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Explaining interest rate decisions when the MPC members believe in different stories

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

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Abstract

Modern central banks do not only announce the interest rate decision, they also communicate a 'story' that explains why they reached the particular decision. When decisions are made by a committee, it could be difficult to find a story that is both consistent with the decision and representative for the committee. Two alternatives that give a unique and consistent story are: (i) vote on the interest rate and let the winner decide the story, (ii) vote on the elements of the story and let the interest rate follow from the story. The two procedures tend to give different interest rate decisions and different stories due to an aggregation inconsistency called the 'discursive dilemma'. We investigate the quality of the stories under the two approaches, and find that alternative (ii) gives stories that tend to be closer to the true (but unobservable) story. Thus, our results give an argument in favour of premise-based, as opposed to conclusion-based, decisionmaking.

Keywords: Monetary policy committees, Communication, Judgment aggregation, Discursive dilemma

JEL Classification: 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 also explain *why* they have reached a particular decision. Thus, modern central banks communicate actual monetary policy decisions and a '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 trivial. Kohn (2001), who assessed the transparency of the policymaking 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. 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 with which monetary policy decisions are explained to the public. The discursive dilemma can arise in monetary policy if several policy makers 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 on the policy rate (Conclusion-Based Procedure, CBP) deviates from the policy rate that is implied by the median view of the premises (Premise-Based Procedure, PBP), there is a discursive dilemma. The following example gives an illustration of the dilemma and how it influence the clarity with which monetary policy decisions can be explained to the public.

Suppose for simplicity that the MPC members have agreed to set the policy rate according to following 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 on r_t^* and y_t are as in Table 1. Then voting directly on the interest rate (CBP) gives $r_t = 4.5$. However, the majority view on the premise variables together with the Taylor rule (PBP) gives $r_t = 4.0$, and there is a discursive dilemma.

Suppose now that the MPC uses the CBP to decide on the interest rate. What should then be the story explaining this decision? The majority story cannot be used, since there is a discursive dilemma. The average story can

Table 1:

| | 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

neither be used, as also that story is 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 more stories consistent with the median interest rate, this strategy will always work and always give a 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 and forecasts in that story are not necessarily close to their actual values. 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 that is made up by an 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 a from a communication point of view, the PBP is better. First, explaining what level of the interest rate was 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, the PBP gives more precise stories as with the PBP, the central bank views on the underlying variables are median observations of the true values of the macro variables. These views are close to their actual values 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 different alternatives for finding a story under the CBP. In Section 4 we analyze the quality of the stories under the CBP and the PBP. Using simulations we show that the PBP clearly yields a better story. In Section 5 we discuss some of the assumptions behind our analysis.

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[1] When discussing information aggregation in committees, it is useful to distinguish "pooling by talking" from "pooling by voting" (Claussen et al. 2011). In this paper we consider pooling by voting.

Literature In an earlier paper (Claussen and Røisland, 2010a) we study the quality of the policy decision under the PBP and the 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 it is not just an artifact of majority decisions and special examples, but represent a general challenge for groups making decisions on the basis of judgments on a set of issues. See e.g. List and Polak (2010) and List and Puppe (2009) for overviews of the literature on binary judgment aggregation, and Claussen and Røisland (2010b) for some general characterization results for non-binary aggregation.

There are only a few papers on the merits of the PBP versus the 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 wrong judgments on the premises, as long as the decision itself is correct. In Claussen and Røisland (2010a), we apply an epistemic perspective, and analyze which of the two alternative decision procedures that give better monetary policy decisions in terms of the smallest means 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 a the procedural and the epistemic approaches. His simulation results, where the group aggregates by majority voting, show that PBP tends to be better than CBP both from a procedural and epistemic perspective. Our simulation results give the same results for non-binary judgments. We even find that in situations when the PBP and the CBP are equal in terms of interest rate decisions (epistemic perspective), the PBP gives 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*

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

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is a function that gives the interest rate as a function of a set of input variables $x_1, x_2, ..., x_m$. Reaction functions can be the result of optimizing an objective (loss) function, or 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 judgements of the input variables $x_1, x_2, ..., x_m$.

We assume that individual MPC members' reaction functions share the common general functional form $R()$, but allow for individual-specific values on 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 (2010a), we call parameters and variables in R to which members may have different judgements or estimates *premise-variables*. The relation between r and the premise-variables is given by a *dependence function*

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

where r_j is MPC member j's judgment of the appropriate interest rate, and $p_{i,j}$ is member j's judgement 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 that says 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. Notice also that in the latter case the dependence function will be non-linear even though the reaction function is linear. Notice also that the MPC members agree by construction on $D(\cdot)$. The dependence function is just an analytical device, and the property that all members agree on the dependence function holds by construction under the assumption that the members' individual reaction functions can be represented by a general encompassing function.

A *story* S is a vector of estimates or judgements on the (sequence of) premise variables $p_1, p_2, ..., p_k$. 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 $j \in \{1, 2, ..., n\}$ 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 the member's best estimate or best judgement of the variable.[3] By the median voter theorem, the outcome of a pairwise majority vote over the alternative values for a variable is then the median of the individual estimates or judgement for the variable. These medians are denoted p_j^m and r^m, i.e.

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

and

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

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.

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

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 when 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 are more than one premise-variable, or
(ii) the dependence function $D(\cdot)$ is (weakly) non-monotonic.

Proof. Claussen and Røisland (2010a) ∎

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[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 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.

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.

When there is not a discursive dilemma, the median story explains the decision, as then $r^m = D(S^m)$. Suppose now that there is a discursive dilemma, i.e. that $r^m \neq D(S^m)$. How can the committee then arrive at a story that explains the decision and which is representative of the committee view?

In the US, the 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, like 'average rules' based on linear combinations of individual judgments.[5]

In the numerical analysis below we assume that the story communicated under the CBP is the story of the winner of the vote on the interest rate. This strategy will always work if it is amended by a lottery, seniority rule, or some other rule that pick one story if there are more stories behind the median interest rate. However, it is sometimes arguable whether this story will represent the center of gravity within the committee. Furthermore, the communication of this story can be very cumbersome, since the median interest rate can sometimes follow from extreme views on the premise variables. We could, for instance, have a situation when the winner of the vote on the interest rate have an extreme view on inflation that is made up by an extreme view on unemployment, making his view on the interest rate the median view. 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 forecasts in that story are not necessarily close to their actual values, 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 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.

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[4]Let, for instance, three individual judgments on rr^* and y be $(2.1), (2.5, 0), (3.2)$, 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 $r = 4.32$.

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 over the premise variables together with the dependence function,

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

With this procedure explaining what level of the interest rate was chosen 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 actual (or true), but unknown story. Although there are examples in the theoretical literature where precise communication could be counter-productive, e.g. as shown by Morris and Shin (2002), we believe that in practice, central banks want their published judgements and estimates to be as precise as possible. Having precise estimates and making good judgments probably enhances the credibility of the central bank.

Since the distribution of the median does not have an analytical expression for small samples, we base our results on Monte Carlo simulations, where we use 10 000 draws of individual judgments. In this section we use the term 'judgment' for short, but it could mean both 'estimate' and 'judgement'. We assume that the individual judgments on each premise-variable are the outcome of draws from some distribution (to be specified). We measure the quality of a story by the root mean squared error (RMSE) of the judgments on premise-variables. In order to get 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 the PBP $relRMSE(p_i^m)$, i.e.

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

where $E\left(p_i\right)$ is the expected value of premise variable i. Similarly, denote the relative RMSE under the CBP $relRMSE(p_i^{r^m})$ where

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

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

and where $p_i^{r^m}$ is the judgement 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 judgments on p_i are the *more precise* the smaller is $relRMSE$.

4.1 Linear dependence functions

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

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

We assume that the individual judgments on each premise-variable are normally distributed. More specifically, we assume that $p_{h,j} \sim N(\bar{p}_h, \sigma_h^2)$ for all $j = 1, 2, ..., n$ and all $h = 1, 2, ..., k$. 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. Notice also that with a linear dependence function, PBP and CBP are normatively equal if we only look at the precision in the interest rate decision, c.f. Claussen and Røisland (2010a). 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 the $relRMSE$ is considerably smaller when voting on each premise-variable than when letting the median voter on the interest rate dictate the story, i.e., $relRMSE(p_i^m) < relRMSE(p_i^{r^m})$. Generally, we have that $relRMSE$ decreases in 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 for why we have monetary policy committees (see, e.g., Gerlach-Kristen (2006)). When

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[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, not both.

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, it does not converge to zero. Actually, in our simulations $relRMSE(p_i^{r^m})$ never gets below 0.70 irrespective of how large n is. We also see that $relRMSE(p_i^{r^m})$ increases in 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.

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 if CBP and PBP give on average 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 relative to a conclusion-based procedure.

4.2 A non-monotonic dependence function

Above we found that voting on each premise-variable gives better stories when there are more than one premise-variable. However, as shown by Claussen and Røisland (2010a), CBP and PBP may also give 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 policy-makers 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 the following (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 the following simple New Keynesian model:

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

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

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, and 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
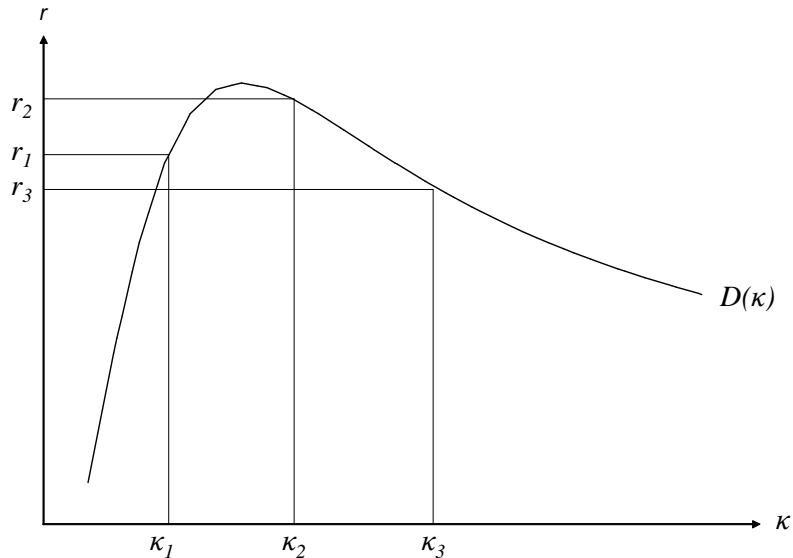
Figure 1: The discursive dilemma under disagreement on κ.

disregard stochastic fluctuations in the neutral real interest rate (or 'demand shocks').

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

$$\kappa\pi_t + \lambda y_t = 0. \tag{10}$$

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

$$r_t = \frac{\kappa}{\kappa^2 + \lambda} u_t. \tag{11}$$

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. The dependence function is illustrated in figure 1, where we see that $D(\kappa)$ is non-monotonic.

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

To investigate which story that is most precise, we perform similar Monte Carlo simulations as above.[8] Table 3 shows the simulation results for the case with $\lambda = 0.5$.

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[7]Under commitment to the timeless perspective, the level of the output gap is replaced

Table 3: Relative $RMSE$ of a premise-variable in a story under CBP and PBP and a non-monotonic dependence function

	$n = 3$	$n = 5$	$n = 7$	$n = 9$	$n = 11$	$n = 1001$
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

As in the previous simulations, we see that voting on κ gives a far more accurate story than letting the median voter on the interest rate decide the story. While PBP takes advantage of the committee gain (Condorcet theorem), such that the noise in the MPC's story disappears as n becomes large, this is not the case with CBP. The qualitative results are independent on the choice of λ, but the magnitude of the difference between the two approaches depends on λ.

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 gives a worse story than letting a completely random member decide (in which case $relRMSE = 1$). The intuition for this can be seen from figure 1 above. If the true value of κ is in an area near the maximum of $D(\kappa)$, members who have judgements on κ close to the true value will very rarely be the median voter on the interest rate. Members that have very low or very high judgements 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 judgements, 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 substituting λ 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

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by the change in the output gap, see Clarida et al. (1999).

[8]Instead of using the normal distribution on the individual judgments, we here use the $beta(1,1)$-distribution. The motivation for this is that we want to aviod negative judgements on κ, since 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.

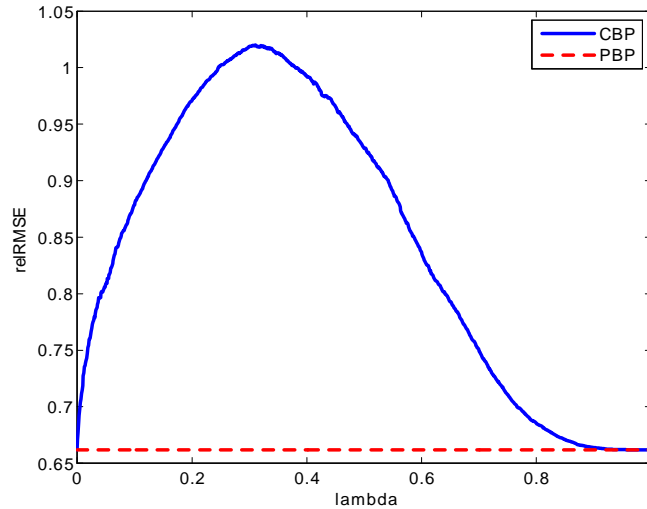[9]See Claussen and Røisland (2010a).

Figure 2: relRMSE under CBP and PBP as a function of the relative weight on output in the loss function.

IS-curve (9) non-monotonic, as shown in Claussen and Røisland (2010a).

To summarize, we find that PBP gives a story which tends to be considerably closer to the (unobservable) truth than a story consistent with CBP. Claussen and Røisland (2010a) found that unless the MPC members are sufficiently overconfident, PBP tends to give better interest rate decisions. 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 who have a dedicated a particular model in their suite of models as their core model for forecasting and policy analysis, such as e.g., at 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

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backward looking expectations and uses the following equations for inflation and the output gap:

$$\pi_{t+1} = \pi_t + \alpha_y y_t$$
$$y_t = \rho_y y_{t-1} - \gamma(r_t - \pi_t)$$

The third member is a monetarist and believes

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

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

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

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

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

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 consider a situation where $y_{t-1} = (p_t - m_{t-1}) = \pi_t = 0$. Let the preferences over models and judgements of u_t be as in Table 4. Then PBP gives $r_t = 1/\kappa$ while the CBP gives

Table 4: Members' preferences and judgments

	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

$r_t = 0$, and there is a discursive dilemma. Notice 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 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 the 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, the PBP might be implausible as as fundamental disagreement over models simply entails that MPC members are unwilling to base their judgment of the interest rate on any other model 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 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 $S_A = (p_1, .., p_h)$ is a vector of premise-variables that are subject to aggregating of judgments within the MPC, and $S_B = (p_{h+1,...,}p_k)$ 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 that the elements in S_B are observable. In fact, if the a sub-set of S_B^j represents parameters and variables representing the member j's view of the economic

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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 on S_A are;

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

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:

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

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 when the criteria for good communication are that the story should be precise and represent the center of gravity of the MPC.

5.3 Why not communicate all individual stories?

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

Generally, one might think that more information is better than less. If members' individual judgments have informational value to private agents, publishing all 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 central tendency-view of the MPC. Some central banks, like 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 Fed 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, it appears to be a strong tendency that central banks focus on one story in their communication.

Our analysis does not provide any answer to why central banks tend to focus on one story. However, 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 members can make the central bank appear less competent from 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 good as possible.

5.4 Strategic voting

We have implicitly assumed that the MPC members report their true judgments. The assumption is important, as the 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 on κ which lies between κ_2 and κ_3, member 1 would become the median voter and dictate r. The other members will then not have any incentives to deviate, we have a Nash equilibrium, and PBP would yield the same result as CBP.

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

We nevertheless think it is useful to assume that MPC members do not act strategically. One reason is that it is necessary to know the outcome when people do not act strategically before analyzing the outcome of strategic behavior. Another reason is that is seems unrealistic 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 seems not reasonable to assume that MPC members will exploit the voting system and openly behave strategically in this way. Second, and related to the previous point, there are social norms in MPCs that probably limit such strategic behavior. Third, MPC members also care about making good judgments on the premises for the decision. In the example above, the median judgment on 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 do not only care about the interest rate decision, but also about the quality of the story, they will have less incentives 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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