Explaining Interest Rate Decisions when the MPC Members Believe in Different Stories*

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Most central banks explain interest rate decisions, i.e., they provide a story. With committee decisions, it can be difficult to find a story that is both consistent with the decision and representative for the committee. We consider two alternative procedures: (i) vote on the interest rate and let the winner decide the story, or (ii) vote on the elements of the story and let the interest rate follow from the story. The two procedures tend to result in different outcomes due to an aggregation inconsistency called the discursive dilemma. We find that (ii) tends to yield better stories.

JEL Codes: E52, E58, D71.

1. Introduction

Modern central banks are transparent. One feature of this transparency is that central banks not only announce the interest rate decision, but they also explain *why* they reached this decision. Thus, modern central banks communicate actual monetary policy decisions and the "story" explaining the decisions. However, finding a story that both represents the view of a majority of the monetary policy committee (MPC) and explains the decision is not straightforward. Kohn (2001), who assessed the transparency of the policy-making process at the Bank of England MPC, puts it this way: "To achieve at least rough alignment between policy and the forecast, whatever is published should reflect the 'center of gravity' of the Committee that made itself felt in the most recent policy decision.

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Table 1. The Discursive Dilemma: An Example

	Story		Interest Rate
	rr_t^*	y_t	r_t
Members 1–3	2.0	1.0	4.5
Members 4–6	2.5	0.0	4.5
Members 7–9	2.0	0.0	4.0
Majority	2.0	0.0	4.5

However, determining and presenting a view that would explain actions and shape expectations constructively is difficult in the context of a Committee, especially one with emphasis on individual accountability."

This paper explores how the "discursive dilemma" can influence the clarity and quality of communication when monetary policy decisions are explained to the public. The discursive dilemma can arise in monetary policy if several policymakers jointly decide on the level of the policy rate based on their views of underlying macroeconomic variables, economic relationships, and preferences, i.e., the "premises" for the decision. If the median view of the policy rate deviates from the policy rate that is implied by the median view of the premises, there is a discursive dilemma. The following example gives an illustration of the dilemma and how it influences the clarity with which monetary policy decisions can be explained to the public.

Suppose that the MPC members' reaction functions are represented by the Taylor rule

$$r_t = rr_t^* + \pi^* + 1.5(\pi_t - \pi^*) + 0.5y_t, \tag{1}$$

where r_t is the nominal interest rate (the decision variable), rr_t^* is the neutral real interest rate, π^* is the desired rate of inflation (inflation target), π_t is actual inflation, and y_t is the output gap. The neutral real interest rate rr_t^* and the output gap y_t are uncertain, particularly in real time. Suppose that π_t can be perfectly observed, and assume for simplicity that inflation is on target, i.e., $\pi_t = \pi^* = 2$. Suppose that the MPC members' individual estimates of r_t^* and y_t are as in table 1.

Then voting directly on the interest rate (a *conclusion-based procedure*, or CBP) gives $r_t = 4.5$. However, the majority view of the premise variables together with the Taylor rule (a *premise-based procedure*, or PBP) gives $r_t = 4.0$, and there is a discursive dilemma.

Suppose now that the MPC uses CBP to decide on the interest rate. What should then be the story explaining this decision? The majority story cannot be used, as there is a discursive dilemma. Nor can the average story be used, as that story is also inconsistent with $r_t = 4.5$. The strategy that seems closest at hand is therefore to take the story of the winner of the vote on the interest rate. If amended with a rule that says which story to choose if there are several stories consistent with the median interest rate, this strategy will always provide one story that is consistent with the decision. It is, however, arguable whether this story represents the "center of gravity" of the committee. Furthermore, the estimates (judgments) in that story can be inefficient and biased. There is no aggregation of information behind the story, and hence no reason to expect that it will be a good one.[1] For instance, the winner of the vote on the interest rate may have an extreme view on inflation, but the effect of this view on his preferred interest rate may be offset by an equally extreme view on unemployment, putting his view on the interest rate close to the average view. The communication of such extreme views is bound to be cumbersome.

We therefore argue that from a communication point of view, PBP is better. First, explaining the level of the interest rate chosen is always easy because it can be inferred directly from the committee's median view on the underlying variables, and the story will always represent the center of gravity in the committee. Second, PBP results in more precise stories, because the central bank's views on the underlying variables are then median (noisy) observations of the true values of the macro variables. These views are close to the true values of the variables, as there is aggregation of information behind them.

The analysis in the paper proceeds in three steps. In section 2 we define some useful terminology and present a general proposition on the existence of the discursive dilemma. In section 3 we discuss

[1] When discussing information aggregation in committees, it is useful to distinguish between "pooling by talking" and "pooling by voting" (Claussen et al. 2012). In this paper we consider pooling by voting.

different alternatives for finding a story under CBP. In section 4 we analyze the quality of the stories under CBP and PBP. Using simulations, we show that PBP clearly yields a better story. In section 5 we discuss some of the assumptions behind our analysis.

1.1 Literature

In an earlier paper (Claussen and Røisland 2014), we study the quality of the policy decision under PBP and CBP. In this paper we ask how well the decisions can be explained to the public and study the quality of the story explaining the decision under the two decision-making procedures. The paper is related to the literature on central bank communication (see, e.g., Blinder et al. 2008) and the recent literature on the discursive dilemma.

There is by now a growing literature on the discursive dilemma. An important finding is that the dilemma is not just an artifact of majority decisions and special examples, but represents a general challenge for groups making decisions on the basis of judgments on a set of issues. See, e.g., List and Puppe (2009) and List and Polak (2010) for overviews of the literature on binary judgment aggregation, and Claussen and Røisland (2010) for some general characterization results for non-binary aggregation.

There are only a few papers on the merits of PBP versus CBP. Pettit (2001) and Chapman (2003) apply a *procedural* perspective and argue that decisions should be made for the right reasons, which, in their view, favors PBP. The second perspective, suggested by Bovens and Rabinowicz (2004), is *epistemic*: The best procedure is the one that is most likely to give the correct decision, irrespective of the underlying reasons. From this perspective, it does not matter whether a decision is reached through incorrect judgments of the premises, as long as the decision itself is correct. In our previous paper, Claussen and Røisland (2014), we apply an epistemic perspective and analyze which of the two alternative decision procedures result in better monetary policy decisions in terms of the smallest mean squared error for the interest rate. In the current paper we take the procedural perspective and look at which procedure gives the best aggregate judgment on the reasons for the decision. These two papers are the only studies in the literature that investigate the merits of the two procedures when judgments are non-binary. List (2005) looks at dichotomous (yes/no) judgments from both the procedural and the epistemic approach. His simulation results, where the group aggregates by majority voting, show that PBP tends to be better than CBP from both a procedural and epistemic perspective. Our simulation results give the same results for non-binary judgments. We even find that in situations when PBP and CBP are equal in terms of interest rate decisions (epistemic perspective), PBP produces better stories (procedural perspective).

2. Analytical Framework

We consider an MPC that consists of n members, where n is an odd number.

A *reaction function,*

$$r = R(x_1, x_2, \dots, x_m), \tag{2}$$

is a function that gives the interest rate as a function of a set of input variables $x_1, x_2, \dots, x_m$. Reaction functions can be the result of optimizing an objective (loss) function, or they can represent simple policy rules. The input variables in the reaction function could be measures of underlying inflation, the output gap, financial conditions, etc. MPC members may have different estimates or judgments of the input variables $x_1, x_2, \dots, x_m$.

We assume that individual MPC members' reaction functions share the common general functional form $R(\cdot)$ but allow for individual-specific values of the parameters in the function. MPC members may have different parameter values, as they have different policy preferences, different estimates, and different judgments on economic mechanisms.

Following Claussen and Røisland (2014), we call parameters and variables in R to which members may have different judgments or estimates *premise variables.* The relation between r and the premise variables is given by a *dependence function,*

$$r_j = D(p_{1,j}, p_{2,j}, \dots, p_{k,j}) \quad j = 1, \dots, n, \tag{3}$$

where r_j is MPC member j's judgment of the appropriate interest rate, $p_{i,j}$ is member j's judgment or estimate of premise variable i, and k is the number of premise variables. Variables and parameters that are relevant for r, but which the members of the MPC always agree on, may be represented by the functional form of D. Suppose, for instance, that $r = \alpha x$ is a reaction function, x is the rate of underlying inflation, and α is a parameter for how much a change in x should affect r. Then, the dependence function is the reaction function if MPC members always agree on the value of α. Otherwise, the dependence function has two arguments: x and α. Note that in the latter case the dependence function will be non-linear even though the reaction function is linear. Note also that the MPC members agree by construction on $D(\cdot)$. The dependence function is just an analytical device, and the assumption that all members agree on the dependence function should be uncontroversial as long as one assumes that all members' reaction functions share the same functional form. We discuss the assumption of a common functional form for the reaction function in section 5.

A *story* S is a vector of estimates or judgments on the (sequence of) premise variables $p_1, p_2, \ldots, p_k$. We say that *a story S explains an interest rate r* if

$$r = D(S). \tag{4}$$

We assume that members of the MPC are rational such that individual stories explain individual interest rate judgments, i.e.,

$$r_j = D(S_j), \tag{5}$$

for all $j \in \{1, 2, \ldots, n\}$ and where S_j is the story of MPC member j.

We assume that the MPC uses majority voting, since this is most frequently used by MPCs in practice.[2] Furthermore, we assume that members' preferences over each variable are single-peaked around each member's best estimate or best judgment of the variable.[3] By the median voter theorem, the outcome of a pairwise majority vote

[2]Majority voting has the advantage that it is robust to strategic behavior (Black 1948). This property, together with its simplicity, probably explains its popularity.

[3]By "preferences" over variable j (or the policy variable) we mean a complete, transitive, and weak order on P_j where $P_j \subseteq \mathbb{R}$ is the set of alternative values for premise variable j (or on a set $Y \subseteq \mathbb{R}$ of alternatives for r). The term "preference" should not be taken literally. All we assume is that each member can, for

over the alternative values for a variable is then the median of the individual estimates or judgments for the variable. These medians are denoted p_j^m and r^m, i.e.,

$$p_i^m = median(p_{i,1}, \ldots, p_{i,n}), i = 1, \ldots, k$$

and

$$r^m = median(r_1, \ldots, r_n).$$

We call the story that follows from a vote over each of the premise variables the *median story* and denote it S^m, i.e.,

$$S^m = (p_1^m, \ldots, p_k^m)\,.$$

There is a *discursive dilemma* if the median story does not explain the median interest rate, i.e., if

$$r^m \neq D(S^m).$$

Situations where the discursive dilemma may occur are then characterized by the following proposition.

PROPOSITION 1. *The MPC may face a discursive dilemma if and only if (i) there is more than one premise variable, or (ii) the dependence function $D(\cdot)$ is (weakly) non-monotonic.*

Proof. See Claussen and Røisland (2014).

3. Consistent Communication

3.1 Conclusion-Based Procedure

The *conclusion-based procedure* (CBP) is a procedure where the MPC's interest decision is the outcome of a direct vote on the interest rate, such that the interest rate decision is given by r^m.

any two distinct alternatives $x, z \in P_j$ (or Y), say that she weakly "prefers" x to z (or z to x). The definition does not say anything about *why* she "prefers" x to z. Member i could, for instance, prefer x to z because she finds that x gives her higher utility than z, she could prefer x to z because she believes that x is closer to the true value of the variable than z (it is a "better estimate"), or—if variable j is a policy variable—she could prefer x to z because she finds that x gives higher social welfare than z.

When there is no discursive dilemma, the median story explains the decision as $r^m = D(S^m)$. Suppose now that there is a discursive dilemma, i.e., that $r^m \neq D(S^m)$. How can the committee arrive at a story that explains the decision and that is representative of the committee view?

In the United States, the Federal Open Market Committee (FOMC) publishes the "central tendency" of the individual estimates and forecasts. In the example in table 1 in the Introduction, the midway between the highest and lowest estimates, $rr^* = 2.25$ and $y = 0.5$, can be interpreted as some kind of central tendency. Interestingly, this central tendency story is consistent with $r = 4.5$. However, this is generally not the case. It is easy to make examples where this definition of the central tendency does not produce a consistent story.[4] The same holds for other central tendency rules, such as "average rules" based on linear combinations of individual judgments.[5]

In the numerical analysis below, we assume that the story communicated under CBP is the story of the winner of the vote on the interest rate. This strategy will always result in a consistent story if it is amended by a lottery, seniority rule, or some other rule that picks one story if there are several stories behind the median interest rate. However, it is sometimes arguable whether this story represents the center of gravity within the committee. Furthermore, the communication of this story can be very cumbersome, as the median interest rate may follow from extreme views on the premise variables. We could, for instance, have a situation where the winner of the vote on the interest rate has an extreme view of the inflation outlook, which in isolation calls for a high interest rate, but also has an extreme view of the outlook for unemployment, which calls for a low interest rate, making his (net) judgment of the interest rate the median. Thus, the communication of stories can be difficult if there is a discursive dilemma and the interest rate decision is based on a direct vote on the interest rate. Furthermore, the estimates and

[4] Let, for instance, three individual judgments on rr^* and y be (2.1), (2.5), and (3.2), which gives $r^m = 4.5$. The central tendency is then $(2.5, 1)$, which gives $r = 5.0$.

[5] In the example in the Introduction, the average story is $(2.17, 0.33)$, which gives $r = 4.32$.

forecasts in that story do not necessarily represent efficient judgment aggregation, as it is only the story of one member. If we have to pick one member to find the story, the median interest rate member would usually be the best one to pick, but there is no aggregation of information behind that story, and hence no reason to expect that it will be a good one. We return to this point in section 4 below.

3.2 Premise-Based Procedure

Under the *premise-based procedure* (PBP), the interest rate decision is the interest rate that follows from the outcome of a vote on the premise variables together with the dependence function,

$$r^P = D\left(S^m\right).$$

With this procedure, explaining the level of the chosen interest rate is always easy, as the decision is always explained by the median story. Furthermore, as the story is the median story, it also represents the "center of gravity" of the MPC.

4. The Quality of the Story

In addition to explaining the decision and reflecting the "center of gravity" of the MPC, a desirable property for the story is that it should be precise in the sense that it is close to the true story, i.e., the story that consists of the true (but unobservable) values of the premise variables. Although there are examples in the theoretical literature where precise communication could be counterproductive—e.g., as shown by Morris and Shin (2002)—we believe that in practice, central banks want their published judgments and estimates to be as precise as possible. Having precise estimates and making good judgments enhances the credibility of the central bank.

To assess the relative performance of CBP and PBP, we conduct a simulation exercise to evaluate the precision of the judgments of the premise variables implied by each procedure. We assume that each individual's noisy observation ("judgment") of premise variable i is drawn independently from a given distribution to be specified below.

We assume that the individual judgments are unbiased, so that the mean of the distribution of the individual judgments is the true (but unobservable) value of the premise variable. For each realization of the individual judgments, we construct the median premise and, using a dependence function described below, we derive the median interest rate that would be chosen under CBP and the rate implied by the median premises under PBP. Since the distribution of the median does not have an analytical expression for small samples, we base our analysis on Monte Carlo simulations, where we use 10,000 draws of individual judgments. In this section we use the terms "judgment" and "estimate" synonymously, but since we do not specify how they are formed, we treat them as noisy observations. We measure the precision of a story by the root mean squared error (RMSE) of the judgments of premise variables. In order to obtain a measure that is independent of the degree of noise in the individual judgments, we divide this measure by the RMSE of the distribution for p_i, i.e., the standard deviation of the distribution, denoted σ_{p_i}. Denote this relative RMSE under PBP $relRMSE(p_i^m)$, i.e.,

$$relRMSE(p_i^m) = \frac{\sqrt{\frac{1}{10000}\sum_{t=1}^{10000}(p_{i,t}^m - p_i)^2}}{\sigma_{p_i}},$$

where p_i is the true value of premise variable i and p_i^m is the median noisy observation (judgment) of p_i. Similarly, denote the relative RMSE under CBP $relRMSE(p_i^{r^m})$, where

$$relRMSE(p_i^{r^m}) = \frac{\sqrt{\frac{1}{10000}\sum_{t=1}^{10000}(p_{i,t}^{r^m} - p_i)^2}}{\sigma_{p_i}},$$

and where $p_i^{r^m}$ is the judgment of premise variable i of the winner on the vote on r. Thus, if the premise variable in the story communicated by the MPC is just as (in-)accurate as the individual judgments on the premise variable, then $relRMSE = 1$. If the MPC's aggregate story provides value added relative to a random individual's story, then $relRMSE < 1$. We say that *the smaller relRMSE is, the more precise are members' judgments on* p_i.

4.1 Linear Dependence Functions

Consider first the general linear dependence function, i.e.,[6]

$$r = p_1 + p_2 + \cdots + p_k. \tag{6}$$

We assume that the individual judgments $p_{h,j}$ of each premise variable p_h are normally distributed with the mean equal to the true value of p_h, i.e., $p_{h,j} \sim N(p_h, \sigma_h^2)$ for all $j = 1, 2, \ldots, n$ and all $h = 1, 2, \ldots, k$. We will treat premise variables symmetrically. It therefore suffices to report the *relRMSE* for one of the premise variables to evaluate the informational value of the story. Note also that with a linear dependence function, PBP and CBP are normatively equal if we only look at the precision of the interest rate decision, c.f. Claussen and Røisland (2014). The results of the simulations are summarized in table 2. Recall that for linear dependence functions, there can only be a discursive dilemma if $k \geq 2$, c.f. proposition 1.

We see that *relRMSE* is considerably smaller when each premise variable is voted on than when we let the median voter on the interest rate dictate the story, i.e., $relRMSE(p_i^m) < relRMSE(p_i^{r^m})$. Generally, we see that *relRMSE* decreases with the number of MPC members. This is akin to the Condorcet jury theorem, which follows from the law of large numbers. This gain from committees has been launched as an explanation of why we have monetary policy committees (see, e.g., Gerlach-Kristen 2006). When the individual judgment errors are unbiased and not perfectly correlated, $relRMSE(p_i^m) \longrightarrow 0$, as $n \longrightarrow \infty$ when the MPC votes on each premise variable. However, if the MPC's story is the story chosen by the median voter on the interest rate, the gain from increasing the number of members becomes smaller and, interestingly, does not converge to zero. Actually, in our simulations $relRMSE(p_i^{r^m})$ never falls below 0.70 irrespective of how large n is. We also see that $relRMSE(p_i^{r^m})$ increases with the number of premise variables. Thus, with CBP, the quality of the story decreases when the story becomes more complex. This is in contrast to PBP, where the quality of the story is independent of the number of premise variables.

[6]The lack of coefficients on the premise variables does not limit the generality, as we may define a given premise variable as the product of the coefficient and the underlying premise variable, i.e., $p_j = \alpha\tilde{p}_j$. Equation (6) is linear as long as there is disagreement about either the coefficient or the variable, but not both.

Table 2. Relative RMSE of a Premise Variable in a Story under CBP and PBP and a Linear Dependence Function

	$n = 3$		$n = 5$		$n = 7$		$n = 11$		$n = 101$	
	CBP	**PBP**	**CBP**	**PBP**	**CBP**	**PBP**	**CBP**	**PBP**	**CBP**	**PBP**
$k = 2$	0.84	0.67	0.80	0.54	0.77	0.46	0.75	0.37	0.71	0.12
$k = 5$	0.95	0.67	0.93	0.54	0.92	0.46	0.90	0.37	0.90	0.12
$k = 10$	0.98	0.67	0.97	0.54	0.96	0.46	0.96	0.37	0.96	0.12
$k = 100$	1.00	0.67	1.00	0.54	1.00	0.46	1.00	0.37	1.00	0.12

To summarize the results, we find that a story based on a premise-based procedure represents a better collective judgment on the premise variables than a story that is consistent with a conclusion-based procedure. Thus, even though CBP and PBP result on average in equally good decisions when the dependence function is linear, the stories that are consistent with each procedure do not have equal quality. To the extent that the quality of the communicated story has positive welfare effects, our results give support to a premise-based procedure over a conclusion-based procedure.

4.2 A Non-Monotonic Dependence Function

Above we found that voting on each premise variable produces better stories when there is more than one premise variable. However, as shown by Claussen and Røisland (2014), CBP and PBP may also result in different decisions if there is only one premise variable, and this enters non-monotonically in the dependence function. This might be seen as a special case, but policymakers may in fact often face this situation, as we shall see in the following application.

Suppose that the MPC's objectives can be represented by a (per-period) loss function

$$L_t = \pi_t^2 + \lambda y_t^2, \tag{7}$$

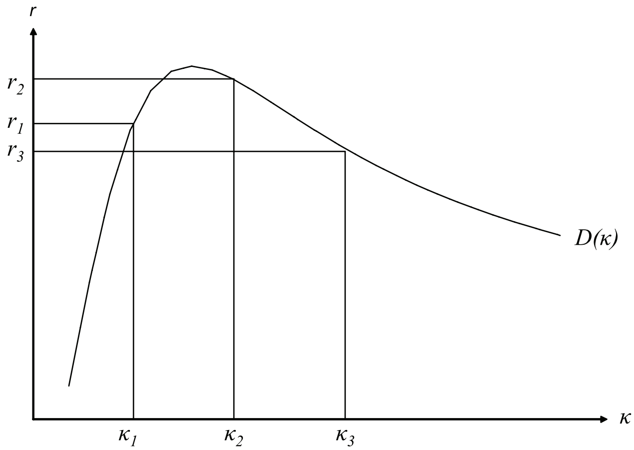
and that the MPC members' view on the economy can be summarized by a simple New Keynesian model, i.e.,

$$\pi_t = \beta E_t \pi_{t+1} + \kappa y_t + u_t, \tag{8}$$

$$y_t = E_t y_{t+1} - (r_t - E_t \pi_{t+1}). \tag{9}$$

Equation (8) is the New Keynesian Phillips curve, where u_t is a cost-push shock, for instance, stemming from stochastic variations in firms' market power. We assume that $E_{t-1} u_t = 0$. Equation (9) is a dynamic IS curve, which can be derived from the Euler equation for an optimal consumption path. We assume for simplicity a unit coefficient on the interest rate, and disregard stochastic fluctuations in the neutral real interest rate (or "demand shocks").

Figure 1. The Discursive Dilemma under Disagreement on κ



The first-order condition for optimal time-consistent policy is[7]

$$\kappa\pi_t + \lambda y_t = 0. \quad (10)$$

Since the shock is not autocorrelated, a discretionary policy is characterized by $E_t\pi_{t+1} = E_t y_{t+1} = 0$. The optimal interest rate is then given by

$$r_t = \frac{\kappa}{\kappa^2 + \lambda} u_t. \quad (11)$$

Assume that the MPC members agree on the size of u_t and λ, but disagree on the size of κ. The only premise variable in the dependence function is then κ. This dependence function is illustrated in figure 1, where we see that $D(\kappa)$ is non-monotonic.

Suppose that $n = 3$, and that the members have judgments on κ as in the figure. If the winner of the interest rate vote (CBP leading to r_1) decides the story, the story becomes $S = \kappa_1$, while if the MPC votes on κ (PBP), the story becomes $S = \kappa_2$.

[7]Under commitment to the timeless perspective, the level of the output gap is replaced by the change in the output gap; see Clarida, Gali, and Gertler (1999).

Table 3. Relative RMSE of a Premise Variable in a Story under CBP and PBP and a Non-Monotonic Dependence Function

	$n = 3$	$n = 5$	$n = 7$	$n = 9$	$n = 11$	$n = 1{,}001$
CBP	0.94	0.92	0.91	0.91	0.91	0.97
PBP	0.78	0.66	0.57	0.52	0.48	0.05

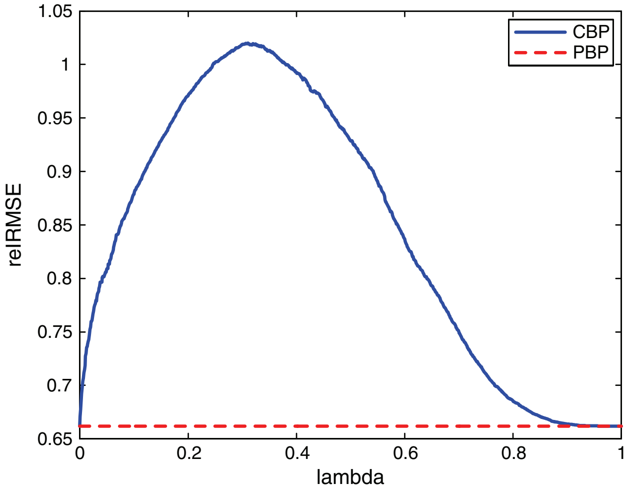
To investigate which story is most precise, we perform similar Monte Carlo simulations as above. Specifically, we assume that the individual judgments on κ have a $beta(1, 1)$ distribution. The motivation for assuming a *beta* distribution rather than a normal distribution is that we want to avoid negative judgments of κ. It is reasonable to assume that although the members disagree about the *size* of κ, they agree about its *sign*, i.e., that a higher output gap gives rise to higher and not lower inflation. We then conduct 10,000 draws to compute the *relRMSE* for each procedure and for different sizes of the MPC. Table 3 shows the simulation results for the case where $\lambda = 0.5$.[8]

As in the previous simulations, we see that voting on κ results in a far more precise story than letting the median voter on the interest rate decide the story. While PBP takes advantage of the committee gain (Condorcet theorem), so that the noise in the MPC's story disappears as n becomes large, this is not the case with CBP.

Figure 2 shows the *relRMSE* for the two approaches as a function of λ in the case where $n = 5$. The two approaches are equal if λ is close to zero or close to one or above. The reason is that in these cases, virtually all of the judgments fall on the monotonic part of $D(\kappa)$, such that there will be no discursive dilemma. An interesting observation is that $relRMSE(p_i^{r^m}) > 1$ for some values of λ. This means that letting the winner of the interest rate vote decide the story results in a worse story than letting a completely random member decide (in which case $relRMSE = 1$). The intuition for this can be seen in figure 1 above. If the true value of κ is in an area near

[8]The qualitative results are independent of the choice of λ, but the magnitude of the difference between the two approaches depends on λ.

Figure 2. *relRMSE* under CBP and PBP as a Function of the Relative Weight on Output in the Loss Function



the maximum of $D(\kappa)$, members who have judgments of κ close to the true value will very rarely be the median voter on the interest rate. Members who have very low or very high judgments of κ will often become the median voter on the interest rate, which gives a bias towards more noisy stories.

In the model above, we have implicitly assumed that the MPC members are certain about their own judgments, such that they do not take parameter uncertainty into account. If they did so, certainty equivalence would not hold, and there would be an additional term σ_κ^2 in the denominator in equation (11), which is the variance of the judgment errors.[9] However, this would not change the results as regards the quality of the story, since we can take this into account simply by replacing λ in equation (11) with $\tilde{\lambda} = \lambda + \sigma_\kappa^2$. Taking parameter uncertainty into account would only make our results more general, as this would also make the dependence function following from disagreement about the coefficient on the interest rate in the IS curve (9) non-monotonic, as shown in Claussen and Røisland (2014).

[9]See Claussen and Røisland (2014).

To summarize, we find that PBP results in a story which tends to be considerably closer to the (unobservable) truth than a story consistent with CBP. In Claussen and Røisland (2014) we found that unless the MPC members are sufficiently overconfident, PBP tends to yield better interest rate decisions than CBP. Here, we have shown another argument in favor of premise-based decision making that is robust to the degree of overconfidence, and which also applies to linear dependence functions.

5. Discussion

5.1 Model Disagreement

In the above analysis, we assumed that the MPC members shared the same general model. This could be a relevant assumption for central banks that have dedicated a particular model in their suite of models as their core model for forecasting and policy analysis, such as the Bank of England, Bank of Canada, and Norges Bank. Without a particular core model, MPC members' policy views might to a larger degree reflect different model beliefs. However, the discursive dilemma is a general phenomenon, and it is likely to be even more prevalent when there is disagreement over models. To see this, consider the following example with an MPC with three members who only care about inflation (i.e., $\lambda = 0$ in (7)). Member 1 believes in the New Keynesian model outlined in sub-section 3.2. Member 2 believes in backward-looking expectations and uses the following equations for inflation and the output gap:

$$\begin{aligned} \pi_{t+1} &= \pi_t + \alpha_y y_t \\ y_t &= \rho_y y_{t-1} - \gamma(r_t - E_t \pi_{t+1}). \end{aligned}$$

The third member is a monetarist and believes

$$\begin{aligned} \pi_{t+1} &= \alpha_m (m_t - m_{t-1}), \\ m_t &= p_t + y_t - \delta r_t, \\ y_t &= \tau y_{t-1} - \varphi(r_t - E_t \pi_{t+1}), \end{aligned}$$

Table 4. Individual Judgments and Preferences over Models

	Pref. over Models	u_t	r_t
Member 1	$M1 \succ M2 \succ M3$	1	$1/\kappa$
Member 2	$M2 \succ M1 \succ M3$	1	0
Member 3	$M3 \succ M1 \succ M2$	0	0
Majority	$M1 \succ M2 \succ M3$	1	0

where m_t is the money stock and p_t is the price level. The reaction functions for the three members then become

$$\text{New Keynesian model } (M1)\text{: } r_t = \frac{1}{\kappa} u_t \tag{12}$$

$$\text{Backward-looking model } (M2)\text{: } r_t = \frac{1}{\alpha_y \gamma} \pi_t + \frac{\rho_y}{\gamma} y_{t-1} \tag{13}$$

$$\text{Monetarist model } (M3)\text{: } r_t = \frac{1}{\delta + \varphi} (p_t - m_{t-1} + \tau y_{t-1}). \tag{14}$$

Suppose now that members are able and willing to rank and vote over the alternative models, and then use the winning model/reaction function as the basis for the premise-based decision. Suppose that all historical values, π_t, and p_t are observable and put $y_{t-1} = (p_t - m_{t-1}) = \pi_t = 0$. Let the preferences over models and judgments of u_t be as in table 4. Then PBP gives $r_t = 1/\kappa$ while CBP gives $r_t = 0$, and there is a discursive dilemma. Note also that in this case there would not have been a discursive dilemma if all three members believed in the same model. This illustrates how the discursive dilemma is reinforced with model disagreement.

The communicational challenges under CBP are even more severe when there is model disagreement. Finding a story that explains the majority interest rate decision and represents the center of gravity of views in the committee is difficult, if not impossible, if there is disagreement about the model. Furthermore, if the committee decides to communicate the story of the winner of the vote on the interest rate, the model in the story that explains the decision may change from decision to decision even if members' preferences over models stay the same: At one meeting it might be the New Keynesian that wins the vote over r. At the next meeting it might be the monetarist, and so on. Monetary policy might therefore appear random and inconsistent over time.

But also PBP becomes more difficult. One problem is that now we might also get a "traditional" voting paradox. If, for instance, member 3 has the preferences $M2 \succ M3 \succ M1$, there is no (Condorcet) winner when voting over models, i.e., no model beats all other models in a pairwise vote over models. Furthermore, PBP might be implausible, as a fundamental disagreement over models simply entails that MPC members are unwilling to base their judgment of the interest rate on any model other than their own. Under fundamental disagreement, the committee might therefore consider alternative communication strategies. We discuss two of these below.

5.2 Partially Premise-Based Decisions

We have so far considered the fully conclusion-based versus the fully premise-based decisions. The motivation was that assuming the alternative procedures in their clean forms facilitates a clean comparison between the two. However, while fully conclusion-based decisions are obviously realistic, it is arguable whether truly premise-based decisions are possible in practice. First, full PBP could be cumbersome and time consuming. Second, as discussed above, full PBP can be difficult, if not impossible, if there is disagreement about models. Third, some members may have a more intuition-based approach to monetary policy and are not able or willing to formulate their models in a precise way.

To consider the more realistic intermediate case of partial PBP, assume that member j's preferred interest rate is given by

$$r_j = D(S_A^j, S_B^j),$$

where $S_A = (p_1, \ldots, p_h)$ is a vector of premise variables that are subject to aggregation of judgments within the MPC, and $S_B = (p_{h+1,\ldots,}p_k)$ is a vector of premise variables that are not subject to such aggregation. These could, for instance, be premise variables that are not judged to be crucial for the central bank's story, or variables that are too difficult to formulate in a sufficiently precise way. This may, for instance, capture the case where members believe in different models, so that the parameters and variables describing the models are embedded in S_B. Note that we do not require the elements in S_B to be observable. In fact, if the subset of S_B^j represents parameters and variables representing member j's view of the economic mechanisms (his "model"), but the member is not able to formulate his model precisely, the elements of S_B^j could be unobservable also to member j. We assume, however, that it is *in principle* possible to formulate his model precisely, although the member is not able to do so.

In this setting it is not possible to perform full PBP, but a partial procedure is still viable as a two-step decision procedure. The first step is that the MPC votes over each premise variable in S_A. The outcome of the vote, given our assumptions outlined in section 2, will then be the median of each element in S_A. Denote the vector of median judgments S_A^m. The individually preferred interest rates conditional on the aggregate judgments of S_A are

$$r_j = D(S_A^m, S_B^j), \quad j = 1, \ldots, n.$$

In the second step, the MPC votes over the alternative preferred interest rates conditional on $S_A = S_A^m$. The decision will then be the median of the conditional preferred rates:

$$r_{m|P_A^m} \equiv median[D(S_A^m, S_B^1), D(S_A^m, S_B^2), \ldots, D(S_A^m, S_B^n)].$$

To explain the story, the central bank may now communicate the story $S = (S_A^m, S_B^{m|P_A^m})$, where $m|P_A^m$ denotes the member who holds the median preferred interest rate conditional on P_A^m. In practice, central banks do not convey a complete story, i.e., a set of information sufficient for the public to make a perfect mapping between S and r. Instead, they may communicate elements of the story that are considered key arguments for the decision. One possibility is to communicate only the elements of the story that have been subject to aggregation, i.e., S_A^m. Then, the (incomplete) story reflects by construction the "center of gravity" of the MPC. The story is also *consistent* with the decision. It does not, however, *explain* the decision, as defined in equation (4), without communicating $S_B^{m|P_A^m}$. Still, the elements of the story that are communicated—i.e., S_A^m—hold the same precision as under full PBP, as analyzed in section 4. Thus, even if full PBP may not always be possible or desirable, the central bank does not necessarily have to resign to full CBP.

A partial procedure will still give better communication than CBP if one wants the story to be precise and represent the center of gravity of the MPC.

5.3 Why Not Communicate All the Individual Stories?

In the above analysis, we have assumed that the central bank publishes only one story. Why not communicate all the individual stories?

Generally, one might view more information as better than less. If members' individual judgments have informational value to private agents, publishing all the members' individual stories would, arguably, be beneficial. However, in reality central banks seem to focus on one story in their communication. The Bank of England and the Riksbank, for instance, publish minutes from the interest rate meetings where individual judgments are provided.[10] These minutes could be regarded as publishing parts of the individual stories. But, nevertheless, the forecasts and analyses in the inflation or monetary policy reports of these two central banks represent one story which is supposed to be the central tendency view of the MPC. Some central banks, such as Norges Bank, do not publish minutes but provide one story in the monetary policy report that is supposed to fully explain the interest rate decision. The Federal Reserve publishes the distribution of individual forecasts from the FOMC members but does not provide the details and the assumptions behind the individual forecasts. In the press release immediately after the FOMC meeting there is one story. Thus, there appears to be a strong tendency for central banks to focus on one story in their communication.

Our analysis does not provide any answer as to why central banks tend to focus on one story. But, one reason could be what Blinder (2007) called the "cacophony problem": "A central bank that speaks with a cacophony of voices may, in effect, have no voice at all." While Blinder did not provide a theoretical rationale for the cacophony problem, Moscarini (2007) shows that a central bank can gain credibility and increase its ability to affect expectations if it appears competent. He argues that publishing conflicting views among MPC

[10] At the Bank of England, the minutes are not attributed, as opposed to at the Riksbank.

members can make the central bank appear less competent in the view of the public and thereby less credible.

We have also assumed that central banks want the communicated story to be consistent with the decision and as precise as possible. Although we do not model the relationship between communication, competence, and credibility, it seems reasonable to think that a central bank that publishes a story that is inconsistent with the decision will hardly appear competent and credible. We therefore find it reasonable to assume that the central bank would like the story to be consistent with the decision, and that the quality of the story should be as high as possible.

5.4 Strategic Voting

We have implicitly assumed that the MPC members report their true judgments. The assumption is important, as PBP will not work if members act strategically. To see this, consider member 1's judgment on κ in figure 1. Under PBP, the interest rate will be r_2 if members do not act strategically. But, if member 1 instead reported a judgment of κ which lies between κ_2 and κ_3, member 1 would become the median voter and dictate r. The other members would then not have any incentives to deviate, i.e., we would have a Nash equilibrium, and PBP would yield the same result as CBP.

We nevertheless think it is useful to assume that MPC members do not act strategically. One reason is that it is necessary to know how things work when people do not act strategically before analyzing how things work under strategic behavior. Another reason is that it seems, arguably, somewhat odd to assume that MPC members will behave strategically in this way. First, the Nash equilibrium above requires that members know each other's true preferences and accept that they do not vote according to these. It does not seem reasonable to assume that MPC members will exploit the voting system and openly behave strategically in this way. Second, and related to the first point, there are social norms in MPCs that probably limit such strategic behavior. Third, MPC members also care about making good judgments of the premises for the decision. In the example above, the median judgment of κ is closer to member 1's best judgment on κ than the κ that will be in the story if member 1 behaves strategically. Thus, if members care not only about the interest rate decision but also about the quality of the story, they will have incentives not to behave strategically.[11]

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[11]We may distinguish between "reason-oriented" and "outcome-oriented" MPC members. The distinction is closely related to the distinction between a procedural and an epistemic perspective on decision making mentioned in the Introduction. Outcome-oriented members behave strategically under the PBP, while reason-oriented members do not.

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