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No. 9602

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INTERNATIONAL MACROECONOMICS



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Discussion Paper No. 9602
August 2013

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ABSTRACT

Estimating the preferences of central bankers: an analysis of four voting records*

This paper analyzes the voting records of four central banks (Sweden, Hungary, Poland and the Czech Republic) with spatial models of voting. We infer the policy preferences of the monetary policy committee members and use these to analyze the evolution in preferences over time and the differences in preferences between member types and the position of the Governor in different monetary policy committees.

JEL Classification: C11, E58 and E59

Keywords: central banking, ideal points and voting records

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*We thank Henry Chappell for comments and discussion. Gyula Seres and Michal Kobielarz helped with collecting Hungarian and Polish background information.

Submitted 09 August 2013

1 Introduction

Monetary policy committees come in a variety of shapes and sizes. Some differences between committees are related to the number of committee members, the length of their appointments, the way they are appointed and by whom they are appointed, the decision taking procedure (formal and informal), the possibility of renewal of an appointment, etc. The academic literature has focused on many of these aspects in order to gain insight on what a good design of a monetary policy committee constitutes. Both theoretical and empirical arguments have been put forward in the debate on an optimal design but as it stands many issues are still unresolved. An example is whether external members should have a seat in a monetary policy committee. And if so, what fraction. Central banks such as the Riksbank or the European Central Bank have a monetary policy committee with only internally appointed members. In contrast, the National Bank of Poland has only one internal member and nine external members in its monetary policy committee. Up until recently the bulk of the empirical literature focused on the Federal Reserve and the Bank of England which in turn also influenced the theoretical literature.

Recently some authors have begun to explore decision making at other central banks. As it stands the empirical literature is still scant.¹ Part of this can be explained by the fact that many central banks are still secretive of their decision making process despite the move towards transparency in the past decade(s). As empirical research typically builds upon voting records, this secrecy has hampered research on this topic. However, there are some central banks that do release voting records. Some of these central banks may seem *unimportant* in the global economy, especially in comparison with the Federal Reserve which is -especially since the onset of the financial crisis in 2007- omnipresent in economic news around the globe. We feel that also studying voting behavior at seemingly less important central banks is a worthwhile activity. Each central bank can be seen as a small, real-world laboratory of high stakes decision making. As such, each central bank provides another case study to learn about decision making by (monetary policy) committees and the optimal design of a monetary policy committee.

In this paper we study the voting records of four central banks: the Riksbank (Sweden), the Hungarian National Bank (MNB), the National Bank of Poland (NBP), and the Czech National Bank. With these voting records we are able to estimate the policy preferences of the central bankers appointed in the committees. Our framework for analyzing the voting records are spatial voting models. Two papers have used such models to analyze voting behavior at monetary policy committees, [Hix, Hoyland, and Vivyan \(2010\)](#) and [Eijffinger, Mahieu, and Raes \(2013\)](#). Both papers limit their analysis to the Bank of England.

Our sample of central banks is marked by stark differences in the monetary policy committees. These differences result also in stark differences in the results of our analysis, reinforcing our argument that the literature on decision making at monetary policy committees benefits from considering other central banks.

We find that the position of the chairman relative to the other committee members varies from one monetary policy committee to another. At the Riksbank the chairman tends to hold centrist preferences which some deem to be a natural position for a chairman. At the CNB and NBP we observe chairmen taking positions across the spectrum with some being in the middle and others being more dovish or more hawkish than the median voter. At the MNB we find that the chairman is always on the hawkish side of the board.

The MNB is an interesting case as it is allegedly a very politicized central bank. The majority of

¹[Horvath, Rusnak, Smidkova, and Zapal \(2011\)](#) analyze the drivers of dissent voting in a sample of central banks overlapping our selection of central banks. [Horváth, Šmídková, and Zápál \(2012\)](#) assess how informative voting records are for predicting future policy and consider the same central banks as we do as well as the Bank of England. [Sirchenko \(2012\)](#) develops an econometric framework to analyze the predictability of monetary policy and investigates the voting records of the Polish central bank.

the monetary policy committee members is externally appointed. Both the press and internal members have pointed out that some appointees are politically influenced and have a strong dovish bias. Our finding with respect to the chairmen of the MNB supports this notion. Another way to analyze this claim is to split the monetary policy committee members at the MNB in two groups according to their status: internal or external. For each group we construct the preference of the median voter and subsequently compare this. The results of such an exercise leave no doubt, the median preference among internals is much more dovish than the median preference among the externals. In fact, our model stipulates a probability of 100% that the external median voter is more hawkish than the internal median voter at the MNB.

A similar analysis is undertaken for the NBP. The NBP has appointment procedure with different legislative bodies appointing external members. Our analysis indicates that these groups of external members tend to have preferences which are markedly different from the overall median voter in some cases. However, these preferences are not stable across the boards we observe. For this reason we are not able to distill what drives this result. We do find that despite the clustering of preferences, the overall median voter does not seem to be affected that much.

The larger part of the literature uses the intercepts of individual reaction functions as approximations for the preferences of monetary policy committee members. We find that our approach of estimating spatial voting models complements this nicely. We demonstrate this by comparing our estimates for the preferences at the Riksbank with preferences estimated by [Chappell, McGregor, and Vermilyea \(2013\)](#). For the majority of committee members our results are in line with theirs, but some estimated preferences differ a lot. We single out one such an example, Svensson and discuss why these differences may arise. Our methodology builds on a long tradition in educational statistics and quantitative research on voting in legislative bodies or in judicial courts. Strictly speaking we only need individual voting records. However the approach is very flexible and can easily be extended in many ways. In this paper we follow [Eijffinger, Mahieu, and Raes \(2013\)](#) and use a small modification to make our estimation procedure more robust.

The remainder of this paper is organized as follows. We explain spatial voting models in [Section 2](#) and discuss the assumptions we make as well as the intuition behind the parameters. In [Section 3](#) we present the data we use and we explain how recoded the raw data. In [Sections 4-7](#) we analyze the voting records of the four central banks case by case. We start with the Riskbank ([Section 4](#)), then we consider the MNB ([Section 5](#)), then the NBP ([Section 6](#)) and finally the CNB ([Section 7](#)). In [Section 8](#) we conclude. ²

2 Methodology

The canonical Bayesian method of ideal point estimation is described in [Clinton, Jackman, and Rivers \(2004\)](#). We refer to this approach from here onwards as the *standard approach*. In this paper we present results which are based on a modifications to deal with the small-group nature of our voting records. To fix ideas we first present the standard approach and then introduce and motivate two modifications.

2.1 The Spatial Voting Model

Consider a monetary policy committee comprised of $n = 1, \dots, N$ voters who vote on $t = 1, \dots, T$ policy proposals. The preferred policy or ideal point of a voter n (monetary policy committee member)

²This paper is accompanied by an online appendix where we provide additional results, robustness checks and sensitivity analyses (see also [Section 2](#)). Upon completion of the paper, we intend to make the replication files for this paper available in a publicly accessible deposit.

is x_n a point in \mathbb{R} . Voters have quadratic loss over policies diverging from that location. A *policy choice* t is a choice over two policies ψ_t and ζ_t . Policies ψ_t and ζ_t are functions of a wide range of variables capturing the contemporaneous economic conditions. However, they differ only in the proposed policy rate. In our framework ζ_t is the policy choice with the higher policy rate and ψ_t with the lower policy rate. Thus the choice of a voter n at proposal t is between the more restrictive, hawkish policy proposal and the looser, dovish policy proposal. If voter n chooses ζ_t then we observe $y_{nt} = 1$, if voter n chooses ψ_t we observe $y_{nt} = 0$. The utility voter n derives from ζ_t can be written as: $U_n(\zeta_t) = -\|x_n - \zeta_t\|^2 + \nu_{nt}$. Similarly we write $U_n(\psi_t) = -\|x_n - \psi_t\|^2 + \eta_{nt}$. Utility maximization implies that voter n only chooses the hawkish policy at policy choice t (we observe $y_{nt} = 1$) when $U_n(\zeta_t) - U_n(\psi_t) > 0$, where:

$$U_n(\zeta_t) - U_n(\psi_t) = \|x_n - \psi_t\|^2 + \eta_{nt} - \|x_n - \zeta_t\|^2 - \nu_{nt} \quad (1)$$

$$= (\psi_t^2 - \zeta_t^2) + 2(\zeta_t - \psi_t)x_n + (\eta_{nt} - \nu_{nt}). \quad (2)$$

Estimation requires a specification of the errors. Assuming a type-1 extreme value distribution on the errors leads to a logit specification:

$$P(y_{nt} = 1) = \Lambda(\beta_t x_n - \alpha_t). \quad (3)$$

where $\beta = 2(\zeta_t - \psi_t)/\sigma_t$ and $\alpha_t = (\zeta_t^2 - \psi_t^2)/\sigma_t$. The parameter x_n is the ideal point of voter n or the policy preference of voter n . The parameters β_t and α_t are policy proposal parameters. The parameters β_t are discrimination parameters. These indicate how much the underlying preferences matter in explaining the observed votes. If this parameter is close to zero then the ideal points do not matter in a given vote on proposal t . If it is positive then the ideal points do matter, if it is negative then the observed votes are in the opposite way. This situation, a negative β_t should not arise often in our context since the way we code our data (see further) will make this unlikely. We return to this later on. Consider now a proposal with $\beta_t = 1$. We see that that parameter α_t or the vote-difficulty parameter, captures the overall inclination to vote dovish or hawkish. A large positive α_t reduces the probability of voting for the hawkish choice. On the other hand, for two voters A and B with ideal points x_A, x_B for which we have $x_A < x_B$ we predict voter A to vote for the hawkish choice with a lower probability than voter B. The basic unidimensional spatial voting model, whether estimated using a normal link or a logit link, is unidentified. The predictions from this model depend only on the relative position of the ideal points and difficulty parameters. Consider again a situation with $\beta_t = 1$, then it does not matter whether we have a scale from -30 to -20 or from -5 to +5. A difference of 1 on the original scale corresponds to 1 on the modified scale. As [Bafumi, Gelman, Park, and Kaplan \(2005\)](#) point out, from the point of view of a classical binary choice regression this nonidentifiability boils down to a case of collinearity and can be resolved by constraining the parameters in some way. The β_t parameters induce a second way in which the model is unidentified since we could multiply α_t by a constant and divide $\beta_t x_n$ by the same constant. Resolving this requires a second independent constraint on the set of parameters. The standard approach in Bayesian ideal-point modeling is to assume that ideal points come from a standard normal distribution. This ensures local identification, that is we only need to fix the left-right ordering. The local identification approach is convenient because we can now interpret ideal points equal to zero as being centrist. We then fix the left-right ordering so that negative ideal points correspond to doves and positive ideal points correspond to hawks.

2.2 Dimensionality choice

Ideal-point estimation is developed to uncover a few meaningful dimensions of variation. Previous research on the Bank of England has found that only one dimension, the dove-hawk dimension, captures

the bulk of the variation in voting behavior. [Eijffinger, Mahieu, and Raes \(2013\)](#) recognize that from a theoretical point of view one could argue for at least one other dimension e.g. an activist-gradualist dimension. Central bankers may have in practice a sense of instrument costs (large changes are relatively more costly) or exhibit a fear of reversals. The latter expression refers to the idea that raising the policy rate the month after the policy rate has been cut (or vice versa) shows a lack of consistency.³ However, [Eijffinger, Mahieu, and Raes \(2013\)](#) find that in the case of the Bank of England, one dimension explains the observed voting record very well with the exception of the voting record of Willem Buiter which is explained (slightly) less well. Adding an additional dimension comes with the cost of additional (strong) assumptions to achieve identification.

2.3 Robustness

One issue with the standard approach is that it may not be robust against outliers, see [Bafumi, Gelman, Park, and Kaplan \(2005\)](#) for a discussion on this. Also, as mentioned in [Eijffinger, Mahieu, and Raes \(2013\)](#) the data we have available on monetary policy committees are typically much smaller than those commonly encountered when analyzing voting data. An outlier in this context refers to a vote which is predicted to be 1 with a high probability given the estimated parameters but is in fact 0 or vice versa. To make the ideal point estimator more robust we need to limit the influence of individual votes on voters' ideal points. We do this by using the robust approach suggested by [Bafumi, Gelman, Park, and Kaplan \(2005\)](#).⁴

To limit the influence of individual votes we can place a floor and ceiling to the predicted probability of a 1-vote. A convenient way is to just add two parameters ϵ_0 and ϵ_1 :

$$P(y_{nt} = 1) = \epsilon_0 + (1 - \epsilon_0 - \epsilon_1)\Lambda(\beta_t x_n - \alpha_t). \quad (4)$$

In this specification each voter has an immediate probability of success ϵ_0 and of failure ϵ_1 . The initial item-response model applies then to the remaining outcomes. In this paper we present the results from this approach. We present the results obtained under the follow prior specifications. The x_n follow a $N(0, 1)$ distribution (local identification). The priors for proposal parameters are: $\alpha_t \sim N(0, 4)$ and $\beta_t \sim N(1, 4)$ truncated from below at zero. The priors for the proposal parameters are fairly diffuse. The truncation of the β_t parameter ensures that the discrimination parameter cannot become negative. This makes sense since we code the votes so that a 1 always corresponds to the higher alternative when voting over two alternatives. With the β_t restricted to nonnegative values we have that hawks (voter with a positive ideal point) are more inclined to vote for the hawkish proposal. A discussion on the restriction can be found in [Eijffinger, Mahieu, and Raes \(2013\)](#). Finally we specify priors for the errors: $\epsilon_0 \sim \text{Unif}(0, 0.1)$ and $\epsilon_1 \sim \text{Unif}(0, 0.1)$. We refer to this specification as the *robust* model.

2.4 Sensitivity analysis and model checks

The analysis we present in the paper is based on the spatial model described by equation 4 with the priors as described in subsection 2.3. We have undertaken some sensitivity analyses and model checks which we do not report fully in this paper to conserve place. The results of the additional analyses are presented in an online appendix to this paper. Specifically we report in that appendix the following: (1) A comparison of our prior choice with alternative prior choices. (2) An overview of the estimated ϵ_0 and ϵ_1 parameters. This overview suggests that the robust version we use in this paper is only relevant

³We thank Willem Buiter for pointing this out and providing insight on monetary policy deliberations in practice.

⁴This robust approach was also used by [Eijffinger, Mahieu, and Raes \(2013\)](#) who present some evidence on the advantages of this approach.

Table 1: Overview of the voting records

	Sample Period	# policy choices	# votes (after recoding)	# voters	# internals
Riksbank	Jan 1999 - Feb 2013	115	55	6	6
CNB	Feb 1998 - Feb 2013	157	82	7	7
MNB	Oct 2005 - Apr 2013	93	87	varies	minority
NBP	Feb 1998 - Dec 2009	143	109	10	1

This table presents an overview of the data. The Riksbank is the Central Bank of Sweden, CNB stands for Czech National Bank, NBP stands for the National Bank of Poland and MNB is the shorthand for the Central Bank of Hungary.

for the Czech National Bank and to some extent the Riksbank. Overall the model we propose seems to outperform the standard approach only by a small margin. Given the ease with which the modification can be implemented we prefer to stick with the adapted model.

3 Data

The four central banks we study have a different institutional setup. Of the four, the Riksbank has the smallest monetary policy committee. The Czech National Bank (CNB) has seven members while the National Bank of Poland (NBP) has ten members. The size of the Hungarian central bank (MNB) underwent changes. In 2005 there were thirteen voting members whereas today the board consists of seven members. The Riksbank and the Czech National Bank have only internal members in their board, while Hungary and Poland have a majority of external members. Poland has even only one internal member on the committee. The frequency of planned meetings differs also. The central banks of Poland and Hungary hold twelve meetings a year. Up until 2007, the Czech National Bank also had twelve meetings a year, but since then only eight meetings. The four committees use majority voting. In case of a tie, the chairperson has the casting vote. This is especially relevant for the National Bank of Poland and the Riksbank who have an even number of committee members. In this paper we use the voting records of these central banks. The voting records of these central banks were obtained from their respective websites. One exception is the data for Poland. For Poland we build upon the dataset developed by [Sirchenko \(2011\)](#). A summary of the data is presented in Table 1.

To be amenable to the econometric framework described above we recode the data. Unanimous votes were dropped as these are uninformative for our purposes. The remaining votes were coded as decisions over two alternatives. To make this clear consider the following fictitious example which is summarized in Table 2.

Table 2: Example of how voting records we coded

Example 1:			Example 2:		
Name	Vote Casted	Coded once as	Vote Casted	Coded once as	Coded a second time as
Alice	-0.25	0	+0	0	0
Bob	+0	1	+0.25	1	0
Cameron	+0	1	+0.25	1	0
David	+0	1	+0.5	1	1

This table explains how the data was coded. Example 1 shows the situation where there were only two alternatives favored. In Example 2, votes were split among three policy choices.

We have a meeting with four voters: Alice, Bob, Cameron and David. Consider a meeting where Alice votes for lowering the policy rate with 0.25% whereas the other three vote for no change in the policy rate. Since the vote by Alice represents the dovish choice, we would code the vote of Alice as 0 whereas the other three votes would be coded as 1. Now consider a meeting where Alice votes for no change, Bob and Cameron vote for raising the policy rate with 25% and David votes for raising the policy rate with 0.5%. This voting record would be coded *twice*. Once as a choice over no change (coded as 0) and an increase in the policy rate (coded as 1). A second time as a choice over no change or an increase with 0.25% (coded as 0) and an increase of 0.5% (coded as 1).

Using the coding scheme described here, we recoded the voting records we study in this paper. We now analyze these voting records country by country.

4 Sweden

In January 1999 an Executive Board with six full-time members was established at the Sveriges Riksbank. In this section we analyze the voting record from the Executive Board. A description of the first eleven years can be found in [Ekici \(2009\)](#).

Members of the Executive Board are elected for periods of five to six years. Initially the terms of office for the board members varied so that only one member would need to be replaced each year. However, some members have resigned before the end of their appointment, disrupting this arrangement. In [Figure 1](#) we present the ideal point estimates. The estimates we present here and throughout the paper are the results of estimating [equation 4](#) with priors specified in [subsection 2.3](#). The lines represent the 95% (Bayesian) confidence intervals, whereas the dots represent the point estimates for the ideal points.⁵

The ideal point estimates suggest that only Persson and Svensson are clear doves. The group of hawks consists of Ingves, Wickman-Parak, Jansson, af Jochnick, Oberg, Srjeber. The other Board members belong to the centrist group. Next it may be of interest to see how the preferences of the Executive Board evolved over time. Following [Ekici \(2009\)](#) we distinguish six board compositions. An overview of these board compositions can be found in [Table 3](#).

Table 3: Board compositions

Board #	Members
Board 1	Bergstrom, Backstrom*, Heikensten, Hessius, Nyberg, Srjeber
Board 2	Bergstrom, Backstrom*, Heikensten, Nyberg, Persson, Srjeber
Board 3	Bergstrom, Heikensten*, Nyberg, Persson, Rosenberg, Srjeber
Board 4	Ingves*, Nyberg, Persson, Rosenberg, Srjeber, Oberg
Board 5	Ingves*, Nyberg, Wickman-Parak, Rosenberg, Svensson, Oberg
Board 6	Ekholm, Ingves*, Nyberg, Wickman-Parak, Svensson, Oberg

This table summarizes the different compositions of the Executive Board of the Riksbank and is based on [Ekici \(2009\)](#), [Figure 1](#). The asterisk indicates the chairman.

For each of these compositions we calculate the median voter ideal point as well as the heterogeneity in ideal points among board members. Since the estimates of the ideal points are subject to uncertainty, this should be taken into account when exploring the median voter and the heterogeneity as well. With the output of our MCMC sampler we can induce a posterior density over the median voter and the het-

⁵The point estimate and the confidence intervals are *summaries* of the marginal posterior probability distribution we obtained on the ideal points. The point estimate is the median of the posterior whereas the Bayesian confidence interval (or credible interval) is constructed by taking the 2.5th and 97.5th quantile of the posterior. A discussion on the differences between classical and Bayesian inference can be found in [Jackman \(2009\)](#).

Revealed Preferences at the Riksbank

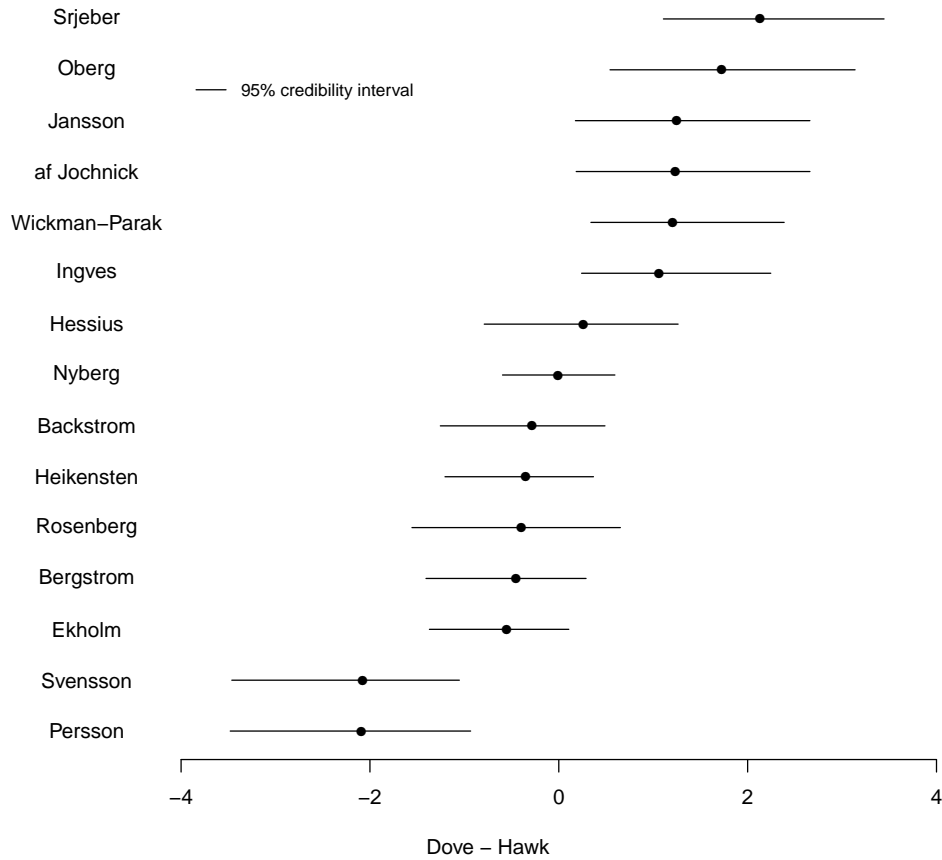


Figure 1: This figure is a graphical representation of the estimated ideal points of the monetary policy committee members. A point indicates the estimate of the ideal point, the thin line represents the 95% (Bayesian) confidence interval.

erogeneity. At each iteration k we have a sample $\xi^{(k)}$ from the joint posterior probability distribution. For each iteration k we can calculate the median and the standard deviation (our measure of heterogeneity) of the ideal points. By calculating both statistics over all iterations $k = 1, \dots, K$ we obtain a posterior density over both statistics.

The results of these calculations can be found in Figure 2. The left graph shows the evolution of the median voter. We see that the median preference is stable throughout the different board compositions. The heterogeneity in policy preferences was initially smaller and subsequently increased a bit until it stabilized.

In our sample the Executive Board was chaired by three different governors: Backstrom, Heikensten and Ingves. It is of interest to see what the preference of the chairman is compared to the other board members. To gauge this, we construct the rank distribution of the chairmen in the different board compositions in similar fashion as we constructed posterior distribution for the median voter and the heterogeneity among voters.⁶ For each iteration k we now produce a rank of the ideal points $r^{(k)} = (r_1^{(k)}, \dots, r_n^{(k)})$ where $r_i^{(k)}$ is the rank of ideal point x_i in iteration k . Each element of $r^{(k)}$ is an integer $r_i^{(k)} \in \{1, \dots, n\}$ with n being the number of ideal points. The posterior probability that an

⁶This idea is explained in Jackman (2009) p.448.

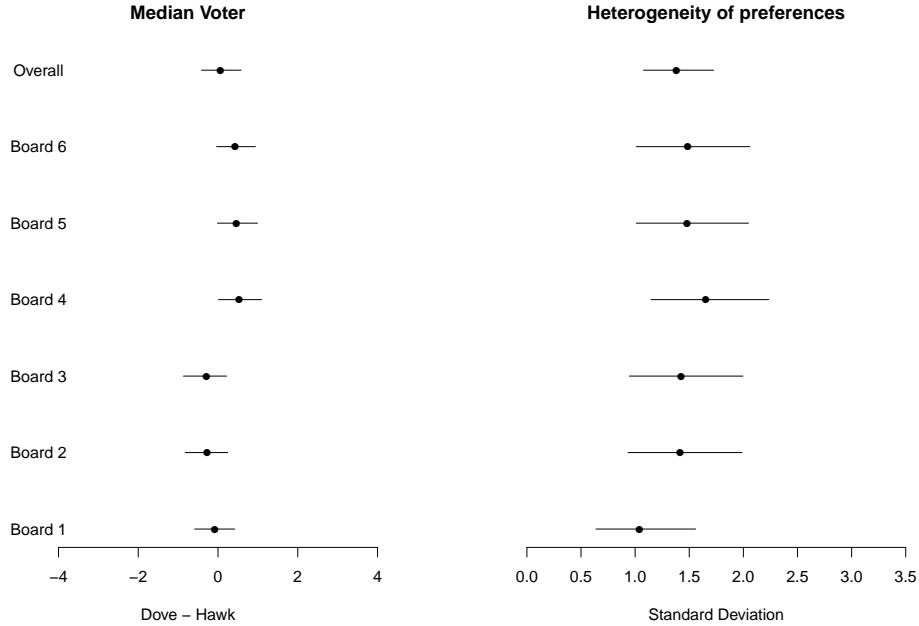


Figure 2: This figure is a graphical representation of the evolution of the median voter and the heterogeneity in preferences in the different executive boards of the Riksbank.

individual n occupies a rank is the proportion of times we see that event over the K iterations of the MCMC sampler.

Figure 3 presents these rank distributions as histograms. We see that in each board composition the governor had a fairly *centrist* position. For Backstrom and Heikensten we find a rank distribution where a wide range of ranks are likely. However both governors have zero probability of being the most hawkish in their executive board. During their tenure, Srjeber was part of the executive board. As can be seen in Figure 1 our estimations suggest that she was much more hawkish than both governors. This finding aligns with the the analysis of Ekici (2009) who reports that Srjeber diverged most from the majority and voted in each case for the higher interest rate. Ingves chaired three boards where he was clearly more hawkish than two of the other board members, Svensson and Ekholm. However among the other board members he seem to be the most moderate. The ideal points in Figure 1 suggest that Ingves has been a more hawkish governor than Heikensten or Backstrom. We can calculate this probability by comparing for each iteration k whether the ideal point of Ingves $x_{\text{Ingves}}^{(k)}$ is larger than the ideal points of Heikensten $x_{\text{Heikensten}}^{(k)}$ and Backstrom $x_{\text{Backstrom}}^{(k)}$. The proportion of the K iterations that $x_{\text{Ingves}}^{(k)} > x_{\text{Heikensten}}^{(k)}$, is then the probability that Ingves is more hawkish than Heikensten. We find that Ingves was a more hawkish governor than both Heikensten and Backstrom with a probability of more than 95%.

4.1 A Validity Check

In our analysis we use spatial voting models to infer the policy preferences of members of the executive committee. The dominant approach in the literature to infer policy preference is the estimation of random intercept reaction functions. The intercept (one for each policy committee member) is subsequently interpreted as policy preference of a voter. Such an approach is used by many authors analyzing voting records of monetary policy committees (mostly for the Bank of England). In a recent paper, Chappell, McGregor, and Vermilyea (2013) estimate policy preferences with this approach for the Riksbank. We compare here our estimated preferences with their results. In Figure 4 we have plotted our estimated

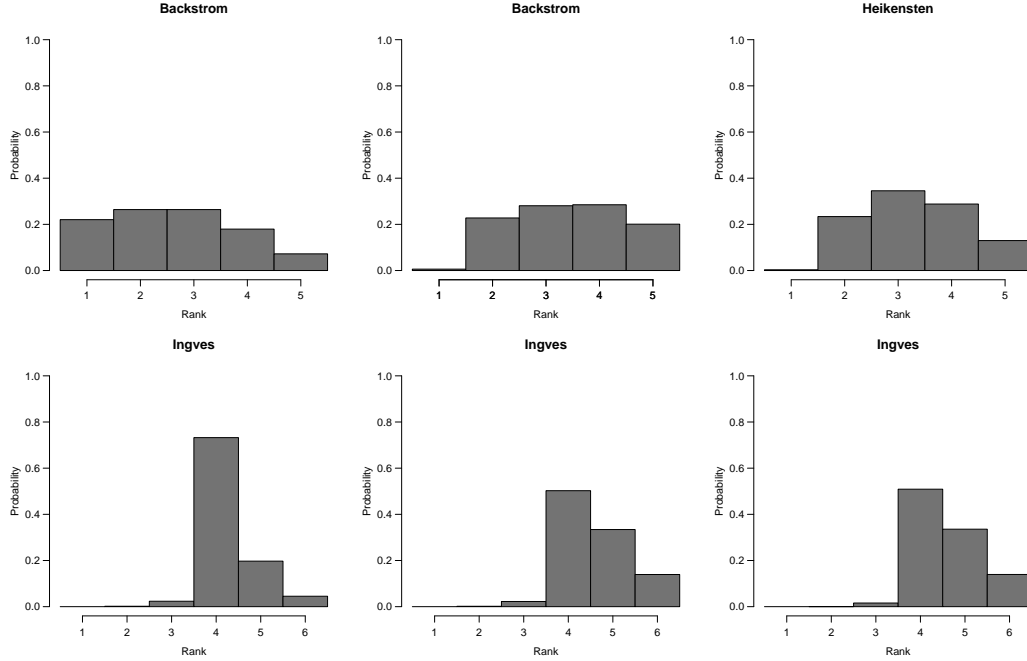


Figure 3: Marginal Posterior Mass Functions of the Governor in the different executive boards.

preferences (on the horizontal axis) against their results (vertical axis). The upward sloping line represents the regression of our preferences against their estimates. [Chappell, McGregor, and Vermilyea \(2013\)](#) use a shorter sample (2000-2008) so we can only compare for a subset of the ideal points presented earlier.

The graph shows that while there is *some* agreement between our results and the preferences presented in [Chappell, McGregor, and Vermilyea \(2013\)](#) some preferences are quite different. As an example consider Svensson. [Chappell, McGregor, and Vermilyea \(2013\)](#) report an intercept of 0.59 for Svensson⁷ which is interpreted as a measure for policy preference. This intercept is the second largest implying a preference for high interest rates when compared to the other board members. In contrast, we find for Svensson an ideal point estimate which is the second most dovish. This suggests a preference for low interest rates. This difference is remarkable.

We see a few reasons for the differences. The authors have a shorter sample and in particular we have more observations on Svensson which allows for better inference. However, in our recoded dataset, Svensson voted only 2 times for the hawkish policy choice, but 26 times for the dovish policy choice in 28 (recoded) votes.⁸ This suggests a classification which puts Svensson in the dovish category instead of the hawkish. Additionally, the authors use a simulated maximum likelihood approach to deal with their complex and non-linear model. Given the small sample they use, it is questionable how well this approach can recover the parameters. [Jackman \(2009\)](#) suggests that problems like this ought to be tackled with a Bayesian approach which has the additional advantage that one does not have resort to a hypothetical sampling distribution.⁹ Finally the authors do not report standard errors. While the rationale they provide for this is reasonable, it may be the case that the estimate for the preference of Svensson is very imprecise and we are not that certain that the model by [Chappell, McGregor, and Vermilyea \(2013\)](#) is

⁷See Table 6 model 1 or Table 7 in [Chappell, McGregor, and Vermilyea \(2013\)](#).

⁸Remember that we ignore unanimous meetings as they are uninformative for inferring differences between voters.

⁹We are not aware of monte carlo studies that have investigated how well maximum likelihood performs in the context of [Chappell, McGregor, and Vermilyea \(2013\)](#) but in other contexts monte carlo studies have found that an appropriate Bayesian approach outperforms maximum likelihood in small samples and with complex likelihood functions, see for example [Stegmueller \(2013\)](#).

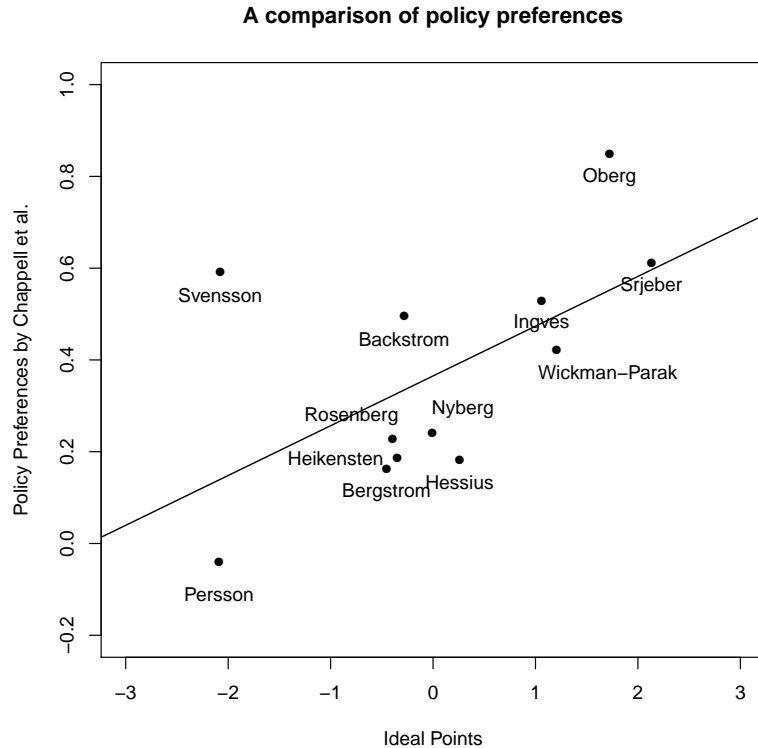


Figure 4: Comparison of our ideal point estimates with the policy preferences reported by Chappell, McGregor, and Vermilyea (2013). The ideal points (see Figure 1) are on the horizontal axis, the estimated preferences by Chappell, McGregor, and Vermilyea (2013) are on the vertical axis. The line represents the regression of our ideal points on the intercepts reported by Chappell, McGregor, and Vermilyea (2013).

entirely suitable for the limited data they have to work with.

5 Hungary

The voting record for the MNB starts in October 2005, the month in which the MNB started reporting individual votes in an effort to increase transparency and predictability.¹⁰ Over time the size of the Monetary Council has changed. In March 2005 the government adapted the appointment rules of the MNB. The size of the committee was increased by four to thirteen members. All four new members were appointed by the prime minister. This intervention as well as other amendments of the appointment rules reflect the (public) confrontations between the government and the MNB.¹¹ Currently the Monetary Council consists of seven members of which are four external. Although the size varies over our sample, the external members are always in majority.¹² The institutional tensions are also reflected in high dissent rates. As before, we start by inspecting the ideal point estimates. Figure 5 presents the estimates.

We notice a group of clear hawks: Adamecz, Auth, Jarai, Karvalits, Kiraly, Kopitz and Simon. Also Bihari P., Hardy and Kadar could be classified as hawks as the confidence intervals on their ideal

¹⁰ We miss one meeting in our dataset. The MNB decided to withhold information on the votes on one occasion however. This happened in October 2008 when, in the peak of the financial turmoil, the Monetary Council held an unscheduled meeting and decided to increase the interest rate by 300 basis points.

¹¹ Governor J arai referred to his tenure at the Monetary Council “as 1 year of work and 5 years of fighting” during his last press conference following the meeting of February 2007. See Jung and Kiss (2012).

¹² A more thorough description of Monetary Policy at the MNB as well as additional references can be found in Jung and Kiss (2012).

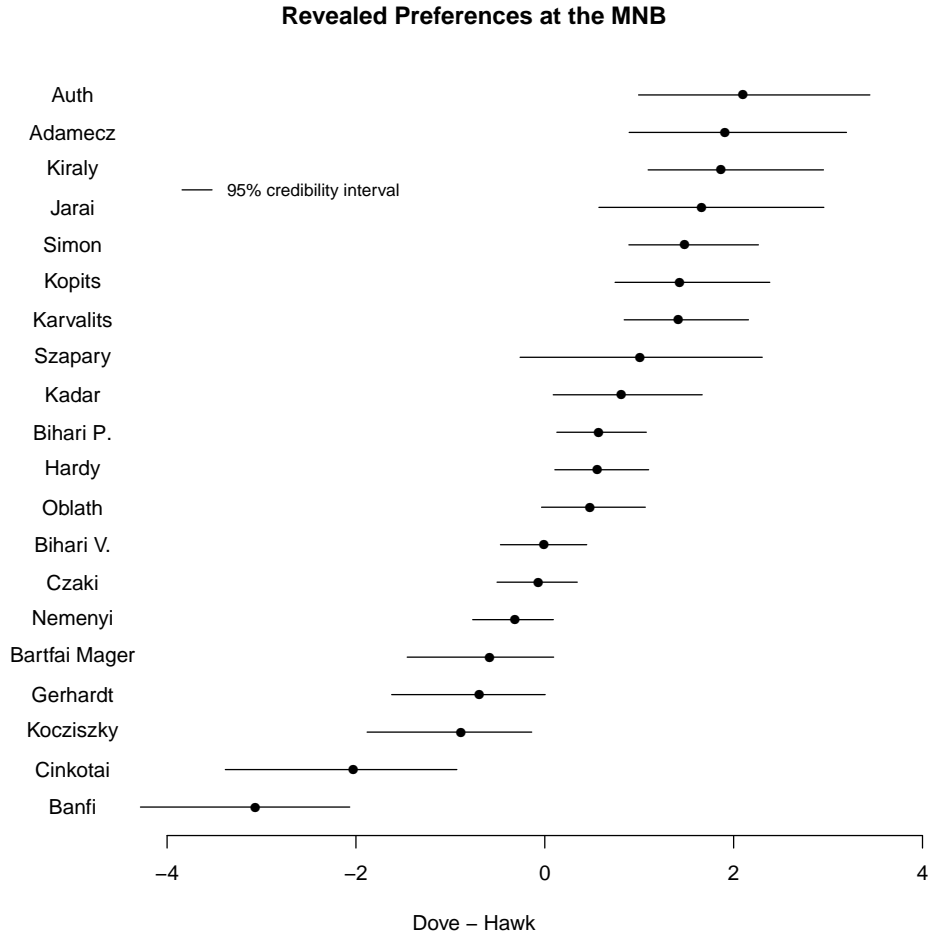


Figure 5: This figure is a graphical representation of the estimated ideal points of the monetary policy committee members. A point indicates the estimate of the ideal point, the thin line represents the 95% (Bayesian) confidence interval.

points do not include zero. The doves consist of Banfi, Cinkotai and Koczinsky. The remaining group is classified as centrist. The Hungarian case is an example of a politicized monetary policy committee. As mentioned above, the influence of the government was formally strengthened by a series of laws which ensures that a majority of the monetary policy committee is external and appointed by the parliament. In practice this leads also to conflicting views between internal and external members as the quote by J arai alludes to.

We quantify the difference between internals and externals in two ways. First we consider the median ideal point as well as the heterogeneity in ideal points in the same way as we have done before. The results of this exercise are show in Table 4. We see that we estimate the internal Median Voter to be hawkish with an estimated ideal point a little over 1.5. The external Median Voter is more dovish with an estimated ideal point of nearly -0.5 . The confidence intervals on both ideal points do not overlap and so our results clearly suggest that the Median Voter among the internals is very different and much more hawkish than the Median Voter among the externals.¹³ When we compare the heterogeneity in ideal points among internals and externals we find that a larger dispersion in ideal points among externals

¹³If we calculate the probability that the external Median Voter is more hawkish than the internal Median Voter, we obtain a probability of 100%. That is in *all* iterations of our Markov Chain we find a larger median ideal point among externals.

Table 4: Comparing internals and externals

	Estimate	Confidence Interval
Median Voter Internals	1.62	[1.15,2.17]
Median Voter Externals	-0.10	[-0.44,0.25]
Median Voter Overall	0.55	[0.21,0.91]
Heterogeneity Internals	0.63	[0.24,1.22]
Heterogeneity Externals	1.27	[1.00,1.59]
Heterogeneity Overall	1.44	[1.20,1.72]

This table presents the point estimates for the median voters, as well as the 95% confidence intervals.

albeit that the confidence intervals overlap.

Another way to assess the difference is to construct the rank distribution as we did before. We make a rank distribution for the two governors for which we have data. We construct the rank distribution by ranking them against all other committee members for which we observe overlapping vote histories in or dataset. The results of this exercise can be found in the top row of Figure 6. To make the difference between the chairman and the externals members even more explicit, we repeat this exercise but we exclude now the other internals members. The bottom row of Figure 6 shows presents the rank distributions of this exercise.

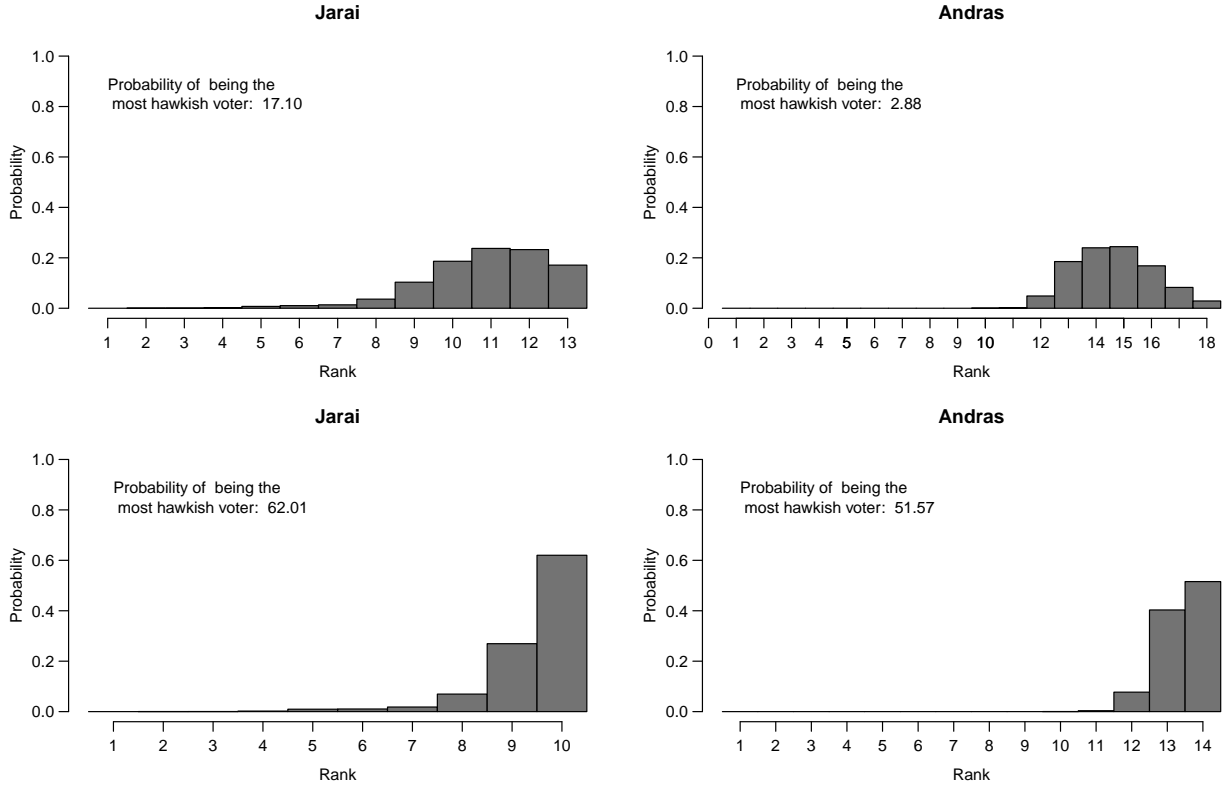


Figure 6: Marginal Posterior Mass Functions of the Governor in the different executive boards. The bottom row provides a rank distribution without the internal members.

The histograms clearly show how both chairmen ranked amongst the most hawkish voting members when they chaired the Monetary Council. Taken together with the difference in median ideal points

between internal and external members it is clear that the policy preference between internal and external members are starkly different. Internal members tend to be less dovish than external members.

6 Poland

For Poland we have data on individual votes from 1998 onwards. This was the same year that the National Bank of Poland (NBP) abandoned the exchange rate based monetary regime and introduced inflation targeting. Similar to the MNB in Hungary the NBP communicates mainly through the Bank's Inflation Report. Throughout the years the NBP made several improvements in its communication strategy, see [Jung and Kiss \(2012\)](#).

A peculiar aspect of the Monetary Policy Council of the NBP is that the council consists of ten members of which nine are external. The only internal member is the NBP president. The senate (upper house of the parliament), the sejm (the lower house of the parliament) and the president each appoint three external members. An overview of these appointments is given in [Table 5](#). The contracts of these nine external members expire at the same time so the Monetary Policy Council gets nearly completely renewed each six years. The only element of continuity is the President. Also the President has a six year contract but his appointment is staggered.¹⁴

Table 5: Appointments at the NBP

Board	Appointed by	Names
1998-2004	Senate	Grabowski, Jozefiak, Laczkowski
	Semj	Czekaj ^a , Dabrowski, Krzyzewski ^a , Pruski
	President	Rosati, Wojtowicz, Ziolkowska
	Internal	Gronkiewicz-Waltz, Balcerowicz
2004-2010	Senate	Noga, Owsiak, Wasilewska-Trenner
	Semj	Nieckarz, Pietrewicz, Czekaj
	President	Fillar, Slawinski, Wojtina
	Internal	Balcerowicz, Skrzypek

This table displays who appointed which monetary policy committee members. The top panel shows this for the 1998-2004 board and the bottom panel the 2004-2010 board. (a): Czekaj replaced Krzyzewski who passed away before the end of his tenure.

The fact that nearly the entire board gets replaced every six years has implications for our ideal point estimates. To be able to classify voters we need to have some overlap in observations. We can evaluate two voters who have never voted at the same meeting as long as we have sufficient *bridging* observations. That means that we need observations on someone who was present and voted in meetings with both voters. When voting records are completely separated, we need to make strong assumptions to be able to combine these records. In our dataset, after recoding the data as described in [section 3](#) we have only one bridging observation and which is insufficient. For this reason we decided to treat the different boards separately.

In [Figure 7](#) we present the ideal point estimates for the board in office between 1998 and 2004. We present the ideal point estimates on 12 members since the first chairman Gronkiewicz-Waltz retired early. His successor was Balcerowicz. Janusz Krzyzewski was replaced by Jan Czekaj after a tragic death. The hawks consist of Dabrowski, Gabrowski, Jozefiak, Laczkowski and Pruski, where Dabrowski is much more pronounced hawkish than the others. The group of doves consists of Krzyzewski, Rosati, Wojtowicz,

¹⁴The reason for this is the early retirement of Gronkiewicz-Waltz in December 2000. In 2010 then Chairman Skrzypek died in a plane crash and was replaced by Belka, just four months after the appointment of nine new external members.

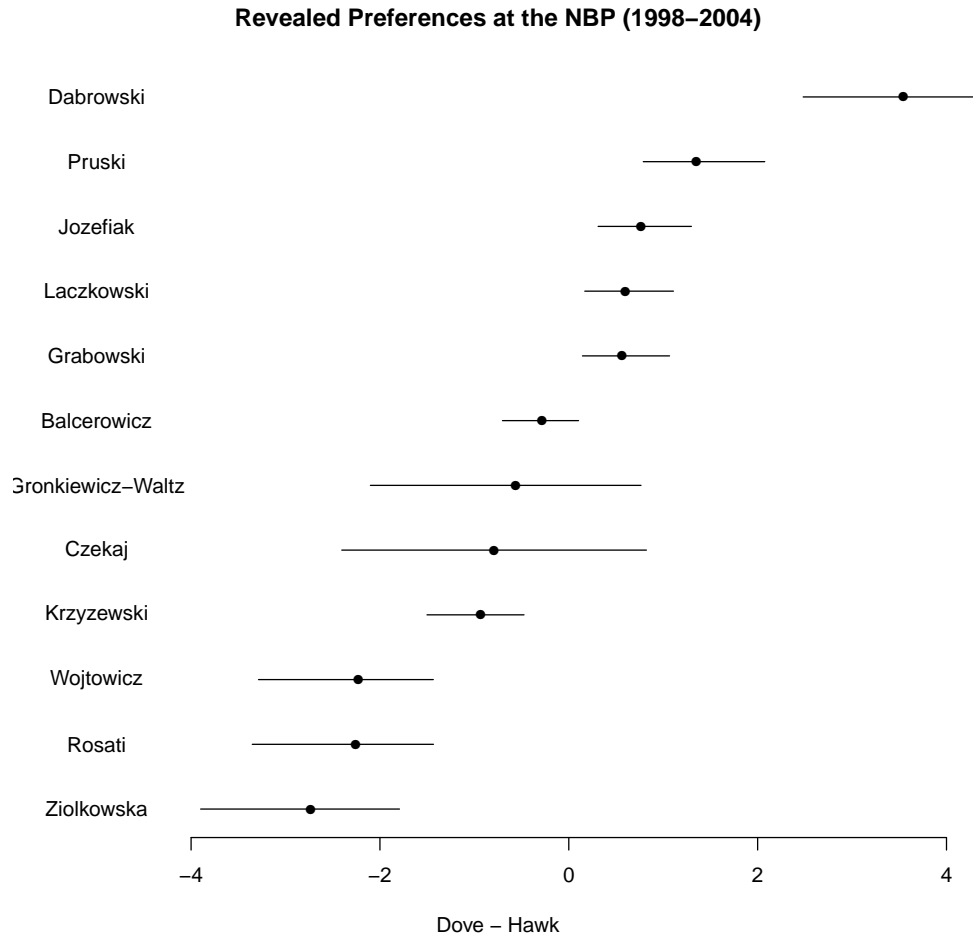


Figure 7: This figure is a graphical representation of the estimated ideal points of the monetary policy committee members. A point indicates the estimate of the ideal point, the thin line represents the 95% (Bayesian) confidence interval.

Ziolkowska. The centrists are Czekaj, Balcerowicz and Gronkiewicz-Waltz. The wide confidence intervals on Czekaj and Gronkiewicz-Waltz reflect the limited amount of observations we have available on these board members.

In Figure 7 we present the ideal point estimates for the board in office between 2004 and 2010. We show the estimates of eleven board members. The term of Balcerowicz ended in 2007 and he was succeeded by Skrzypek. The results suggest that Fillar is the most hawkish, but also Balcerowicz, Wasilewska-Trenner and Noga are hawks. The group of doves consists of Nieckarz, Owsiak, Pietrewicz, Slawinski, Czekaj and Skrzypek. The centrist group only consists of Wojtyna. It is remarkable that the ideal point estimates are so far stretched out and that we only a small centrist group.

We have two voters for which we have estimated ideal points with the 1998-2004 sample. The estimates for Czekaj point in the same direction although we had a very wide confidence interval for the 1998-2004 estimate. The remarkable finding is that the ideal point of Balcerowicz is remarkably different in both periods. For the 1998-2004 sample we find a centrist ideal point, whereas for the 2004-2010 sample we find an outspoken hawkish ideal point. What explains this stark difference? The ideal point estimation is a measurement exercise where the relative position of preferences matters. Either it could be the case that Balcerowicz truly became more hawkish in his second term. Or it could be that the

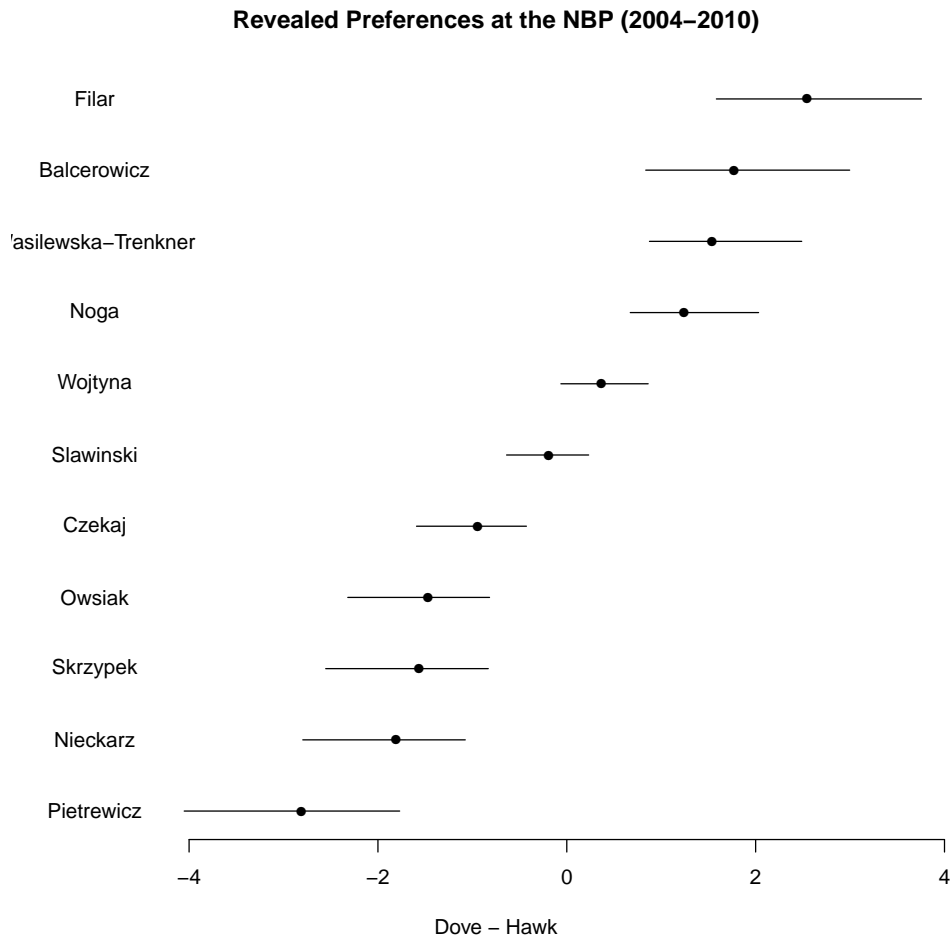


Figure 8: This figure is a graphical representation of the estimated ideal points of the monetary policy committee members. A point indicates the estimate of the ideal point, the thin line represents the 95% (Bayesian) confidence interval.

board in the 2004-2010 term was more dovish than in the board in 1998-2004. However, the ideal point of Czekaj is similar in both boards suggesting that the 2004-2010 board was not vastly more dovish than before. But as mentioned before the very wide confidence interval on Czekaj lends little weight to this argument. With the data available we cannot tell. The data suggests indeed that there was a difference between the voting behavior of Balcerowicz in both boards. In the first board over 60% of the votes for the dovish choice, whereas in the second board he did so in less than 10% of the votes.¹⁵

In our sample on the Polish National Bank we observe four different chairmen. We now explore how they ranked in terms of dovishness compared to the board members who were on the board in the same period. For the 1998-2004 period, we find that both chairmen ranked fairly centrist. In the 2004-2010 period we find that Balcerowicz had an outspoken hawkish voting profile whereas Skrzypek voted very dovishly.

One peculiarity of the Polish monetary policy committee is the presence of nine external members and only one internal member, the governor. Moreover, the external members consist of three groups: external members appointed by the senate, the sejm and the parliament. We compare these three groups with each other and with the governor. The results are presented in Figure 10. The left graph shows

¹⁵This count does not include unanimous meetings (see earlier). Also some meetings count as multiple votes as explained in section 3.

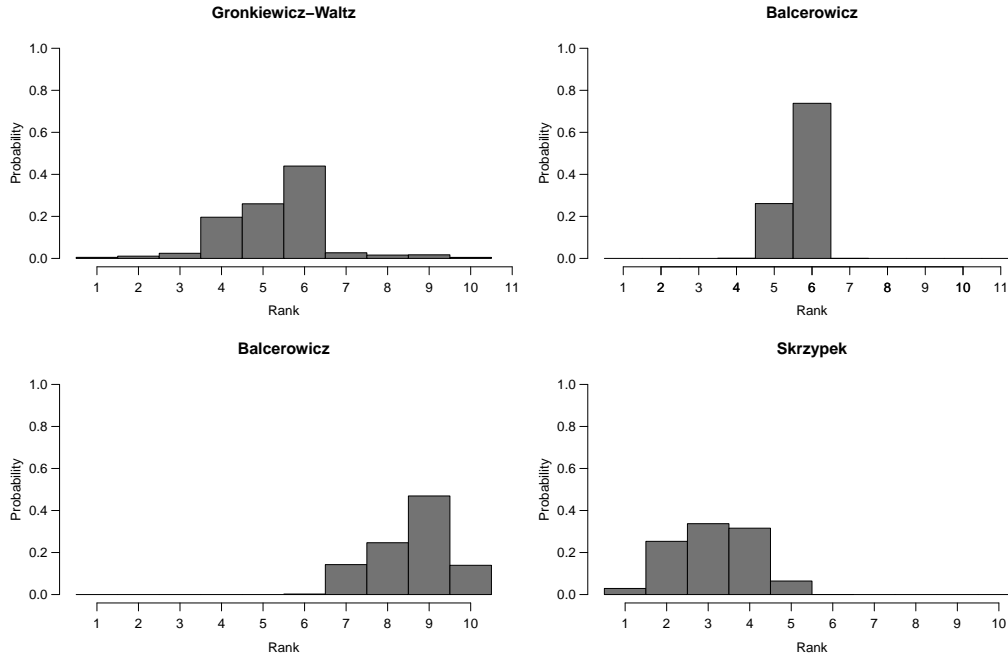


Figure 9: Marginal Posterior Mass Functions of the Governor in the different executive boards.

the median voter for the 1998-2004 board. We see that the median voter among the appointees by the president are far more dovish than the median voter among the other groups of external members. The right graph shows the results for the 2004-2010 board. This time it are the appointees of the Sejm who appear to be more dovish. These results suggest that there are different in groups of voters depending on whom they were appointed by. However, in contrast to the Hungarian case, the influence does not go in one direction. This suggests less political influence on the voting behavior of the monetary council of the NBP than in the Hungarian case. This conclusion is reinforced by the fact that in both board, the preference of the internal members does not seem to deviate a lot of the overall median voter nor from the median voter of two of the three groups of externals.

7 Czech Republik

In this section we analyze the voting record of the Czech National Bank. The monetary policy committee at the Czech National Bank consists of seven members, all of which are internally appointed. We distinguish eight different board compositions in our sample. An overview is given in Table 6.

We start by inspecting the ideal point estimates for all monetary policy committee members. These are shown in Figure 11. This Figure indicates that the group of hawks consists of Zamrazilova and Niedermayer. The group of doves consists of Singer, Tomsik, Lisal, Frait and Tosovsky. The remaining board members are classified as centrist. This group is rather large compared to our results for other countries (see for example Poland).

For each of these boards we calculate the median voter as well as the heterogeneity in preferences. The results of these calculations are summarized in Figure 12. The median voter seems to be fairly stable across boards. The heterogeneity in preferences at the board was the highest in board 4 but has decreased a bit since then.

We also inspect the position of the board chairman in the eight boards we distinguished earlier. We find that Tosovsky, as a chairman, leaned towards to dovish side. Tuma began as a centrist. But due to

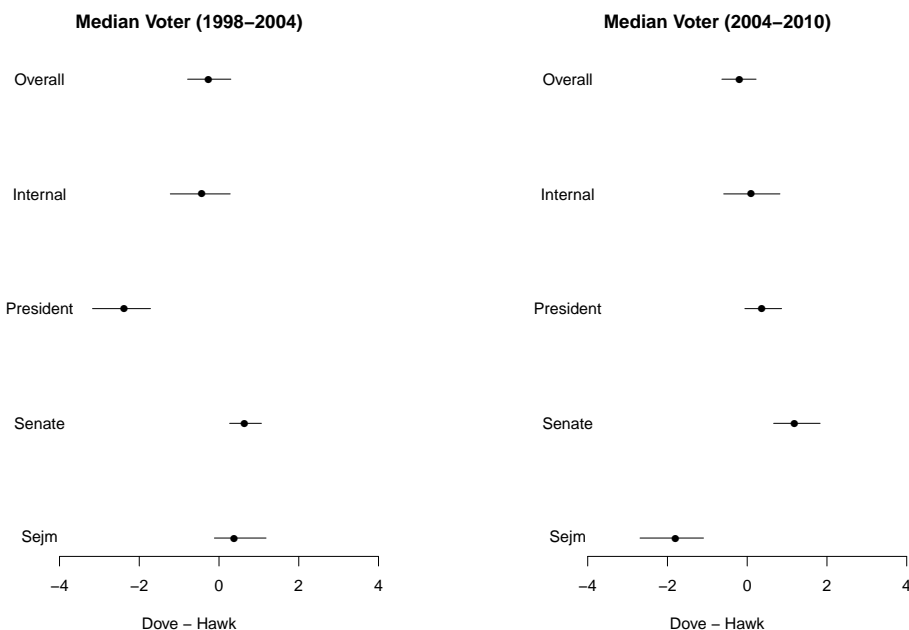


Figure 10: This figure is a graphical representation of the evolution of the median voter in the two different executive boards. of the Riksbank.

Table 6: An overview of different board compositions at the CNB

Board #	Period	Members
Board 1	27/08/1998-28/01/1999	Kysilka, Vit, Hrcir, Kaftan, Niedermayer, Pospisil, Tosovsky*
Board 2	25/02/1999-21/12/2000	Tuma, Niedermayer, Dedek, Racocho, Stepanek, Tosovsky*, Hrcir
Board 3	25/01/2001-27/01/2005	Tuma*, Niedermayer, Erbenova, Frait, Dedek, Racocho, Stepanek
Board 4	24/01/2005-20/12/2006	Tuma*, Niedermayer, Erbenova, Frait, Holman, Rezabek, Singer
Board 5	25/01/2007-07/02/2008	Singer, Hampl, Tomsik, Rezabek, Holman, Tuma*, Niedermayer
Board 6	26/03/2008-23/06/2010	Singer, Hampl, Tomsik, Rezabek, Holman, Tuma*, Zamrazilova
Board 7	05/08/2010-03/02/2011	Singer*, Hampl, Tomsik, Janacek, Rezabek, Holman, Zamrazilova
Board 8	24/03/2011-	Singer*, Hampl, Tomsik, Janacek, Lizal, Rezabek, Zamrazilova

This table summarizes the different compositions of the Executive Board of the Czech National Bank. The asterisk indicates the chairman.

changes in composition at the board we rank him increasingly hawkish (although we still see him taking the middle ground within his board). Singer finally, was a clear dove in his board.

8 Conclusion

Up until recently, the empirical literature on voting at monetary policy committee focused almost exclusively on the FOMC and the MPC of the Bank of England. In this paper we analyzed votes of monetary policy committees which only recently have begun to receive attention. Our analysis centers around spatial models of voting which offer a convenient way of estimating preferences of central bankers. This approach is commonly used in the analysis of voting behavior at the US congress and senate or in judicial courts. In the context of voting at central banks, this modeling approach has to our knowledge only been used for the analysis of votes at the Bank of England, see [Hix, Hoyland, and Vivyan \(2010\)](#) and [Eijffinger, Mahieu, and Raes \(2013\)](#).

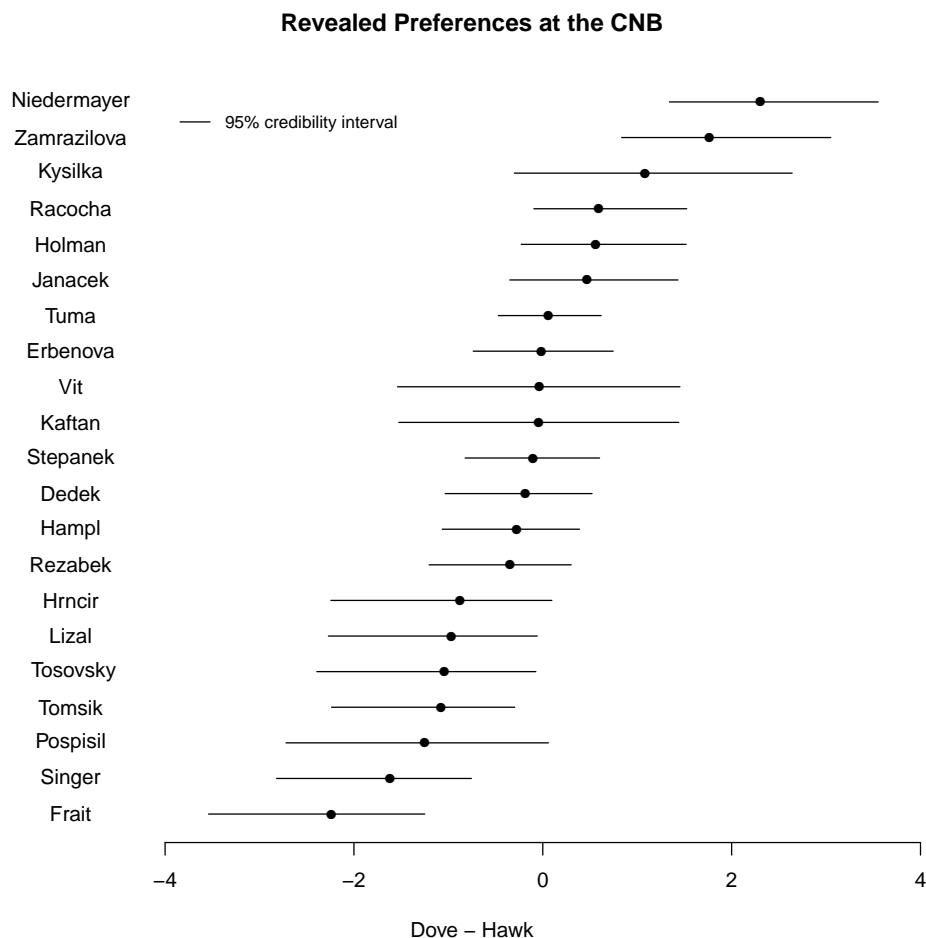


Figure 11: This figure is a graphical representation of the estimated ideal points of the monetary policy committee members. A point indicates the estimate of the ideal point, the thin line represents the 95% credibility interval.

Each central bank provided another case study to learn about voting at monetary policy committees. The analysis of the Riksbank showed that the chairmen tend to hold centrist positions in their board. This is in line with the notion of a chairman as a consensus builder and is sometimes seen as a *natural position* for a chairman, see [Jung and Kiss \(2012\)](#). The Swedish case also provided the possibility to compare our approach with the predominant approach for estimating preferences, the estimation of varying coefficient reaction functions. In a recent paper, [Chappell, McGregor, and Vermilyea \(2013\)](#) used such a modeling strategy to analyze the voting records of the Riksbank as well. Comparing both methods revealed that they tend to agree for the majority of voters. However, for a few voters the results diverged and we provided some reasons why this might be the case. In particular their method does not provide measures for uncertainty surrounding the point estimates. At the same time it may be questioned whether the approach is suitable for uncovering parameters in small samples. Our estimates seem to make more sense -from a statistical and economic viewpoint. In particular we classify Svensson as a dove whereas the estimates in [Chappell, McGregor, and Vermilyea \(2013\)](#) place him among the hawks. The voting records seem to favor our classification.

The analysis of the MNB provided the opportunity to analyze votes of an allegedly politicized monetary policy committee. The MNB has a monetary policy committee where the majority is appointed

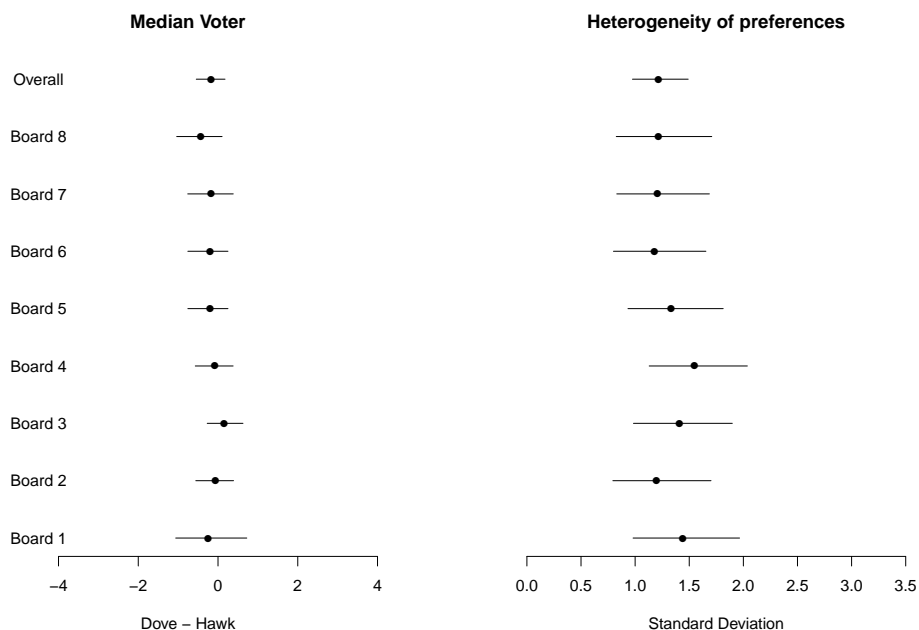


Figure 12: This figure is a graphical representation of the evolution of the median voter and the heterogeneity in preferences in the different executive boards of the Czech National Bank.

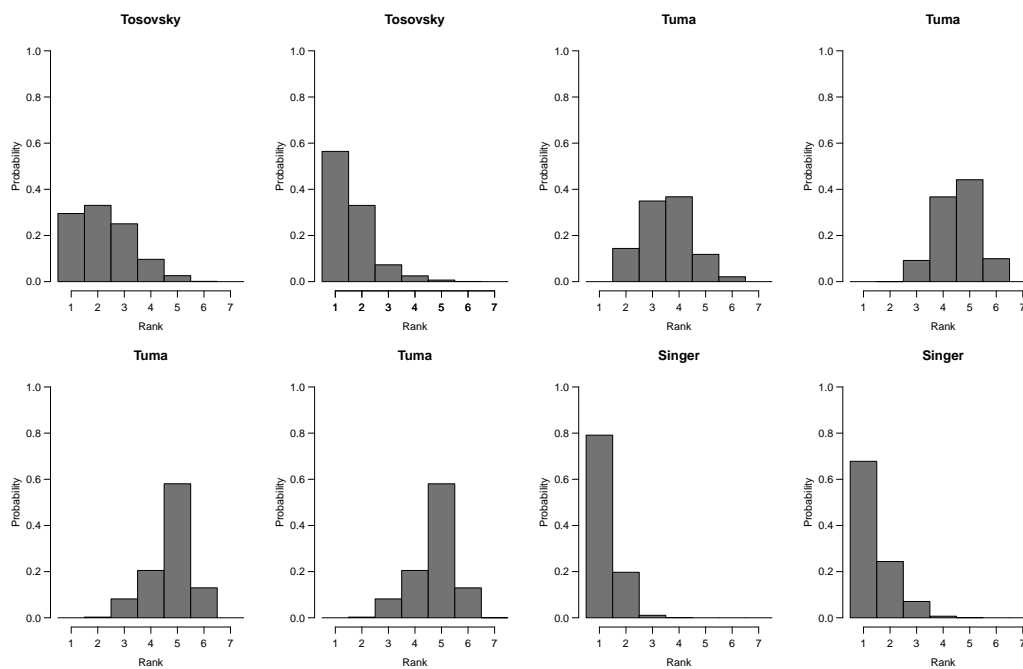


Figure 13: Marginal Posterior Mass Functions of the Governor in the different executive boards.

by the government. Many different sources suggest that the appointees are far from independent. Our analysis shows that the external appointments indeed tend to hold *much* more dovish preferences than the internal members. Consequently our results are highly suggestive of a political appointment channel. These results are disturbing, given that independence of central banks is one of the central tenets of monetary economics.

The analysis of the NBP was split up in two parts. We analyzed the two boards in our sample

separately since we have to little overlap to adequately combine the voting records of both boards. The NBP is peculiar in the sense that only one committee member is internal (the governor) and all others are external. Moreover, the external members are appointed in equal proportions by the lower house, the higher house and the president. We found that in both boards there was one category of externals with deviating preferences from the other groups. However, there was no consistency across both boards. In the 1998-2004 board, the appointees by the president held much more dovish preferences, while in the 2004-2010 this was not the case and it were the appointees by the lower house who seemed to be particularly dovish. While it may be questioned whether an ostensibly political appointment procedure is the best way to go, the overall median voter does not seem to be much influenced by this institutional setup.

Finally we considered the voting records of the Czech national bank. We observe many different boards for the Czech National Bank. Over time the median voter as well as the diversity in preferences seems to be fairly stable. We observe three governors for the Czech National Bank. In contrast to the Swedish case, two of them (Tosovsky and Singer) appear to be fairly dovish whereas Tuma held the middle ground in the different boards he chaired.

All central banks considered here have reasonably high dissent rates and display an *individualistic* character in the sense of [Blinder \(2007\)](#). However, these four central banks differ in important ways from each other. The analyses in this paper show that there is value in analyzing monetary policy committees other than the FOMC or the MPC to learn about central bank decision making as each monetary policy committee is a small real life laboratory where we can learn about decision making by committees in general and at central banks in particular.

For Online Publication: Appendix to “Estimating the preferences of central bankers”

This is appendix to: *Estimating the preferences of central bankers: an analysis of four voting records*. This appendix consists of the following parts:

1. Inspection of the ϵ parameters.
2. Comparison of different identifying prior specifications.

A Improvement over the basic spatial model

In the paper we used a modified version of the spatial voting model following [Bafumi, Gelman, Park, and Kaplan \(2005\)](#). The question is what we *gain* by using this approach. In the analysis of voting behavior at the Bank of England, [Eijffinger, Mahieu, and Raes \(2013\)](#) found that this approach resulted in more stable estimates when considering different priors. One simple way to check whether what the modification adds is to inspect the estimates for the parameters ϵ_0 and ϵ_1 . If the estimates for these parameters are close to 0, they add nothing to the standard approach. When they are closer to 0.1 we effectively absorb some misclassification. The point estimates for these parameters are presented in [Table 7](#). The results indicate that our modification was only meaningful in case of the Riskbank and the CNB. For Poland and Hungary, the estimates are close to zero.

Table 7: Estimates of the ϵ parameters

Model	ϵ_0	ϵ_1
Riksbank	3.2%	1.2%
MNB	1.2%	0.4%
CNB	3.8%	5.7%
NBP (1998-2004)	0.4%	0.4%
NBP (2004-2010)	0.5%	0.8%

This Table presents the posterior median for the parameters ϵ_0 and ϵ_1 for each central bank we analyzed.

B Compare different priors

In the paper we use the following set of priors:

$$\begin{aligned}
 \epsilon_0, \epsilon_1 &\sim \text{Uniform}[0, 0.1] \\
 \alpha_t &\sim N(0, 4) \\
 \beta_t &\sim N(1, 4) \quad \text{truncated from below at zero} \\
 x_n &\sim N(0, 1).
 \end{aligned} \tag{5}$$

The prior choice for the ideal points x_n are used to fix the scale and are referred to as local identification. The prior choice on β_t fix the left-right ordering (global identification). Moreover this constraint is in line with how the data is coded so we have a theoretical motivation for this prior for the truncation. In [Eijffinger, Mahieu, and Raes \(2013\)](#) all priors in the above list are sequentially relaxed. The results of such an exercise indicate that the data quickly overwhelms the priors and that the results are fairly insensitive to the prior choices. Here we compare the results we obtain under two different identifying constraints. The above set of priors (as used in the paper) and the set of priors listed here:

$$\begin{aligned}
 \epsilon_0, \epsilon_1 &\sim \text{Uniform}[0, 0.1] \\
 \alpha_t &\sim N(0, 4) \\
 \beta_t &\sim N(1, 4) \\
 x_n &\sim N(0, 1), \quad \text{with some priors truncated from below or above.}
 \end{aligned} \tag{6}$$

So we relax the prior on the parameters β_t but now we truncate some priors on the ideal points. In particular, we truncate for each voting record two ideal points from below and two ideal points from above. The choice of ideal points to restrict is based on the voting record. For example, for Sweden we restrict the the ideal points of Srjeber and Jansson to be positive and the ideal points of Svensson and Persson to be negative. We chose these four ideal points because inspecting our (recoded) dataset showed that Svensson voted for the dovish choice in more than 92% of the votes and in 100% of the votes. Srjeber in only 8% of her votes and Jansson in none of his votes. These 'raw' summaries are suggestive for where (below or above zero) we expect the ideal point estimates. In principle, fixing restricting two ideal points should suffice but our experience shows that four works better. In the case of the Polish subsamples we fixated only two ideal points.

Both restrictions (restriction on the β_t or on some ideal points) can also be checked themselves. This is done by inspecting the marginal posterior on these parameters to see whether the prior restricting is binding. If it is not, then the prior does not influence the posterior distribution (and thus not the estimates). We do not report all these checks here but we found no indication of worrisome influence of these priors.

The comparison of both sets of priors can be found in [Figure 14](#). Along the horizontal axis we find the results as reported in the paper i.e. with the priors listed in [\(5\)](#). Along the vertical axis we show the results from applying the alternative priors listed in [\(6\)](#). Given that the scale is determined by the local identification, we expect all point estimates to be the same. If this is the case they should all lie close on the diagonal line (or close, given monte carlo error). We find that this is the case and that all dots lie on or very close to the diagonal line.

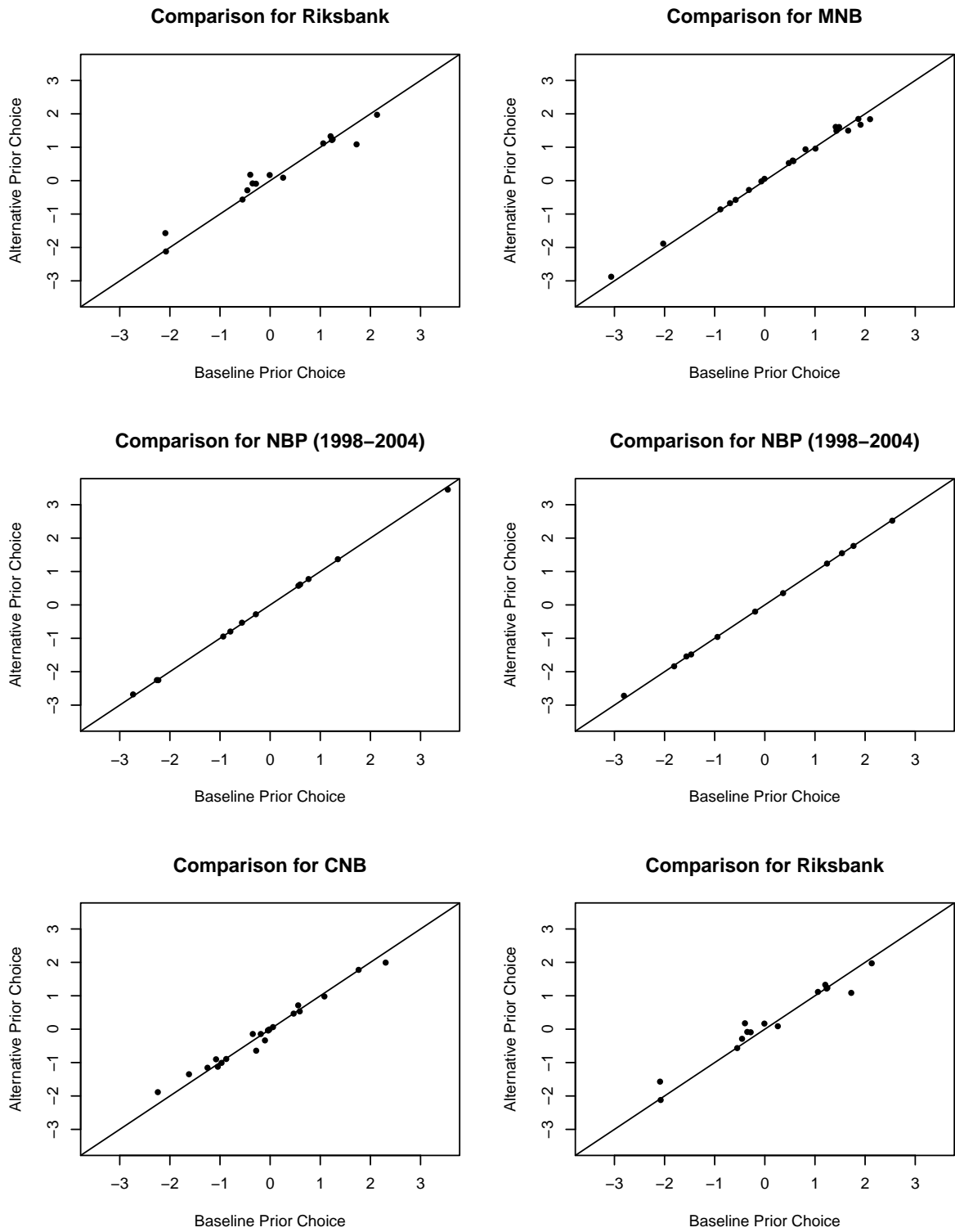


Figure 14: Comparing two sets of priors. If the identifying priors do not matter, then we expect all dots to lie on the diagonal.

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