts, the description is based on a single cabinet with $N$ cabinet parties and $J$ portfolios.

Step 1: Create preference-matrices

The first step is to compute government parties’ payoffs from holding individual cabinet positions. Party $i$’s preferences for portfolios 1 to $J$ can be summarized using a vector $\left[ \alpha_i u_1 + (1 - \alpha_i) v_{i1}, \ldots, \alpha_i u_J + (1 - \alpha_i) v_{ij} \right]$, where $u_j$ captures the objective importance of holding portfolio $j$, $v_{ij}$ indicates party $i$’s emphasis on policy issues related to portfolio $j$ while the relative importance of ministry- and party-specific preferences is indicated by the weighting factor $\alpha_i$. To incorporate the uncertainty in measures for the parties’ portfolio preferences $u_j$ and $v_{ij}$, we perceive party $i$’s preferences as random variables. For the simulation of the sequential allocation process, we take 1,000 draws and each draw represents a slightly different combination of party preferences for the individual portfolios. We simulate the variation in experts’ average judgments $u_j$ using 1,000 random draws from a $t$ -distribution with $n - 1$ degrees of freedom and mean $\mu$, standard deviation $\sigma$, and the number of experts $n$. 
as reported in the expert surveys (Druckman & Roberts 2008; Druckman & Warwick 2005). For the party-specific value for each cabinet position, $v_{ij}$, the uncertainty estimates are retrieved using the approach suggested by Benoit et al. (2009). This is done by matching policy areas to ministerial portfolios following Bäck et al. (2011: 454-455). For all ministerial portfolios not included in their analysis we mimic their approach to identify policy categories that match with the respective ministerial responsibilities. As suggested by Benoit et al. (2009), we estimate bootstrapped standard errors for manifestos with $n$ statements by simulating 1,000 artificial manifestos, each based on $n$ draws from a multinomial distribution with probabilities $p_{il}$ (for more information see Benoit et al. 2009).

This simulation procedure results in a $1,000 \times J$ matrix $M_i$ with 1,000 slightly different estimates for party $i$’s preferences for portfolios 1 to $J$:

$$M_i = \begin{bmatrix}
\alpha_i u_{11} + (1 - \alpha_i) v_{i11} & \cdots & \alpha_i u_{1J} + (1 - \alpha_i) v_{i1J} \\
\vdots & \ddots & \vdots \\
\alpha_i u_{1,0001} + (1 - \alpha_i) v_{i1,0001} & \cdots & \alpha_i u_{1,000J} + (1 - \alpha_i) v_{i1,000J}
\end{bmatrix},$$

where each row (i.e. random draw) represents a slightly different configuration of party $i$’s preferences for portfolios 1 to $J$.

**Step 2: Obtain individual choice sequence for each sequential mechanism**

The second step is to obtain the individual choice sequence for each sequential mechanism $k$ (the mechanisms are described in more detail in the main text). Based on the cabinet parties’ seat share in the legislature’s lower chamber, we obtain a row vector $S_k$ which specifies the choice sequence among cabinet parties with $J$ elements (i.e. portfolios) for each sequential mechanism $k$:

$$S_k = [s_{k1}, \ldots, s_{kJ}].$$

It may happen that the different mechanisms result in two or more parties being assigned the next pick in the choice sequence (see also endnote 7). This is most obvious for
allocation via *Alternation* if cabinet parties have an equal seat share in parliament. In these instances we use randomization as a tie-breaker to allocate the initial choice. The two divisor methods, *Sainte-Laguë* and *D’Hondt*, may likewise provide ambiguous predictions for the choice sequence among cabinet parties. In instances where two or more cabinet parties have identical highest quotas we resort to a simple fairness norm and grant the next choice to the smallest party. An alternative implementation of the sequential approach likewise uses randomization as tie-breaker for the *Sainte-Laguë* and the *D’Hondt* method. All empirical findings concerning the estimates obtained in step 3 and step 4 (see below) are robust to randomly determine which party chooses next instead.

**Step 3: Estimate predicted probabilities and predictive success**

In a third step, information on the cabinet parties’ preference matrices $M_i$ is matched with the choice sequence of each mechanism $S_k$. For a given combination of $\alpha_i$s and a pre-defined choice sequence $S_k$, cabinet parties choose their most-preferred of the remaining cabinet positions until all portfolios are distributed among them. Thus, for each of the 1,000 simulated preference distributions we obtain a prediction whether party $i$ obtains portfolio $j$ using mechanism $k$ (1) or not (0). Predicted probabilities $\hat{P}_{ijk}$ are simply the averages of these predictions over 1,000 simulations. We define ‘correct predictions’ as those where the cabinet party with the highest predicted probability $\hat{P}_{ijk}$ is identical to the empirically observed allocation. For each mechanism $k$ we thus obtain the share of correctly predicted cabinet positions.

**Step 4: Estimate weighting parameters $\alpha_i$**

In order to identify the parameters $\alpha_i$, we repeat the simulation process for each allocation mechanism $k$ for all possible combinations of $\alpha_i$, ranging from 0 to 1 using 0.1 intervals.
There are $11^N$ possible combinations, ranging from 121 for two-party governments up to 161,051 possible combinations for coalition governments with five parties. For each combination, we re-run the sequential allocation approach in order to identify the combination of parameters $\alpha_i$ with the highest predictive success. If this procedure results in more than one optimal combination of party-specific weighting parameters $\alpha_i$, we take the average $\alpha_i$s. However, these instances are rare (see endnote 12) and the differences between combinations of optimal $\alpha_i$s are rather small: the average Euclidean distances between optimal vectors $\alpha$ in the $N$-dimensional space ranges from 0.03 (Alternation) to 0.06 (D'Hondt).

Choice sets for parameters $\alpha_i$ are restricted for computational reasons, as more fine-grained intervals significantly increase the time it takes to estimate parameters $\alpha_i$. To test how the size of intervals affects our results, we let the intervals vary and compare the predictive success for different specifications. We correlate the share of correctly predicted portfolios for the given 0.1 interval with that of an artificially restricted sample with an interval of 0.2. The correlation between shares of correctly predicted portfolios is about 0.99 for each mechanism under scrutiny. We also estimate the share of correctly predicted portfolios for all two- and three-party cabinets reducing the interval from 0.1 to 0.02. Here, we likewise observe correlation coefficients around 0.99 for all mechanisms.
Appendix Figure 1. Predictive success for different combinations of $\alpha_i$

*Note:* Distribution of correctly predicted cabinet positions ($z$-axis) for different values of $\alpha_i$ for the Social Democrats (SD) ($x$-axis) and the Liberals (RL) ($y$-axis) in Denmark in 1998.

Appendix Figure 1 exemplifies the distribution of correctly predicted cabinet positions for the coalition between the Social Democrats (SD) and the Liberals (RL) in Denmark in 1998. Specifically, it illustrates how the share of correctly predicted portfolios via *D’Hondt* varies for different combinations of party-specific weighting parameters $\alpha_i$. The present example reiterates several of our key findings. First, the share of correctly predicted cabinet positions varies considerably between 69 and 86 percent for different combinations of $\alpha_i$. Second, the maximum share of correctly predicted portfolios is obtained for $0 < \alpha_i < 1$ ($\alpha_{SD} = 0.6$ and $\alpha_{RL} = 0.9$). This suggests that cabinet parties have mixed motives and that they are neither exclusively driven by portfolio importance nor by their policy-issue emphasis. Third, the maximum share of correctly predicted portfolios is obtained for $\alpha_i > 0.5$ ($\alpha_{SD} = 0.6$ and $\alpha_{RL} = 0.9$), indicating that objective portfolio importance generally trumps party-specific policy preferences when it comes to allocating cabinet positions.
Appendix B

In the empirical section we compare the results of the sequential approach with a naïve model assuming mutual independence in the allocation of individual cabinet positions. The first column in Appendix Table 1 reports the detailed results of the conditional logit model. Here, the allocation of each portfolio is the unit of analysis while each cabinet party is conceptualized as the choice alternative. As expected both party seat share and party preferences exert a positive and significant effect on the likelihood that a party controls a given portfolio.

Appendix Table 1. Conditional logit and mixed logit model of portfolio allocation

|                         | (Model 1) Conditional logit | (Model 2) Mixed logit |
|-------------------------|-------------------------------|-----------------------|
|                         | Coefficients | Mean coefficients | Standard deviation of coefficients |
| Party seat share        | 2.020***     | 2.273***           | 0.779                  |
|                         | (0.076)      | (0.133)            | (0.473)                |
| Party preferences       | 0.960***     | 1.146***           | 1.820                  |
|                         | (0.181)      | (0.261)            | (0.978)                |
| N (cabinet parties)      | 6,676         | 6,676               |                        |
| N (portfolios)          | 2,365         | 2,365               |                        |
| Share correctly predicted (in %) | 58.6  | 58.2               |                        |
| AIC                     | 4,083.1       | 4,086.0          |                        |
| (Simulated) log-likelihood | -2,035.6     | -2,039.0          |                        |
| Likelihood-ratio $\chi^2$ versus conditional logit (p-value) | 2.44 (0.29) |

Note: Conditional logit and mixed logit models of portfolio allocation. Standard errors clustered by coalition government in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

The second and third columns in Appendix Table 1 present the results of the mixed logit model, which relaxes the independence of irrelevant alternatives assumption by allowing the model parameters to be randomly distributed. Similar to the conditional logit model the mean coefficients indicate that party seat share and party preferences continue to exert a positive and significant effect on the allocation of individual portfolios. At the same time, we find no significant variance for either coefficient while the likelihood-ratio test likewise suggests that
there is no unobserved heterogeneity in these effects. Finally, both models lead to very similar shares of correctly predicted cabinet positions, further strengthening the robustness of the alternative approach modelling mutual independence via a conditional logit model.